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NEW FORMS OF PRIVATE PROPERTY: PROPERTY RIGHTS IN ENVIRONMENTAL GOODS

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Abstract

This entry examines the relationship between property rights and environmental protection. According to the 'tragedy of the commons' model, environmental pollution and resource depletion result from the inadequate specification of property rights in environmental goods. Two solutions typically are offered for averting the 'tragedy': (1) specify property rights (that is, privatize the commons) or (2) regulate entry and use. For some environmental goods, such as land, privatization has been the preferred (though not an exclusive) approach. For other environmental goods, such as air and water, regulation has been the preferred (though, again, not an exclusive) approach. Each of these approaches involves the imposition of property rights on formerly 'open access' (nonproperty) resources. Public regulations of entry and use increasingly rely on property 'rights'-based mechanisms, such as tradeable pollution 'rights', to improve regulatory efficiency. Some law and economics scholars maintain, however, that better protection could be achieved at still lower cost by replacing regulatory regimes altogether with a system of completely-defined private property rights in environmental goods. They advocate a combination of resource privatization and deregulation as both a necessary and a sufficient remedy for environmental problems. This position is controversial, even within the law and economics literature. This entry assesses the arguments for and against the complete privatization of environmental goods.
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1. Introduction

A property right is a form of power - as Denman (1978, p. 3) puts it, 'a sanction and authority for decision-making' over resources. Dasgupta (1982, p. 38) refers to property as 'a set of rights to control assets', including environmental goods (also known as natural resources). Scholars have long recognized that the nature, extent, and allocation of property rights can significantly affect the rate of resource depletion and degradation. In the fourth century bc, Aristotle (1941, sec. 1262b34-35) wrote, ‘that which is common to the greatest number has the least care bestowed on it’. His observation has resonated throughout history and today is understood (after Hardin, 1968) as ‘the tragedy of the commons’.

Despite Aristotle’s early warning, many environmental goods never have been subject to private (that is, individual) ownership, for a variety of economic, technological, political and cultural reasons. Writing 350 years after Aristotle, the Roman poet Ovid (1992, p. 111) put these words in the mouth of Dædalus: ‘Though he may possess everything, Minos does not possess the air’. Indeed, according to Roman Law, it was against natural law for any individual, even the emperor, to own the air or other important environmental goods. The Institutes of Justinian (Grapel, 1994, p. 50), compiled one thousand years after Aristotle, decreed, ‘[b]y the law of nature these things are common to mankind - the air, running water, the sea and consequently the shores of the sea’. In most countries, for most purposes, these environmental goods have ever since remained off limits to private ownership.

If we were to construct a syllogism, positing Aristotle’s observation as a major premise and the rule from Justinian’s Institutes as a minor premise, the conclusion would be that the commonly owned air, running water, sea and seashore have the least care bestowed upon them. History, unfortunately, has too often confirmed this. In the absence of property rights to protect them, environmental goods have been abused, sometimes to the point of destruction. As Hardin (1968, p. 1245) puts it, we have been ‘locked into a system of “fouling our own nest”’. In more technical terms, environmental degradation has resulted from ‘incomplete and asymmetric information combined with incomplete, inconsistent, or unenforced property rights’ (Hanna, Folke and Mäler, 1996,p. 3).

Two general solutions typically are offered for resolving environmental problems: (1) specify property rights in environmental goods, that is, privatize them, or (2) control access to and use of environmental goods through governmental regulation (see Hardin, 1968, p. 1245). This entry concerns the role of property rights in both solutions. More specifically, it concerns the utility of property rights for resolving environmental problems in tandem with, or in place of, regulation.

In recent years regulators have begun replacing command-and-control environmental regulations with ‘market-mechanisms’, including property ‘rights’-based programs, such as tradeable pollution ‘rights’, in order to improve regulatory efficiency. This shift in regulatory approach, which amounts to a limited reallocation of environmental goods from public to private control, has been completely uncontroversial among law and economics scholars, who have advocated the use of rights-based approaches for decades (see, for example, Dales, 1968). More controversial is the suggestion, issuing from certain quarters of the law and economics literature, that governmental environmental regulation should be completely replaced (with the exception of the common law and its courts) by a regime of well-defined, private (meaning individual, corporate or communal) property rights in environmental goods (see, for example, Anderson and Leal, 1991, p. 3; Block, 1990). This recommendation is premised on the belief that some form of non-public ownership of environmental goods is both necessary and sufficient for optimal environmental protection. Property rights are necessary, according to this theory, because state regulation cannot provide adequate environmental protection; and they are sufficient because they obviate the need for any state regulation beyond traditional common law protections. These assertions and the policy recommendations of self-described 'free market environmentalists' are highly controversial. This chapter does not purport to resolve the issue, but merely reports its treatment in the law and economics literature.

2. Types of Property Rights Regimes

Before examining the relationship between property rights and environmental goods, it may be useful to review the four basic property rights regimes: private, common, state and nonproperty (or open access). In the law and economics literature, 'private property' (*res privatae*) typically denotes property owned by individuals holding rights to use (in socially acceptable ways), dispose of, and exclude others from resources. 'Common property' (*res communes*) refers to collective ownership situations, in which the owners cannot exclude each other, but can exclude outsiders. 'Public' or 'state' property (*res publicae*) is a special form of common property supposedly owned by the all the citizens, but typically controlled by elected officials or bureaucrats, who are free to determine the parameters for use and exclusion. Finally, 'nonproperty' or 'open access' (*res nullius*) denotes a situation in which a resource has no owner; all are at liberty to use it, thus no one has the right to exclude anyone else. Some scholars have elaborated more extensive typologies of property rights regimes (see, for example, Hanna, Folke and Mäler, 1996; McCay, 1996).

It is important to recognize that these property categories are idealizations. Real-world property regimes inevitably combine features from various ownership categories (see, for example, Feeny, Hanna and McEvoy, 1996). And *de facto* property regimes sometimes trump *de jure* property rights (see, for example, Ellickson, 1991). The academic typology also differs significantly from the ways in which most people distinguish property regimes. For example, in common parlance 'private' property is not counterpoised to 'common' property as it is in much of the academic literature. Co-owned property, including joint tenancy, partnership, and corporate property, is usually considered 'private', so long as it is not owned by the state or some other public entity (see, for example, Denman, 1978, p. 102). Indeed, were the term 'private' strictly limited to describing property owned by individuals, there would be precious little 'private' ownership of land in the United States or in any other country. From another point of view, however, co-ownership simply denotes multiple individual ownership, with each co-owner possessing individual rights in (or attributes of) the property (see Barzel, 1990; Bromley, 1991, pp. 25-26).

A more significant terminological problem in the academic literature is the conflation of common property with nonproperty or open access (Hardin, 1968; North and Thomas, 1973 and others have been criticized for this; see, for example, Cox, 1985 and Bromley, 1991, pp. 22, 137). However, the conflation of common with open access is somewhat understandable because, in the vernacular, nonproperty resources are often described as commonses or 'common pool' resources. Indeed, they *are* commonses in that they are common to all. What really distinguishes open access resources from common property, as that phrase is defined in the law and economics literature, is the unlimited size of the group capable of accessing and using the resources (see, for example, Seabright, 1993, p. 114, n. 1). In order for property to be common (*res communes*) rather than open access (*res nullius*) there must be at least two groups, one of which collectively controls the resource and excludes the other from access and control (see Ciriacy-Wantrup and Bishop, 1975, p. 715). Moreover, as Bromley (1991, pp. 25-26) points out, 'common property represents *private property for the group of co-owners* because all others are excluded from use and decision making'. That, plus the fact that each member of the group possesses individual rights in the property, makes common property more like private (individual) property than like open access, which is characterized by universal access and the utter absence of legal rights and duties with respect to the resource.

Common property is also sometimes confused with state property. The state may be viewed, after all, as just another group of co-owners, like partnerships, collectives or villages. But those, such as Ostrom (1990), who write about common property resources distinguish state from common ownership based on the size of the ownership group and its location *vis-à-vis* the resource. When a group of self-governing villagers controls access to a fishery, for example, that is considered common ownership. But when non-users, far removed from the village control access and use, that is state or public ownership. Moreover, depending on the political circumstances and management practices, state or public property may more closely resemble individually- or corporately-owned private property than common property (see, for example, Denman, 1978, pp. 3-4; Eggertson, 1990, p. 37 and Rose, 1994, pp. 116-117).

In view of these terminological confusions, which arguably reflect ideological issues more than real distinctions between property rights regimes, Dales (1968, p. 61) sensibly abandons the conventional typology. Rather than opposing private to common property, he merely refers to 'property rights, by whomever exercised'. Depending on the circumstances, property rights may be vested in individuals, groups (collectives or firms), or the state. The implication is that distinctions between individual, group and state property tend to be more informative and less ideologically loaded than the conventional distinction between private and common property (see also Goetze, 1987, p. 187).

One final conceptual problem concerns the general neglect of a crucial question: just what specific rights and corresponding duties do the various property regimes entail? As Bromley (1989, p. 187) notes, those who write about property or property rights rarely are specific about the content of those terms. They often assume facilely that private property means Blackstonian absolute dominion (which has always been a myth). But, as Demsetz (1988, p. 19) explains, 'full private rights, full state rights, full communal rights are notions that are very elastic with respect to the substantive bundle of entitlements involved'.

Honoré (1961) lists 11 distinct 'sticks' in the *complete* bundle of property rights - the right to exclusively possess, the right to use, the right to manage, the right to the income, the right to the capital, the right to security, transmissibility, absence of term, the prohibition of harmful use, liability to execution, and the right to residuary character - but none of these rights is strictly necessary in the sense that one cannot be considered an owner of property without it. Even if one or more sticks are missing from a particular bundle, someone may still meaningfully be said to 'own' property. It is not good enough, therefore, to recommend a certain property regime for environmental goods; one must also specify just what rights and corresponding duties that regime would entail (see Ostrom, 1990, p. 22). Those rights and duties may well vary from one environmental good to another, or, with respect to any particular environmental good, from one institutional context to another.

Although the problems arising from the ideal typologies of property rights regimes are troublesome, especially when they are neglected, they do not go to the ultimate concern of law and economics scholars, which is not the ownership regime *per se* but the costs of transacting (or refraining from transacting) over resources. The ownership (and management) regime is important only in so far as it impacts on externalities and transaction costs (see, for example, Coase, 1960; Demsetz, 1967; Dahlman, 1979; and Terrebonne, 1993).

3. The Allegory of 'The Tragedy of the Commons'

The relationship between property rights and resource depletion - specifically, Aristotle's observation that goods held in common receive the least care - has been a subject of extensive economic research throughout the twentieth century. Warming (1911), Gordon (1954) and Scott (1955) each elaborated on

Aristotle's observation in the context of unowned and over-exploited fisheries. In the late 1960s Hardin (1968) and Demsetz (1967) provided the classic accounts of, respectively, the depletion of open-access resources, including many environmental goods, and the historical evolution of property institutions to avert the over-exploitation of such goods by reducing externalities and transaction costs.

Hardin's 'The Tragedy of the Commons' provides a particularly useful framework for the analysis of property rights in environmental goods. Its thesis is that resource depletion and pollution problems both stem from the incentives created by open access regimes, in which no one can exclude anyone else from using a given resource. Unless property rights are imposed, these incentives lead inexorably to 'the tragedy of the commons' - the despoliation and ultimate destruction of environmental goods. Hardin suggests two means of averting the tragedy, which he combines under the heading, mutual coercion, mutually agreed upon. The first is privatization: convert the open-access pasture to private (but not necessarily individual) ownership. On a privately-owned pasture, the costs of any decision to add an extra animal would be internalized by the pasture owner(s). They would continue to use the pasture but not to the point of destruction because, Hardin assumes, such over-exploitation would generate net costs for the presumptively rational pasture owner(s). Hardin's second means of averting the tragedy of the commons is government regulation (loosely defined). Under this regime, economic incentives toward overexploitation might be reduced or eliminated through (self-)imposed restrictions on all herders. Assuming enforceability and sufficient penalties for noncompliance, entry and use restrictions would raise the (internal) cost of adding animals to the common, but no longer open-access, pasture.

Each of Hardin's proffered solutions to the tragedy of the commons involves the conversion of the resource from open access (nonproperty) to some form of property ownership - private, common, or state. However, contrary to the claims of critics such as Cox (1985), Berkes et al. (1989), Feeny et al. (1990), and Feeny, Hanna and McEvoy (1996), Hardin's analysis provides no basis for preferring private ownership over common or state ownership (as those regimes are conventionally defined). In other words, his analysis calls for the creation of property rights where none previously existed, but does not suggest in whom (individuals, groups or the state) those property rights should be vested. In a subsequent writing, Hardin (1978) lists private and state ownership (or 'private enterprise' and 'socialism') as the only two viable solutions to the tragedy of the commons, implying that common property regimes (as defined in Section 2) would not suffice. But nothing in Hardin (1968) supports such a claim; and numerous empirical and theoretical studies dispute it (see, for example, Ostrom, 1990; Bromley, 1992; and Hanna and Munasinghe, 1995).

A more legitimate criticism of Hardin concerns his assumption that rational private owners would never knowingly exploit their resources to destruction. This assumption is empirically and theoretically dubious. Empirically, individual private owners have often done exactly what Hardin assumes they would not do. Bromley (1991, p. 171) reminds us of the dust bowls created when supposedly "omniscient" private entrepreneurs' plowed up the prairies against the advice of agricultural experts. Indeed, even as a matter of economic theory, it is rational for resource users to extinguish rather than conserve resources in some circumstances (see Gordon, 1958, pp. 117, 119-120). Clark (1973a, pp. 950-951) has shown, for example, that 'extermination of an entire [animal] population may appear as the most attractive policy, even to an individual resource owner', when '(a) the discount (or time preference) rate sufficiently exceeds the maximum reproductive potential of the population, and (b) an immediate profit can be made from harvesting the last remaining animals'. The outcome may not be socially optimal, but private property owners make decisions to maximize private, not social, benefits. See also Clark (1973b), Larson and Bromley, (1990), and Schlager and Ostrom (1992). We will revisit this point later in Section 11, when reviewing claims that the complete privatization of environmental goods would necessarily result in their optimal conservation.

Despite these criticisms, Hardin's chief insight remains nonetheless valid: open access resources will be unsustainably exploited unless *some* property rights regime is imposed for their protection. But which property rights regime? Open access may be replaced by a traditionally-conceived private property regime, in which units of the resource are allotted to individual owners. Or the resource may be kept intact as common property, with entry and use restrictions imposed by some governing body. This governing body may be private - collective self-government by the group of resource users *cum* 'owners' - or public - state ownership or regulation.

An adequate theory of property rights on environmental goods must consider the full range of possible property rights and regulatory solutions to the tragedy of the commons, and recognize that no single regime is likely to work for every resource and in every institutional and ecological setting. As Noll (1989), Komesar (1994) and Eggertsson (1996, p. 166) have all pointed out, each circumstance requires a comparative assessment of the costs of production, exclusion and administration. A private property regime based on individual ownership may be appropriate in cases where the costs of governance are relatively high, but exclusion costs are relatively low. Some form of (private or public) common or state ownership may be preferable, however, in the converse situation of high exclusion costs and relatively low costs of administration. Finally, where the costs of either exclusion or governance would be extraordinarily high (reflecting, perhaps, the technological infeasibility of exclusion) or the resource itself is superabundant (see Demsetz, 1964, p. 20), open access may be inevitable, maximally efficient or both (see Coase, 1960, p. 39 and Libecap, 1989, pp. 13-14). Stated as a rule: that property regime is best (that is, most efficient) which, in the circumstances, would achieve social goals at the lowest cost.

Of course, stating a rule is one thing; implementing it is quite another. As Libecap (1989, p. 5) points out, society will not always (and perhaps never) select the 'best' property regime for conserving environmental goods: 'examination of the preferences of individual bargaining parties and consideration of the details of the political bargaining underlying property rights institutions are necessary for understanding why particular property rights institutions are developed and maintained, despite imaginable alternatives that would appear to be more rational'. This has public choice implications that are explored briefly, as they relate to free market environmentalism in Sections 10 and 11.

4. Regulatory Solutions to the Tragedy of the Commons

In most countries environmental goods have been subject to multiple property rights regimes. Some environmental goods, such as land, have been protected primarily (though not exclusively, and not at all in most socialist economies) through the allocation of private property rights. Many other environmental goods, such as the atmosphere, have, for various reasons, never been allotted to private owners. Thus, societies have relied on both of Hardin's proffered solutions - privatization and regulation - to avert the tragedy of the commons. Most property regimes governing environmental goods are admixtures of individual private ownership, private (non-state) common property management, state ownership and management (that is, regulation). These actually-existing systems of property rights on environmental goods hardly resemble the idealized versions presented above in Section 2. Some law and economics scholars maintain, however, that a private property regime of the ideal type would offer more effective *and* efficient environmental protection than any other ownership/management regime. Their arguments are reviewed in Sections 10 and 11. Sections 5 through 9 focus on the theory and practice of environmental regulation using property or quasi-property mechanisms. The balance of this section, meanwhile, merely identifies different types of environmental regulation.

The law and economics literature distinguishes between regulatory approaches in a number of different ways. Many scholars recognize two categories of regulation: command-and-control and market-based (see, for example, Stavins and Whitehead, 1992). The second category actually encompasses (at least) two distinct regulatory approaches: taxes and trading systems (see, for example, Baumol and Oates, 1988, and Opschoor and Vos, 1989). Percival et al. (1996, pp. 154-158) derive a more expansive list of 12 distinct approaches, including (1) design standards or technology specifications, (2) performance standards or emissions limits, (3) ambient or harm-based standards, (4) product bans or use limitations, (5) marketable allowances, (6) challenge regulation or environmental contracting, (7) pollution taxes or emissions charges, (8) subsidies, (9) deposit-refund schemes, (10) liability rules and insurance requirements, (11) planning or analysis requirements, and (12) information disclosure (for example, labeling) requirements. The regulatory approaches in this more expansive typology combine varying amounts of commands, controls and economic incentives.

From the perspective of regulated industries, these typologies are misleading because, at bottom, all regulatory approaches are economic; the only meaningful difference between one approach and another lies in their differential costs of compliance. As a practical matter, then, the key to choosing between different regulatory approaches to achieve certain environmental protection goals is cost-effectiveness or regulatory efficiency: in any given situation, how much pollution control or resource conservation would alternative regulatory regimes buy for the buck? This is the question that law and economics scholars have been addressing in their theoretical modeling and empirical investigations of environmental protection regimes.

5. The Theory of Property Rights-Based Environmental Regulation

All forms of environmental regulation constitute, in effect, property-based solutions to the ‘tragedy’ of open-access environmental goods (see Barnes, 1982). Whenever the state regulates air pollution, for example, it imposes a system of rights and obligations with respect to the atmosphere. Whether it employs technology-based standards or market-based incentives, the state imposes on polluters a legally enforceable duty to comply with all restrictions on use of (what amounts to) the public’s atmosphere. Alternatively, the state may choose not to assert public rights on the environmental goods themselves but on privately-generated information respecting those goods, for example, through the use of public disclosure requirements (see, for example, Hamilton, 1995; Konar and Cohen, 1997). Such state regulations may be characterized as exercises in sovereignty (imperium) rather than ownership (dominium) (see Denman, 1978, pp. 25, 29-30). But this makes little practical difference. Whether the state is purporting to act as sovereign or owner, the rights it asserts are in the nature of property.

By viewing the state as owner (in some meaningful sense) of the environmental goods it regulates, it becomes clear that the choice in regulating is not *whether* to adopt a property-based approach in environmental regulation, but *which* property-based approach to adopt. To what extent should the state assert public rights (as owner or sovereign), as opposed to vesting (limited) property rights in individual users or groups of users? The answer to this question requires the same comparative assessment of production, exclusion and administrative costs discussed at the end of the preceding section.

Since the advent of federal pollution-control regulation in the late 1960s and early 1970s, economists have advocated the allocation of transferable property (or quasi-property) rights in wastes, as less costly alternatives to command-and-control environmental regulations (see Dales, 1968). The idea is simple enough in theory. The government sets a pollution control goal and determines the extent of emissions reduction necessary to attain it. Necessary reductions are then subtracted from current emissions levels to derive total allowable emissions. Next, the government unitizes and allocates those allowable emissions, in the form of transferable pollution rights or allowances among regulated firms. The total number of rights in circulation should match the emissions level the government deemed appropriate to achieve its pollution-control goal. Assuming the government's calculations were accurate, its pollution control goal should be achieved, regardless of whether the firms can trade rights to pollute. The primary purpose of allowing trading, therefore, is not to reduce emissions but to minimize the costs of reducing emissions (though, depending on market conditions, allowing trading may create incentives for emissions reductions beyond government-mandated levels). By making pollution rights transferable, the government 'automatically ensures that the required reduction in waste discharge will be achieved at the smallest possible total cost to society' (Dales, 1968, p. 107). It does so by creating markets that efficiently allocate the costs of pollution control among regulated firms. Firms with low pollution-control costs may find it worthwhile to reduce their emissions below mandated levels, leaving them with excess rights to sell to firms with higher pollution-control costs. In theory, exchanges of pollution rights should occur at any price below the marginal pollution-reduction costs of some firms and above the marginal pollution-control costs of others.

The great advantage of this system over traditional command-and-control regulations is that it takes account of the different cost structures individual firms have for pollution control. Command-and-control regulations disregard differential compliance costs, forcing all regulated firms to reduce emissions by the same amount. The market-based system of transferable pollution rights, by contrast, allocates the bulk of the pollution-control burden to those firms that can reduce emissions at lower cost. Firms that cannot reduce emissions so cheaply are allowed to pollute more, though they must pay for the privilege by purchasing pollution rights on the open market.

In addition to lowering the total cost of achieving administratively determined environmental goals, there is evidence that property rights-based trading systems encourage the development of new abatement technologies, leading to even greater emissions reductions (see Jung, Krutilla and Boyd 1996). And some proponents of emissions trading, such as Ackerman and Stewart (1985) contend that it is a more democratic approach to regulation than command-and-control because it focuses public attention on the fundamental question of how much pollution is acceptable, supposedly leading to more meaningful public participation in the political process and more reasoned deliberation over environmental policy by elected representatives. Heinzerling (1995) disputes such claims, however, pointing to actual legislative deliberations over pollution trading programs, in which the public and their elected representatives avoided entirely the fundamental questions of environmental policy.

Property rights-based approaches to environmental regulation obviously place a premium on a government's ability to calculate current waste levels and necessary waste reductions to achieve environmental goals. If the government fails to accurately measure current emissions or necessary reductions, its environmental goals may not be met. This is similar to the problem of getting the prices right in a tax-based pollution control regime (see, for example, Baumol and Oates, 1971). Of course, in a tax-based system the government can adjust the tax rate up or down until it achieves the desired incentive effects. Dales (1968) recommends something similar for transferrable pollution rights: the rights may be limited in duration (one-year, five-year, and so on), so that the government can make occasional adjustments to ensure the attainment of existing or newly-adopted pollution-control goals. Although this makes good sense from a regulatory perspective, it may seem problematic from a property rights perspective.

Holders of property rights typically cannot be defeased involuntarily. When a person holds property rights in something, that means that everyone else has a corresponding duty not to interfere (see Hohfeld, 1920). The government may take the property pursuant to Eminent Domain, but only upon payment of just compensation. What, then, is the status under property law of rights to pollute that can be confiscated by the government without compensation? Are they *really* property rights?

As noted earlier, whenever the government regulates for environmental protection, it is (if only implicitly) asserting public rights in environmental goods. And when the government creates a market in transferable pollution rights, this can be viewed as a conveyance of some of the public's property rights in the atmosphere to market participants. What the private firms receive is something akin to a usufruct, a leasehold, or a defeasible fee on the environmental goods. These are certainly valuable property rights, though they amount to something less than fee-simple ownership. To say they are not property rights simply because they are neither absolute nor perpetual would be akin to saying that fee simple is the only legitimate estate in land.

From an economic point of view, the legal characterization of property rights is less important than their incentive effects for market participants. The less secure property rights are, the less likely potential buyers will be to invest in them (assuming alternative investment possibilities) (see Posner, 1992, p. 32). Leaseholds certainly are less valuable than freeholds precisely because of their more limited tenure and security. And there is every reason to suspect that defeasible pollution rights would have lower market value than absolute pollution rights. Of course, if the market value of the rights falls too low, the market for them will simply disappear.

6. The Development of Property Rights-Based Environmental Regulations: Netting, Offsets, Bubbles and Banking

The theory of property rights to pollute has been implemented at various times, in various ways, in various environmental goods and with varying degrees of success. This section and the two that follow focus on the American experience with tradeable pollution rights because it has been the most extensive (see Opschoor and Vos, 1989, p. 99). And most of the American experience with emissions trading has occurred under the Clean Air Act (42 U.S.C. §§ 7401 to 7671q).

The first generation of federal pollution control regulations, adopted in the early 1970s, took a predominantly command-and-control approach to regulation. Federal regulators not only set environmental goals (or pollution reduction targets), but imposed industry-wide, health- or technology-based performance standards that applied to all plants, regardless of their differential costs of compliance. The Clean Air Act of 1970 included nothing like the transferable pollution rights system that Dales (1968) had envisioned.

In early days of federal environmental regulation, the command-and-control approach made some sense. The Environmental Protection Agency (EPA), at its inception in 1970, may not have possessed the ‘technical capability’ or economic expertise needed to design and implement transferable pollution rights programs (see Tripp and Dudek, 1989, p. 375). According to some analysts, such as Latin (1985), command-and-control air pollution regulations were easier and less costly for a new and inexperienced administrative agency like the EPA to design and implement. It was almost certainly cheaper and easier for the fledgling agency to require firms to install and operate specified air pollution-control devices, which would reduce emissions by known amounts, than to monitor and enforce individualized output levels at thousands of sources (see Maloney and McCormick, 1982, p. 106).

Moreover, in the early days of federal environmental regulation improvements came cheap, so that even a relatively expensive system of command-and-control regulations provided substantial net social benefits. Indeed, the Clean Air Act may have provided its greatest net social benefits at the very time it was most heavily dominated by expensive command-and-control regulations. According to best estimates, the total social cost of Clean Air Act regulations between 1970 and 1981 amounted to $13.7 billion, while the easily quantifiable benefits from those regulations in 1978 amounted to $37.3 billion, yielding a net social profit of almost $24 billion (not including the more difficult to quantify health, aesthetic and ecosystem benefits of pollution control) (see Portney, 1990, p. 69). Still, many have argued that the net social benefits of air pollution control would have been far higher had the government adopted less costly approaches to regulation than command-and-control. According to various studies, federal air pollution regulations in the 1970s and early 1980s were between 7 and 400 percent more expensive than least-cost solutions (see Ackerman and Stewart, 1985, p. 1338; Tietenberg, 1985, pp. 39-56).

Even in its early years, however, the EPA was not oblivious to alternative approaches to regulation. It began experimenting with emissions trading programs as early as 1974 (see Hahn and Hester, 1989a, p. 109). By 1980 the agency had approved four different types of emissions trading schemes: netting, offsets, bubbles, and banking (see Liroff, 1986).

Netting

First, in 1974 EPA adopted 'netting', a policy that allows firms to avoid the application of expensive 'New Source Performance Standards' by netting increased emissions from modernized or expanded existing sources with emissions decreases from other existing sources at the same facility (see Hahn and Hester, 1989a, pp. 132-133). So long as the net increase in plant-wide emissions does not equal the minimal requirement for a 'major' source, as defined in the Clean Air Act, the modernization or expansion will not be treated as a 'new' source for purposes of the Clean Air Act. Netting can occur in all areas of the country, whether or not they have attained the National Ambient Air Quality Standards. But netting obviously applies only to internal trades, that is, trades between sources located at the same facility (see EPA, 1986a). Nevertheless, according to Hahn and Hester (1989a, p. 133), it 'is the most commonly used emissions trading activity by a wide margin'. Between 1974 and 1984, as many as 12,000 sources used netting to avoid more onerous regulatory burdens under the Clean Air Act. The result has been estimated cost savings of between $525 million and $12 billion (Hahn and Hester, 1989b, p. 374).

Offsets

'Offsets' were the second form of emissions trading created by the EPA. By the mid-1970s, the agency had become concerned that many of the country's Air Quality Control Regions would fail to attain the National Ambient Air Quality Standards by the 1977 deadline. The question arose whether the Clean Air Act would permit the construction of new air pollution sources in nonattainment areas. A construction ban obviously would have entailed great economic costs for nonattainment areas, as well as political fall-out for state and federal regulators. To avoid this prospect, the EPA in late 1976 promulgated offset regulations that permitted the construction of new stationary sources in nonattainment areas, provided that their new emissions were offset by reductions at existing sources. Under this offset rule '[e]xisting sources are, in effect, given pollution rights equal to their existing emissions, which can then be sold to new sources or to existing sources that wish to increase their emissions' (Stewart and Krier, 1978, p. 593).

Offsets are different from netting in several respects: they apply only in nonattainment regions (and in certain attainment regions where contributes to nonattainment in other regions); they are mandatory; and they cannot result in a net increase in emissions. EPA's original offset rule was codified in § 178 of the 1977 Amendments to the Clean Air Act, which additionally required that all new emissions in nonattainment regions be *more than offset* by reductions from existing sources. The purpose was to ensure that new economic development in nonattainment regions would contribute to the attainment of the National Ambient Air Quality Standards. Subsequently, the 1990 Clean Air Act Amendments established precise offset ratios, ranging from 1.1:1 to 1.5:1, that apply depending on the region's level of nonattainment. For example, in Los Angeles, which is the only 'extreme' nonattainment area in the country, 1.5 tons of Volatile Organic Compound (VOC) emissions must be retired from existing sources for every ton to be emitted from a new source. As of about 1988, some 2,000 offset transactions had taken place, though only about 10 percent of these were external, that is, involving more than a single facility (Hahn and Hester, 1989b, p. 373). The economic effects of these transactions are difficult to estimate. Offsets are not designed to yield direct regulatory cost savings. However, the fact that offset transactions occur at all suggests that they must provide some economic benefits both for firms seeking to locate in nonattainment regions and for the nonattainment regions themselves. (see Hahn and Hester, 1989b, p. 375).

Bubbles

In 1979, EPA permitted regulated firms to use 'bubbles' to avoid more burdensome regulations. A single plant may contain many individual sources of pollution. The bubble policy allows existing plants (or groups of plants) under common management to place all their individual smokestacks under a bubble, as it were, with a single opening at the top. By treating the entire plant or group of plants as a single source with a single emissions target (for each pollutant), plant managers are free to allocate necessary reductions to those smokestacks with the lowest control costs. Instead of having to reduce emissions by a certain amount at each and every smokestack, the plant (or plants) can reduce emissions more at some smokestacks and less (or not at all) at others. 'In effect, emissions credits are created by some sources within the plant and used by others' (Hahn and Hester, 1989b, p. 372). By the mid-1980s the EPA had approved 42 bubbles for firms and various states with EPA-delegated authority had approved another 89; but only two of them involved external trades (see Hahn and Hester, 1989a, pp. 123-125, 1989b, p. 373). The total cost savings from bubbling have been significant. Federally-approved and state-approved bubbles have saved an estimated $435 million in regulatory costs. While this total is lower than the total cost savings from netting, it reflects a higher average savings per transaction (see Hahn and Hester, 1989b, p. 374).

Banking

Also in 1979, EPA began allowing regulated firms to bank emissions credits for future use, sale or lease. This banking system is not so much a separate emissions trading scheme as a mechanism to facilitate the use of other emissions trading schemes, notably bubbles and offsets. The EPA delegated authority to the states to administer their own emissions credit banks. But, according to Hahn and Hester (1989b, p. 373), banking has not been well-received by either state administrators or regulated firms. As of September 1986, firms had withdrawn credits from banks for sale, lease or use only 100 times. Thus, the cost savings realized through banking were 'necessarily small' (Hahn and Hester, 1989b, p. 374). One possible reason for the reluctance of firms to use the banking system for emissions reduction credits is the lack of secure property rights in the credits, which can be confiscated by state or federal regulators at any time in order to further environmental protection goals (Hahn and Hester, 1989a, p. 130).

Indeed, none of the four pollution trading programs discussed in this section - netting, offsets, bubbles, and banking - provide secure property rights in emissions reduction credits (ERCs). According to the EPA (Oct. 1980, p. 2), '*an ERC cannot be an absolute property right*'. Because of its continuing statutory obligation to attain National Ambient Air Quality Standards, the agency reserves the right to impose new emissions controls that could, in effect, confiscate saved or purchased emissions reduction credits (see Hahn and Hester, 1989a, p. 117). As noted earlier, the lack of secure property rights on ERCs is not necessarily a fatal flaw in the system; the market will discount their economic value based on the risk of confiscation. But, according to Hahn and Hester (1989b, p. 379), the lack of secure property rights on ERCs has served 'as a disincentive for engaging in trading in nonattainment areas, and especially for external trading in those areas'. The lack of secure property rights raises similar issues with respect to the most ambitious emissions trading program to date: the sulfur dioxide allowance trading program under the 1990 Clean Air Act Amendments.

7. The Clean Air Act's Sulfur Dioxide Allowance Trading Program

7.1 Program Design

When the federal government took over primary responsibility from the states for air pollution control in 1970, one of its main justifications was the problem of interstate air pollution (see Revesz, 1996, p. 2341). Since then, ironically, interstate air pollution problems have been among the 'thorniest' problems for federal regulators (Squillace, 1992, p. 301). Acid rain is a prime example. It is created when sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions, primarily from midwestern power plants, combine with constituent elements in the atmosphere to produce sulfuric and nitric acids that precipitate back to earth, acidifying lakes, burning forests and corroding structures. The biggest regulatory problem with acid rain is that most of it falls far from its midwestern emissions sources in the northeastern United States and in Canada. In 1990, after more than a decade of political wrangling, Congress enacted an innovative new program to control acid rain. The 'acid deposition control' program established in Title IV of the 1990 Clean Air Act Amendments (42 U.S.C. § 7651) sought to cut SO_2 emissions by ten million tons and NO_x emissions by two million tons by the year 2000. To reduce NO_x emissions, Congress relied primarily on traditional technology-based standards, that is, command-and-control: regulated utilities were required to retrofit controls on existing boilers. The SO_2 reduction effort, by contrast, relied on a new, two-phase (quasi-)property-based approach utilizing transferrable emissions allowances.

The different regulatory approaches may reflect the fact that NO_x controls are significantly cheaper than SO_2 controls (see, for example, State Utility Forecasting Group, 1991, p. 45, estimating the capital cost for NO_x control retrofits at less than \$100 million, compared to \$0.9 billion for SO_2 control retrofits). Consequently, the marginal benefits of an emissions trading program for NO_x would be lower, perhaps so low as to be outweighed by the higher administrative costs of such a program.

In Phase I of the SO_2 program, Congress issued emissions 'allowances' - with each allowance equalling one ton of SO_2 emissions - for the 240 dirtiest generators at 110 power plants in 21 states. Sixty-three percent of regulated generators were located in just six states: Illinois (17), Indiana (37), Kentucky (17), Ohio (41), Pennsylvania (21) and Tennessee (19). The total number of allowances issued equalled approximately one-half of the total emissions of all

240 generators, in order to achieve a 3.5 million ton reduction in aggregate SO_2 emissions before the second phase of emissions reductions begins in the year 2000. The allowances were allocated to individual generating units based on their average quantity of fossil fuel consumed during the three-year period 1985-87, assuming 2.5 lbs SO_2 per each million BTUs of fuel input. In Phase II, the goal is to reduce SO_2 emissions from all but the smallest generating units by an additional 6.5 million tons, based on a formula of 1.2 pounds per million BTUs of fossil fuel input during the 1985-87 period.

Congress's pollution reduction targets really are not as stringent as they appear because the Act provides extra allowances for plants in 'high growth' states, including the six states that produce the lion's share of the country's SO_2 emissions. The Act also provides that deadlines may be extended for plants that take early steps to reduce emissions beyond the Act's requirements. However, the Act sets a fast 8.7 million pound cap on utility SO_2 emissions after 2000. Moreover, the Act does not hold in reserve any emissions allowances for new sources entering the market; new sources must obtain allowances from existing ones.

All the pollution reduction realized under the Clean Air Act's acid rain program will result from these administratively set quotas. They are 'commands', but they have been issued without attendant 'controls'. The Act does not specify *how* sources are to meet emissions reduction requirements. In fact, the law does not even require sources to reduce emissions to the levels set by Congress but only to possess allowances equal to their actual emissions. Congress designed the Act to utilize market forces by expressly authorizing the nationwide buying and selling of emissions 'allowances'. Sources that can economically reduce their emissions below required levels can sell their excess allowances. Sources with higher costs of controlling emissions can purchase extra allowances, that is, increase their quota, rather than reduce emissions to Phase I or Phase II levels. Congress even provided for the creation of a futures market in emissions allowances, authorizing generating units to buy and sell allowances for future years (see Mazurek, 1994). The goal of this trading system is primarily to minimize the total costs of achieving the legislatively commanded reductions in SO_2 emissions. According to some estimates, it could reduce the total cost of achieving a 10 million ton reduction in SO_2 emissions by 20 percent, from \$5 to \$4 billion or less (Menell and Stewart, 1994, p. 410).

Not everything about the program is market-driven, however. The program places a premium on monitoring trades and emissions. When a generating unit buys or sells an allowance, that alters its emissions quota. The EPA has to keep track of the trades to know, at any given moment, how much SO_2 each generating unit is permitted to emit. To that end, the agency created a central accounting system to which firms must report all allowance transactions. And to ensure that sources are complying with their emissions quotas, they must install continuous emissions monitoring systems and report their actual emissions to the EPA. Sources that violate their emissions limitations are subject to a penalty of $2,000 per ton. This penalty is significant, amounting approximately to 20 times the price of one ton of SO_2 at the March 1997 auction.

The key to the design of the acid rain program is the development of a well-functioning emissions market. But certain aspects of the program's design initially caused some to doubt that a market would develop. One major concern was the lack of property rights in emissions allowances. Congress expressly provided in § 403(f) of the 1990 Clean Air Act Amendments (42 U.S.C. § 7651(f)) that an 'allowance is not a property right'. And it expressly authorized the EPA 'to terminate or limit' allowances, when necessary to achieve environmental goals, without having to pay just compensation for taking property under the 5th Amendment to the US Constitution (see Dennis, 1993, pp. 1118-1122). This provision may serve to placate environmentalists, who are repulsed by the very notion of a right to pollute, as well as the idea that firms might profit from trading in pollution (see Percival et al., 1996, pp. 829, 832). However, § 403(f) is premised on a typical confusion between property rights in something and the thing itself. An emissions allowance is not a property right, but there certainly are property rights in allowances. A utility that holds an allowance to emit SO_2 cannot prevent the government from confiscating it but certainly can exclude all others from interfering with it. The rights to possess and exclude (within limits) certainly are property rights in the allowance. Indeed, disputes over property interests in emissions allowances have led to civil litigation (see *Ormet Corporation v. Ohio Power Company*, 98 F.3d 799, 4th Cir. 1996).

In addition to property rights concerns, some analysts expected allowances to be priced beyond any potential market (see Squillace, 1992, p. 302). However, the performance of the SO_2 emissions trading system to date has allayed this concern.

7.2 The SO_2 Market in Operation

By November 1995, 23 million allowances worth $2 billion had been transferred in more than 600 transactions under the acid rain program. In addition to external transfers, many sources had reduced their emissions and banked the excess allowances for future use after Phase II emissions restrictions go into affect in the year 2000. The result has been a greater than expected reduction in SO_2 emissions and a 10 to 25 percent reduction in acid precipitation in the Northeast (see Swift, 1997, p. 17).

Sources have selected various means to reduce emissions: 30 power plants have installed scrubbers, which reduce SO_2 emissions by more than 90 percent; many plants have switched from high-sulfur to low-sulfur coal. For a detailed review of utility compliance strategies, see Energy Information Administration

(1997). The larger than expected reductions flooded the market with available allowances, which meant far lower sales prices for allowances than many analysts anticipated. The first allowances sold in 1992 for between $250 and $400 per allowance; by 1996, the average price was down to $68 (see Percival et al., 1996, pp. 831-832). (However, in 1997 the average price rebounded to $106.75 per allowance; see BNA Chemical Regulation Daily, March 28, 1997.)

In economic terms, the acid rain trading market has proven to be 'a terrific bargain' (Percival et al., 1996, p. 832). Even the lowest estimates of its annual health benefits ($12 billion) are four times higher than the highest estimates of annual program costs ($3 billion). And, it is worth noting, the benefit estimates do not include difficult-to-quantify environmental benefits, such as reduced acid rain damage to forests, lakes, rivers and buildings (Percival et al., 1996, p. 832). One recent assessment of the Clean Air Act's acid rain program concluded that 'the benefits ... exceed the costs by a substantial margin' (Burtraw et al., 1997, p. 26).

7.3 Perceived Problems and Unresolved Issues

The lack of secure and perpetual property rights in emissions allowances apparently has not impeded trading. As noted earlier, markets compensate for the risk of confiscation by discounting prices. So, if SO_2 allowances were perceived to be highly insecure, their value would fall, perhaps so low as to completely wipe out the market. But the EPA is well aware of this potential threat, which it has encountered in earlier emissions trading programs (see EPA, 1986b, p. 43,847 n. 48). In order to preserve the market, the EPA is likely to treat emissions allowances as if they were property rights, except in unusual circumstances (see Dennis, 1993, p. 1137). The risk of confiscation should, therefore, be remote (see Rosenberg, 1994, p. 508, n. 54).

The acid rain program is not completely without problems, however. In creating a nationwide market in SO_2 emissions, Congress ignored distributional considerations related to emissions of SO_2 and acid deposition. As noted earlier, the states that suffer the most from acid rain are located in the Northeast, while the states that produce most of the SO_2 emissions that cause the acid rain are located in the Midwest. The emissions trading program does not guarantee that midwestern power plants will reduce their emissions sufficiently to resolve acid rain problems in northeastern states. Imagine if power plants in Indiana purchased emissions allowances from plants in New York. This would permit Indiana plants to continue emitting high levels of SO_2, creating further acid rain problems for the State of New York, while power plants in New York profited from the transactions. This prospect has led to some political and legal skirmishes between northeastern states and the EPA. But, in fact, the problem has not materialized. Power plants upwind of New York have actually reduced their emissions more than required by their Phase I quotas (see US General

Accounting Office, 1994, p. 56). On state and regional responses to this and other perceived problems with the Clean Air Act's acid rain program, see Mostaghel (1995) and Rosenberg (1994).

A 1994 report by the US General Accounting Office (GAO) (1994, pp. 43-58) identifies other impediments to a more vibrant market in SO_2 emissions allowances, including the fact that Phase I reductions apply to only about 14 percent of the country's power plants. More trading can be expected in Phase II as the program is broadened to cover another 700 power plants. The GAO also points out that potential traders feel insecure about how state legislatures, public utility commissions and the Federal Energy Regulatory Commission will treat SO_2 allowances. Finally, the GAO suggests that the tax treatment of allowance trading under the Internal Revenue Code may discourage trades because sales of allowances are taxed as ordinary capital gains with zero basis. This last assertion is dubious. Utilities incur tax liability only when they sell allowances; meanwhile, utilities that purchase allowances realize equivalent tax savings. The tax treatment of trades therefore should be revenue neutral for the federal government (see Revenue Procedure 92-91, October 29, 1992, 92 Fed. Reg. 46,595). If taxes on emissions allowance transactions created a disincentive for traders, we should expect to see evidence of it on the supply side. Yet, the price and availability of SO_2 allowances on the market suggests that supplies have been more than adequate; any lack of trading appears to be more a problem of demand, which cannot be explained by federal tax policy.

Uncertainties about the SO_2 emissions trading program may have complicated the compliance strategies of regulated utilities. But trading volume is not the only or even the most important measure of the acid rain program's success (see Burtraw, 1996). Allowance trading is but a means to the end of attaining administratively-set emissions reduction targets at the lowest possible cost. And on that measure, the program has so far proven to be a great success. According to the EPA, in 1995 100 percent of the 110 power plants regulated in Phase I were in compliance with their emissions allowances, and they had reduced aggregate emissions of SO_2 well below the 8.7 million ton limit established in the 1990 Clean Air Act Amendments. Total emissions in 1995 were 5.3 million tons, 39 percent below the ceiling and more than 50 percent below 1980 emission levels (see BNA Daily Environment Report, Aug. 12, 1996). The total cost savings from using the trading system, as opposed to regulatory controls, to achieve this level of emissions reduction are difficult to estimate, but must be substantial. Consider that just four utilities, Central Illinois Public Service, Illinois Power Company, Duke Power and Wisconsin Electric Power Company estimate their aggregate savings from purchasing allowances rather than installing scrubbers at $706 million (US General Accounting Office, 1994, pp. 33-34). This figure almost matches the total annual costs of compliance with Phase I requirements - estimated, through

1995, at $836 million - according to a report prepared by the Massachusetts Institute of Technology (see Energy Information Association, 1997, p. 12). In sum, the Clean Air Act's acid rain program is achieving both pollution reductions and cost savings beyond all expectations.

8. Other Pollution Rights Trading Schemes

Although the Clean Air Act's acid rain program constitutes the most extensive use to date of pollution rights trading, there are several other examples worth mentioning. In the mid-1980s, the EPA introduced a short-lived but highly successful program for trading rights to use lead in gasoline. This program is discussed extensively in Hahn and Hester (1989b, pp. 380-391). Another largely successful program, described in Tripp and Dudek (1989, pp. 378-382), concerned the use of tradeable development permits to conserve the New Jersey Pinelands, the world's largest pineland forest. Less successful efforts include tradeable water pollution rights programs on Wisconsin's Fox River and Colorado's Dillon Reservoir, both of which are discussed in Hahn and Hester (1989b, pp. 391-396).

More recently, in 1993 California's South Coast Air Quality Management District (SCAQMD), the agency responsible for implementing federal and state clean air legislation in Los Angeles, established a new allowance trading model, to help the country's most polluted city attain the National Ambient Air Quality Standards. The goal of its Regional Clean Air Incentives Market (RECLAIM) is to reduce stationary source emissions of nitrogen oxides (NO_x) and sulfur dioxide (SO_2) at average annual rates of 8.3 percent and 6.8 percent, respectively, between 1994 and 2003. Polesetsky (1995) provides a complete description of the RECLAIM program. Since the program has just recently been launched, it is too early to judge RECLAIM's success. But early signs have been promising. As of the end of 1996, some $20 million worth of emissions credits had been traded, $9.9 million in 1996 alone. The average trading price was $142 per ton for 1996 SO_2 credits and $154 per ton for 1996 NO_x credits. Actual NO_x and SO_2 emissions in 1996 were 70.5 tons per day, 29 percent below the allotted level of 98.4 tons per day. And 92 percent of the 330 facilities participating in RECLAIM were in compliance with their emissions credits (see Utility Environment Report, March 14, 1997).

Other states also are beginning to experiment with pollution trading systems as part of their efforts to attain the National Ambient Air Quality Standards. See, for example, Schroder and Johnson (1997) on Michigan's new trading program, which applies to all 'criteria' pollutants. And beyond US borders, several other countries have been experimenting with property rights-based approaches to environmental protection. Denmark's 1991 Environmental

Protection Act, for example, relies heavily on contractual agreements between polluting industries and the government. Polluters receive permits that embody the contract terms, but, as with emissions allowances under the American acid rain program, Danish pollution contracts create only 'quasi-rights', so that the government can, if necessary to attain environmental goals, amend permits without expropriating property (see Ercmann, 1996, pp. 1226-1227).

9. Assessing Pollution Rights Trading Schemes as a Method of Environmental Regulation

Based on the various early experiences with pollution rights trading, analysts have derived certain lessons for designing successful trading systems. Tripp and Dudek (1989), for example, identify eight 'institutional guidelines': the responsible administrative agency must have (1) 'clear legal authority' and (2) the 'technical capability' to design, implement and enforce the program; (3) the program must be 'evasion proof', meaning that regulated sources have no way (through loopholes, waivers, and so on) to avoid either reducing emissions or purchasing additional allowances; (4) the program should have 'clearly specified objectives' based on sound science and with strong political backing; (5) trading programs work best when applied to pollution problems with 'regional significance', as opposed to those with only local impacts; (6) the tradeable 'rights must have economic value'; (7) the program should provide an 'equitable and administratively simple method for allocating' tradeable rights, although there may be 'trade-offs between fairness and administratively simplicity'; and (8), the institutional structure for buying and selling rights should be designed so as to minimize transaction costs. This last guideline ties in with the sixth: the higher the transaction costs involved in trading - '[t]he greater the administrative or public hassle confronting a prospective buyer or seller of rights' - the less economic value rights will have.

Interestingly, Tripp and Dudek do not list security of property rights as a distinct guideline for a successful pollution trading program, though it implicitly factors into their sixth guideline, concerning the economic value of the rights to be traded. Their decision not to focus on the lack of secure property rights is supported by the success of trading schemes, such as the Clean Air Act's acid rain program and the EPA's earlier lead trading program, both of which involved rights that could be confiscated by the government. Other analysts, however, consider the lack of secure property rights in pollution as a potentially major hindrance to trading. Hahn and Hester (1989a, p. 149), for example, maintain that trading systems would operate more efficiently, creating greater cost savings, if 'uncertainties over the definition of property rights' in pollution were eliminated. But even they would not recommend absolutely secure property rights in pollution emissions, in recognition that the government might need to reduce emissions further in order to meet environmental quality goals (Hahn and Hester, 1989a, p. 150). And in comparing various emissions trading programs it appears that the transaction costs associated with variable administrative rules governing trading systems can exert a far greater negative influence on trading than the lack of protection against governmental confiscation of pollution rights (see Foster and Hahn, 1995, pp. 38-40; Hahn and Hester, 1989b, pp. 396, 401-406).

The few successful experiments with pollution trading have encouraged scholars to innovate new applications for conserving ocean resources (see Tipton, 1995), endangered species habitat (see Sohn and Cohen, 1996), and wetlands (see Sapp, 1995). Although these schemes could all work, it is doubtful that pollution-rights trading would be both effective and efficient for all environmental goods in every ecological and institutional context (see, for example, Miller, 1996 and Thompson, 1993, both identifying institutional impediments to successful trading programs in water pollution rights).

10. Beyond the Regulatory Model: A Complete Property Rights Solution to Environmental Problems

Somewhat surprisingly, the most hostile critics of pollution rights trading schemes have not been environmentalists but certain law and economics scholars, including McGee and Block (1994) and Anderson and Leal (1991, pp. 158-159), who contend that such schemes really amount to nothing more than 'market socialism'. These self-described 'free market environmentalists' do not doubt that so-called 'market-based' environmental regulations are an improvement over traditional command-and-control - just as market socialism would constitute an improvement over 'feudalism' (see Yandle, 1992) - but they reject the assumed need for *any* form of government environmental regulation. Instead, they promote a complete property rights solution to environmental problems. This section reviews and Section 11 critiques their arguments.

10.1 The Worldwide Trend Toward Privatization

Privatization has swept the globe. Spurred by the Reagan-Thatcher Revolution of the 1980s, governments around the world have been selling off public assets to private owners in order to improve efficiency and increase production. In the ten-year period from 1985 to 1994, some $468 billion worth of state enterprises were sold off to private investors (see Poole, 1996, p. 1). Interestingly, these sales have been limited to economic enterprises. States have not, with a few notable and controversial exceptions, been shedding their vast natural resource holdings, which include forest lands, parks, waterways and the atmosphere. Free market environmentalists argue that they should do so, pointing out that the same economic theories that favor of private ownership of economic producers also support the private ownership of environmental goods. As Stroup and Goodman (1992, p. 427) put it, 'government ownership and control works just as badly with environmental resources as with all other resources'.

10.2 What Constitutes 'Privatization'

The word 'privatization', as it is used throughout the law and economics literature, encompasses a wide variety of activities by which some public entity conveys property rights to a private entity or entities - everything from outright giveaways or sales of public lands to licenses or concessions under which private firms finance, construct and manage hotels, airports, wastewater treatment plants, highways, prisons, and schools (see Poole, 1996, p. 1). On this broad definition, privatization can but need not be total. One could sensibly maintain that government allocations of transferable pollution permits, for example, constitute partial privatization. But many of privatization's most vociferous advocates would reject this broad understanding of privatization. They (often implicitly) adopt a narrower definition which requires *total* government relinquishment of property rights through the outright sale or gift of public resources (see, for example, Anderson and Leal, 1991).

10.3 'Free-Market Environmentalism'

Conventional welfare economics explains environmental problems as symptoms of market failure, caused by externalities, which justifies corrective government intervention in the marketplace (see, for example, Royal Commission on Environmental Pollution, 1971, pp. 4-6; Samuelson, 1980, p. 450). Government intervention can take various forms. Davis and Kamien (1969), for instance, list six distinct governmental means of resolving environmental problems: (1) by prohibition; (2) by directive; (3) by taxes and subsidies; (4) by regulation; (5) by payment; and (6) by action. They also list one nongovernmental means: by voluntary action. Stewart and Krier (1978, pp. 109-111, 116) provide just four categories of governmental action for environmental protection: (1) redefinition of property rights; (2) subsidies or payments; (3) coercive commands; and (4) financial penalties or fees.

Free-market environmentalists do not dispute that environmental problems arise from market failures; nor do they take issue with the need for responsive government action (though they often sound as if they do). But they challenge the conventional welfare economics story concerning the cause(s) of market failure and the appropriate governmental response(s). According to free market environmentalism, environmental market failures occur only because property rights are incompletely specified. Government remedies that ignore that root cause are, at best, palliative; they may treat the symptoms of environmental externalities, but they do not cure the underlying cause of the market failure.

The only way to do that - and, thus, the only truly appropriate and effective remedy to environmental problems - is to completely specify property rights in environmental goods, that is, privatize them. Free market environmentalists claim that a system of completely specified and protected property rights should prevent inefficient externalities and, therefore, market failures. And in the absence of market failures government regulatory intervention is neither necessary nor justifiable.

It is important to note that the theory of free market environmentalism does not necessarily support individual ownership over group or communal ownership (see Anderson and Leal, 1991, p. 3). The important distinction under this theory is between 'public' property (*res publicae*) and private property, where private is defined to include both individual property (*res individuales*) and common property (*res communes*). Free Market Environmentalists contend that there should be no public property rights in environmental goods for reasons that derive largely from the public choice writings of Downs (1957), Buchanan and Tullock (1962), Olson (1965), and Niskanen (1971).

10.4 Public Environmental Goods, Bureaucratic Management and Government Failure

Free market environmentalists, in essence, deny the very possibility of public property, claiming that private individuals, whether politicians, bureaucrats or members of favored interest groups, inevitably will assert what amounts to *dominium* over so-called public assets. As Huffman (1994) put it, there will always be 'private rights in public lands'. Like private owners, the politicians and bureaucrats who are *de facto* owners of *de jure* public property presumably manage resources so as to maximize their self-interests (see, for example, Anderson and Leal, 1991, p. 4 and Stroup and Baden, 1983, p. 43). But their incentives turn out to be quite different from those of private owners for two main reasons. First, bureaucrats and politicians do not bear all the costs of their management decisions because they are not personally invested in the resources. If they manage resources poorly, they do not bear the economic losses. Thus, as Anderson and Leal (1991, p. 14) put it, the '*political sector operates by externalizing costs*'. This is also true for private property owners in many circumstances, but only because property rights on some resources are insufficiently specified (see Anderson and Leal, 1991, p. 20).

The second main difference between the incentives of public resource managers and private owners is their relative myopia. Many environmental management issues include significant time-preference aspects - an old growth forest harvested today will not be available to future generations of users or viewers. All resource owners, whether public or private, implicitly or explicitly weigh present use values against expected future benefits, if current use is foregone. They do so by discounting the expected future benefits, reducing them to present day dollars, which can then be compared directly with current use values. If the discounted expected future value is greater than the present use value, the resource will be conserved (that is, invested for future use); otherwise, it will be presently used or consumed. The comparison of present and future values depends predominantly on two variables: the estimation of future value and the owner's subjective discount rate, that is, the interest rate at which they reduce future values to present dollars. A low discount rate favors longer-term investments or conservation; a higher discount rate tends to favor current usage or consumption.

One common justification for public control of environmental goods is that the discount rates of private owners exceed the social rate of discount, resulting in too rapid resource use and depletion (see, for example, Hotelling, 1931; Howe, 1979, p. 103). But free market environmentalists counter that private property owners can be expected to have lower discount rates and longer time horizons than public resource managers, that is, politicians and bureaucrats (see, for example, Stroup and Goodman, 1992). As Baden and Stroup (1983, p. 24) put it, 'there is no "voice of the future" in government equivalent to the rising market price of an increasingly valuable resource. The wise public resource manager who forgoes current benefits cannot personally profit from doing so.' For politicians facing re-election in two-, four- or six-year cycles, the choice between preserving natural resources for unborn generations of voters and developing them for living generations of voters is a no-brainer. Indeed, studies of congressional voting patterns on environmental legislation indicate that legislators do not vote for or against policies based on abstract conceptions of inter-generational public welfare but on the estimated costs and benefits to living constituents (see Pashigian, 1985).

Bureaucrats do not face re-election of course, but they are dependent on the legislative authorizations and annual budget decisions of politicians who do. Bureaucrats are not driven to maximize profits, as are private resource owners, but to maximize budget allocations and administrative turf (see, for example, Orzechowski, 1977; Stroup and Baden, 1983). 'Accordingly', writes Gary Libecap (1981, p. 9), 'they do not have the same incentive that profit-maximizing firms do to increase the discounted net value of the resources under their control'. Their actions respond not to market conditions but to political conditions, 'even though it reduces the total value of production'. Given their incentives, bureaucrats are likely to favor, and therefore to subsidize, resource uses that increase (or protect) their budgets and political influence, regardless of economic waste or environmental degradation. Even if this were not true and public agencies endeavored to maximize both economic and environmental values in resource management, it remains doubtful, especially in light of the demise of socialism, that any government agency could 'accurately measure, simulate, predict, and plan for both ecological and economic outcomes' (Rasker, 1994, p. 392).

The usual result of bureaucratic management, according to free market environmentalists, is government failure to allocate environmental goods efficiently. In many, if not all, cases, public ownership does not protect the environment from market failure, but itself becomes 'the cause of environmental problems' (Baden and Stroup, 1990, p. 132). And because governments fail too, market failure cannot automatically justify government intervention (see Castle, 1965, p. 552).

10.5 Evidence of Government Failure in the Management of Public Natural Resources

The free market environmentalism literature is chock full of evidence of government mismanagement of publicly owned natural resources, where 'mismanagement' is defined (if only implicitly) as economically inefficient and/or environmentally harmful management (see generally Anderson and Leal, 1991; Stroup and Baden, 1983; Nelson, 1995; Klyza, 1996). Libecap (1981) explains how government rangeland management practices have led to overgrazing on, and even desertification of, rangeland resources. Stroup and Baden (1973) and Hyde (1981), among many others, identify 'social failures' (inefficiencies and environmental harm) resulting from federal timber management policies, such as below-cost timber sales in National Forests. Anderson (1994, p. 36) discusses just one of many uneconomic and environmentally harmful water projects promoted by the Federal Bureau of Reclamation. And Epstein (1995, pp. 291-296) and Anderson and Leal (1992, pp. 306-308) explain the perverse incentives created by well-meaning but misguided federal wildlife preservation policies. The entire history of public resource management is presented as an immense tragedy of the 'political commons' (Borcherding, 1990, p. 99). And the only solution to this tragedy, according to free market environmentalists, is complete privatization.

10.6 The Privatization Solution

Free market environmentalists claim that privatization, that is, the complete specification of private property rights in environmental goods, would avert both market failures and misguided government efforts to correct them, resolving problems ranging from the mismanagement of timber resources to global warming (see Anderson and Leal, 1991). Their argument is a logical (though unwarranted) extension from Demsetz (1967), who established that private property rights in land evolve at a certain stage of socio-economic development (that is, when resource scarcity relative to the rate of demand becomes problematic) in order to reduce the externalities that impede effective investment, that is, resource conservation. If property rights reduce externalities, the logic goes, then more completely specified property rights should more completely reduce externalities (but see Demsetz, 1968, noting that efficiency is sometimes maximized through government action rather than market transactions of private property rights).

Privatization replaces the decision making of bureaucrats and politicians with the decision making of private owners whose incentive structures, according to free market environmentalists, are more conducive to economically and environmentally sound resource management. Unlike public resource owners, who make management decisions - present use versus conservation - without the benefit of market prices to guide their valuations, private owners operate within the marketplace where prices can accurately measure an asset's value. Stroup and Goodman (1992, pp. 431-432) explain how the information provided by market prices induces private resource owners to take a longer-term perspective in resource management decision-making:

> The current market price reflects the present, discounted value of all future revenue flows that are expected to stem from the asset.
> The ability to capitalize future value into an asset's present value induces property owners to consider the long-term implications of their asset-use decisions. It creates a strong incentive for owners to consider fully the effects of deferring consumption of their asset returns. Furthermore, it implies that property owners will be responsible to future users. Any activity that reduces the future benefits or increases the future costs stemming from an asset results in a reduction of that asset's current value. As soon as an appraiser or potential buyer anticipates future problems, his assessment of a property's value falls, and the owner's wealth declines immediately.

Thus, '[p]otential buyers interact with owners to maximize asset value over time'. And this logic holds for both individual and corporate resource owners (Stroup and Goodman, 1992, p. 432). But, as we have already seen, it does not hold for public resource owners, who make their management decisions outside the marketplace, without benefit of the information market prices provide. Free market environmentalists conclude, therefore, that the privatization of publicly owned resources would promote better-informed and longer-view management of environmental goods.

Of course, some publicly owned environmental goods are easier (that is, less costly) to privatize than others. National parks and forests, like other land areas, could easily be parcelized and allotted to private owners. But other environmental goods, such as the atmosphere, are notoriously difficult (that is, costly) to privatize. Clean air traditionally has been considered a subtractible public good - a good from which no one can be excluded, but which can be depleted by use (see, for example, Goetze, 1987, pp. 188-189). But free market environmentalists point out that neither clean air, nor any other natural resource, is inevitably a *public* good. It is not strictly impossible to impose private property rights on the atmosphere, only too costly so long as the supply of clean air remains plentiful relative to the rate of demand. Under these circumstances, the costs of developing the technologies necessary to create enforceable boundaries and, hence, property rights, are not economically justifiable; the transaction costs would outweigh the benefits to be gained from privatization. But this situation is not immutable. It is quite possible for clean air to become scarce enough relative to the rate of demand to justify the costs of privatization. Alternatively, the supply of clean air might remain constant relative to the rate of demand, but the costs of imposing property rights could drop because of technological innovations (see Anderson and Leal, 1991, pp. 165-167). The innovation of barbed wire in the 1870s, for example, greatly reduced the cost of enclosing land, which facilitated settlement and private ownership of formerly public lands. Anderson and Hill, (1975, p. 172). What counts as a 'public good', then, is determined economically by reference to the rates of supply and demand and the costs of privatization, given technological capabilities. Under the right circumstances, property rights can be imposed on all environmental goods.

10.7 Privatization in Action

Free market environmentalists point to many cases where private property rights and markets have combined to conserve or produce environmental goods. Private environmental organizations, such as the Nature Conservancy, pay market prices for lands they dedicate for conservation (see Anderson and Leal, 1991, pp. 3, 70-71). Of course, the Nature Conservancy is a non-profit organization, but many for-profit companies also find that good resource stewardship enhances profits. The International Paper Company, for example, finds it profitable to manage its forest resources for wildlife as well as for timber (see Anderson and Leal, 1991, p. 68). This and other examples, free market environmentalists contend, prove the power of private property to protect and promote environmental values.

11. The Critique of Free Market Environmentalism

The property rights prescriptions of free market environmentalists have not greatly influenced policy, though they have been widely disseminated. The Reagan Administration tentatively proposed to privatize public lands in the early 1980s, but rapidly retreated for (at least) two reasons. First, certain interest groups - including extractive industries and environmentalists - that benefit from current public land ownership and management policies exercised their political clout to protect their 'investments' (see Nelson, 1995, p. 181). This explanation conforms to the Public Choice view of public resource ownership. However, Public Choice theory itself has been critized for not capturing the full flavor of public decision making. Critics claim that it is inaccurate as a positive theory of political and bureaucratic behavior because it fails to account (among other things) for ideology, the role of culture, and the endogeneity of preferences (see generally Farber and Frikey, 1991; Green and Shapiro 1994; Menel, 1992; and Wittman, 1995). And these same criticisms apply, by association, to free market environmentalism. Indeed, studies of the environmental regulatory process have shown that although political interests certainly influence (perhaps not inappropriately) the process, the results often conform to implicit or explicit benefit-cost analyses (see, for example, Cropper et al., 1992).

In any case, there certainly was more to the policy failure of free market environmentalism than simple interest-group politics. Efforts to privatize public lands and resources proved to be highly unpopular with both the public-at-large and economists; those who advocated privatization were 'a clear minority even in their own profession' (see Leman, 1984, p. 113). Indeed, many economists and legal scholars have criticized both the policy prescriptions and basic assumptions of free market environmentalism.

One common criticism is that the advocates of privatization rely too heavily on anecdotal evidence of poor public management and superior private management of environmental goods, while ignoring a wealth of contrary evidence (see, for example, Bromley, 1991, p. 171). As we saw earlier (in Section 3), private owners cannot always be relied on to conserve environmental goods because they too often possess high discount rates and short time horizons (see Clark, 1973a, 1973b). Consider, as just one example, private timberland owners in the Pacific Northwest, who accelerated harvests beyond sustainable levels during the late 1980s either to avert or to pay for junk bond-financed hostile take-overs (see Power, 1996, p. 138). That this should be an acceptable practice simply because the economic costs are internalized to private owners is questionable, even assuming the idealized circumstances of complete privatization of all environmental goods (see Menell, 1992, pp. 495-496, discussing reasons for, at least sometimes, preferring the 'expression of preferences through democratic processes').

Free market environmentalists have also been criticized for their background assumptions, including the assumption that market prices capture all relevant values (see, for example, Randall and Castle, 1985, pp. 613-614, providing reasons 'to be suspicious of normative uses of land market theory in support of privatization proposals'). After criticizing government management agencies for trying to value environmental goods without prices, they simply presume that market prices would incorporate all values worth considering (see, for example, Menell, 1992, pp. 493-494). Free market environmentalists also assume that private resource owners would possess environmental information superior to that possessed by public resource managers (see Anderson and Leal, 1991, pp. 4-6, 170-172). But critics point out that environmental regulation itself was largely a response to inadequate environmental information provided by the market (see Blumm, 1992, p. 379; Hines, 1966, pp. 197-201). Menell (1992, p. 502) argues that '[e]conomies of scale in research and difficulties in appropriating returns to innovation may enable even highly imperfect public institutions to outperform private entrepreneurs in some technological fields'. There is little reason, therefore, to presume that private owners would possess better environmental information on the basis of which to manage environmental goods.

Economies of scale are important not only in the provision of environmental information but also, in many cases, for the provision of environmental goods themselves. For example, a recent study found that 'farms with larger acreage have a higher probability of making [soil] conservation expenditures' (Featherstone and Goodwin, 1993). And the scale economies involved in soil conservation are minuscule compared to those involved in the provision of many other environmental goods, such as wilderness or species habitat, which can require land masses larger than entire states. Anderson and Leal (1991, p. 69) provide a lone anecdote about a group of private landowners who contracted with one another to provide a 2.8 million acre recreation area in the North Main Woods in upper New England. But this may be the exception that proves the rule. According to Lueck (1991, pp. 250, 251), in many (if not most) cases 'the contracting costs among landowners may eliminate the potential gains' from the private provision of wildlife habitat. Individual land holdings, meanwhile, tend to be 'small compared to the territories of most valued species'. Thus, private landowners suffer from a comparative disadvantage in wildlife regulation, which explains why wildlife are, for the most part, publicly owned and regulated (see also Lueck, 1989 and Rasker, Martin and Johnson, 1992). Some free market environmentalists, such as Nelson (1995), implicitly concede that scale economies sometimes favor public (state or federal) ownership of environmental goods, when they distinguish between public resources that should and should not be sold off to private owners.

Another criticism of free market environmentalists is that they tend to treat the market and private legal institutions, including the common law, far less critically than they treat public institutions, including politicians and bureaucrats. As Menell (1992, p. 505) puts it, their '[s]anguine view of markets and legal institutions contrasts sharply with their deeply cynical perception of public institutions'. They provide no reason to expect that common law courts should be immune from the public choice pressures that influence legislative decisions (see, for example, Beerman, 1991, pp. 187-188, noting the failure of Public Choice theorists to confront 'economic influences on judicial behavior'). Nor do they provide reason to believe that traditional common law remedies, such as nuisance and trespass, would efficiently internalize pollution costs. As Menell (1991), Brunet (1992), Thompson (1996) and many others have explained, common law remedies are highly imperfect and costly mechanisms for resolving most types of environmental disputes (especially those involving causation-proof problems and/or large numbers of parties).

The fundamental implication of all these criticisms is that the benefits of privatization and deregulation might not be worth the costs. This claim should, of course, be testable. But, despite their pronouncements about the relative benefits of privatization, free market environmentalists have provided no actual assessments of the costs. They do not deny that privatization would entail significant, perhaps even enormous, transaction costs. Anderson and Leal (1991, p. 167) concede that '[p]roperty rights are costly to define and enforce'. Anderson and Hill (1983, p. 438) even acknowledge that 'the definition and enforcement process may preclude whatever gains might have been realized by the establishment of [property] rights' (compare Hanna, Folke and Mäler, 1995, p. 18; Noll, 1989). Nevertheless, one is hard pressed to locate in the free market environmentalist literature efforts to assess the potential transaction costs that privatization would entail. Libecap (1989) is exceptional in providing empirical and historical transaction cost analyses to explain why some open access resources have been privatized, while others remain subject to public ownership/regulatory control or open access.

In the absence of a detailed assessment of the costs and benefits of privatization, how could Anderson and Leal (1992, p. 165) possibly conclude, for example, that the privatization of roads together with strict liability rules for common law enforcement would *efficiently* resolve traffic congestion problems? Funk (1992, p. 512) has raised several pertinent questions about this policy prescription: 'Who is going to sue for damages under this strict liability regime? The class of all persons in the greater metropolitan area? What damages are we talking about? ... And what about causation?' Ellickson (1993, p. 1385) notes that '[t]he laying out of a major road is a quintessential 'large' event that private landowners and travelers cannot well coordinate on their own'.

Examples such as this may explain why some critics consider free market environmentalism to be an 'institutional fantasyland' (Menell, 1992). The danger is that fantasylands are designed to appear more attractive than the real world. As Schlager and Ostrom (1992, p. 260) have written, '[n]o real-world institution can win in a contest against idealized institutions'. Yet, the sheer lack of realism in much of the free market environmentalist literature may explain why their ideas, though widely disseminated in the academic and popular media, have not mined broader public, academic or political support.

12. Conclusion

The great insight of Demsetz (1967) was that property rights regimes evolve over time, in response to social pressures and technological changes, to increase efficiency by minimizing the costs of coordinating human interactions (including those with nature). But, contrary to the claims of free market environmentalists, this evolution is never unidirectional. As Horwitz (1977, p. 102) and Rose (1990) have shown in the context of water law, property rights sometimes evolve in the opposite direction - from more sharply-defined private rights to more ambiguous correlative rights. This reflects the fact that property rights themselves are costly (sometimes too costly) to impose and protect. In a given ecological and institutional context the question is whether and to what extent property rights provide an efficient (or *more* efficient) means of accomplishing social goals.

This chapter has raised that question in the context of environmental policy: to what extent can property rights contribute to the efficient attainment of society's environmental protection goals? The first part of the chapter focused on the evolution of property rights-based approaches to environmental regulation, about which there is little controversy. The use of rights-based regulatory mechanisms, such as pollution trading programs, can, in many circumstances, achieve environmental goals at far lower cost than traditional command-and-control regulations. Far more controversial is the contention that the complete privatization of environmental goods, assuming that were even possible, would in every ecological and institutional context obviate the need for state regulation beyond common law property rights protections. This claim brings to mind Solow's (1974) admonition that one ought to be equally suspicious of the uncritical centralization *and* the uncritical free-marketeering of environmental goods.

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