10

Public Goods, Externalities, and the Commons

The social dilemmas that arise from properties of goods, and the manner in which they are produced or consumed, bear a close relationship to the establishment and maintenance of cooperation and collective action. This may sound like economics but, in fact, it's politics through and through. Markets are best thought of as human constructions, not as elements of some natural order. They require that political understandings and institutions come into being and persist. Surely, politics can break markets, as economists are wont to remind us in their critiques of overly zealous regulation; but politics makes markets, too.

Defining Terms

Most goods exchanged in economic markets are called *private* because the "owner" has full control over their use. If you buy a tube of toothpaste it belongs to you in the sense that its use is entirely under your control.[1] Specifically, you can exclude others from enjoying its use. This is an especially important

[1] Of course, there are (politically imposed) limits to your discretion. In most societies there are laws against squeezing toothpaste into someone else's iPod without their permission, for example.

form of control inasmuch as toothpaste gets "used up"; if the purchaser could not exclude others, then it would hardly be worth it for her to make the purchase in the first place. Consequently, private goods are defined by two properties: *excludability* (the owner may exclude others from enjoying the good) and *solitary supply* (use depletes the availability of the good).[2]

Goods lacking in both of these properties are called *public goods.* They are *nonexcludable*—anyone can enjoy them whether she has paid for that privilege or not—and are *jointly supplied* (nonrivalrous)—one person's use does not diminish the supply available to others. Classic examples of public goods include national defense and lighthouse services.

Consider the former. If defense services are extended over a broad territory, then anyone living in that territory is a beneficiary. Suppose, for example, that a feudal lord's castle, cannon, and knights in fourteenth-century England effectively protect a territory extending, say, twenty miles in any direction from the castle. The significance of this is that bands of robbers are discouraged from practicing their trade within the lord's jurisdiction.[3] Thus, anyone living within the boundary enjoys relative peace—and that enjoyment is not contingent on whether the person pays general feudal dues to the lord, pays specific user charges for protection, or is an ally of the lord. Just by being a resident of the castle's territory, one may "consume" the lord's protective services.

What, really, is this protective service? In effect, it is deterrence. The lord's might discourages predators, and this discouragement cannot be parceled out very effectively to some in the territory and denied to others. Thus, the entire territory

[2] Alternatively, these goods are sometimes called *rivalrous.*

[3] This does not mean there is *no* robbing and thievery. Robber bands may hide out in, say, Sherwood Forest and make raids on the lord's territory. The presence of the lord's defense forces, however, by raising the costs of thieving, discourages the frequency and intensity of the activity. Citizens, consequently, may not be spared entirely but are spared more so than if the lord's defense forces did not exist at all.

enjoys it. In this instance, we say that defense is a public good because it is nonexcludable (it is available to everyone if it is provided to anyone) and jointly supplied (one person's enjoyment of this deterrence does not diminish its availability for enjoyment by others in the territory).

In between the ideal types of private and public goods are mixtures of the two. Some goods are jointly supplied, but excludable. A Madonna concert comes to mind in which a high wall, a limited number of entry points, and turnstiles serve to exclude those without tickets, even though, within limits, Madonna's music is jointly supplied.[4] Other goods are nonexcludable but not jointly supplied. What is ideal about a Cape Cod beach in August is enjoyment of the sun and surf without feeling like you are crowded together with others like sardines. The ideal beach, then, shares with private goods the attribute of solitary (or at least limited) supply—beyond some level of density its enjoyment by an additional family diminishes its pleasure for other families. (This density threshold is often surpassed on Cape Cod in August!) But it does not possess the other private-good attribute of excludability. To the contrary, nonexcludability, at least as regards public beaches, means that on the hottest days of summer you are cheek-by-jowl with loads of others. All these distinctions are illustrated in Display 10.1. I shall focus mostly on the extreme cases of an ideal-type public good and an ideal-type private good.

[4] The limits have to do with the degree to which jointness of supply is compromised by crowding. If greater crowding, beyond some limit, actually affects the quality of the good, then we cannot claim that the good is jointly supplied. We shall pursue this prospect in the next illustration.

DISPLAY 10.1
PUBLIC AND PRIVATE GOODS

		Excludability	
		Yes	**No**
Jointness of Supply	**Yes**	Madonna concert	**Public goods:** defense, lighthouse services
	No	**Private goods:** toothpaste, BMW 320i	Crowded Cape Cod beach

PUBLIC GOODS AND POLITICS

Politics rears its ugly head because, like cooperation (which is often undersupplied) and collective action (which is often underachieved), the provision of public goods is subject to socially destructive incentives. Because a public good is nonexcludable, it may be enjoyed without paying a price for it. But a producer will be loath to provide a good if he cannot elicit payment for it. And even if there were some imperfect method by which a potential producer could extract a return from providing a public good, the amount supplied would likely be very much less than it would be if payment could be extracted directly. As a result, everyone is worse off.

Peasant farmers in a feudal world may well be willing to pay something for the lord's protection (certainly as much as they would have to pay, in terms of time, energy, and lost opportunities, to guard against predators themselves); but if the lord has no way of eliciting this payment from beneficiaries of his protection, then he will be less disposed to provide it, or very much of it at least, in the first instance. It was something like this that supported the enforcement of feudal arrangements in many parts of the world; accordingly, peasant families were coerced into contributing hours of labor in the lord's

fields, a younger son to the lord's army, and a proportion of their crops to the lord's granary in exchange for being kept safe. Because protection is a public good, its supply by means of ordinary market exchange is problematic, necessitating the substitution of politics—the enforcement of coercive feudal institutions—for economic exchange. Political institutions, like feudalism, arise to fill the economic vacuum.

Sometimes the political arrangement is at one remove. The classic example of lighthouses illustrates this. The services of a lighthouse constitute a quintessential public good. If a lighthouse is erected on high ground near a shipping hazard, the warning it emits is available to every ship that passes (nonexcludability) and its use by one ship does not deny it to others (jointness of supply). No ship will willingly pay for lighthouse services, since nonpayment cannot lead to a refusal of service to nonpayers—if the service is provided at all. But if a private individual or firm cannot be compensated sufficiently to earn a normal return, it will not be inclined to invest in the provision of lighthouse services. For this reason, lighthouses turn up in introductory economics texts as the classic instance of a public goods problem—in which a public good is undersupplied owing to socially perverse incentives.

In a superb piece of economic detective work, the Nobel laureate Ronald Coase revealed that generations of undergraduates had been misled by the lighthouse example.[5] In England, at least, lighthouses were quite commonly provided along its western coastline by private enterpreneurs. But how could such entrepreneurs obtain a return on their investment? The ingenious answer Coase provided is that lighthouses typically were positioned near harbors, allowing ships to enter without crashing onto dangerous shoals. The lighthouse was primarily needed by precisely those ships coming into port.

[5] Coase's essay first appeared in 1974 and has been reprinted in R. H. Coase, *The Firm, the Market, and the Law* (Chicago: University of Chicago Press, 1988), pp. 187–215.

Ships not intending to put ashore would typically travel somewhat farther out to sea, thus not especially requiring the services of a lighthouse. Consequently, there was a way to discriminate between most users and nonusers. Was there a method for converting this capacity to discriminate into a capacity to extract payment? If a monopolist controlled the waterfront of the harbor, then he could price lighthouse services jointly with docking privileges in a manner that captured a return for the former. Lighthouse services, then, were part of a *tie-in sale*; if a ship owner wanted to use wharf and warehousing facilities of the port, he would be required to pay for the lighthouse services he consumed as well.

The monopoly position of the entrepreneur is crucial here. If the lighthouse provider was only one of many owners of wharfs and warehouses, he could not charge extra because of competition for customers. Other wharf and warehouse owners could charge a price for their services lower than the tie-in sale price. So, in order for a lighthouse to be provided, an entrepreneur must enjoy the *political protection* of his monopoly position.[6]

Consider one last illustration, this one of more contemporary vintage. In the 1970s the entire industrialized world was held hostage by a cartel known as OPEC—the Organization of Petroleum Exporting Countries. This organization, led by the oil ministers of the member states, conspired to jack up the price of petroleum by restricting the amount that would be available for export. The logic according to which they oper-

[6] Having just read a chapter on multiperson cooperation, the astute reader might wonder whether there are alternatives to granting an entrepreneur monopoly rights. That is, even if there were several wharves and warehouses in port, their owners might arrange to jointly finance a lighthouse and cover their costs through charges on their port services. This is an interesting possibility that the reader might like to think through. Note, however, that this type of cooperation is, in a modern context, regarded as collusion in restraint of trade and thus a violation of the law, because it essentially entails price-fixing. A waiver from antitrust prohibitions, like protection of monopoly power, is a *political* necessity.

ated was quite straightforward and well-known. From the simple law of supply and demand, for a given level of world demand for oil, if the supply were restricted, then its price would rise. Suppose the competitive price for and quantity of a barrel of oil—the ones that would emerge from competition among oil producers in the absence of a cartel—are P_c and Q_c, respectively, with total revenue, $R_c = P_c \times Q_c$. If the cartel could successfully restrict quantity to Q_{opec}, an amount less than Q_c, then the price would rise to P_{opec}, an amount higher than P_c. The new total revenue is $R_{opec} = P_{opec} \times Q_{opec}$. Under conditions prevailing in the 1970s, it was possible to find a Q_{opec} and its associated P_{opec} that produced a larger total revenue, that is, $R_{opec} > R_c$. Thus, if the oil producers could agree on a system of quantity-restricting production quotas—one for each exporter—that added up to Q_{opec}, and could hang together by honoring these quotas, they would thereby reduce the amount of oil available on the world market and have a bigger revenue pie to slice up among themselves.

The higher price that prevails because of this restriction on oil supply is a public good for OPEC (and a public bad for everyone else). Let's see how this works. I said that a public good is, first of all, nonexcludable, and this is certainly true of a prevailing price. Every oil exporter gets the prevailing price—certainly those in the cartel, but even those that are not members. Second, a public good is jointly supplied, and this, too, is true of the prevailing price. One supplier selling its product at that price does not deny that same price for some other supplier.

The joint actions that sustain this price require each supplier to stick to its production quota (so that the total amount of oil for sale adds up to the optimal Q_{opec}, thus generating the optimal revenue, R_{opec}). But providing this particular public good, like the provision of public goods generally, is problematic. Each supplier will be tempted to cheat on the cartel by producing more than its quota. If the little bit extra is suffi-

ciently small so as not to affect the prevailing price, then a cheater can sell more than its quota at the cartel-supported higher price than it would if it honored the quota. But if each member of OPEC cheats on the cartel, then there will be more oil on the market, the price will decline, revenues will drop, and each member will have incentives to begin a further round of cheating. In the end, like so many instances of collective action that we have already examined, everything unravels and the cartel fails.

Indeed, this is what ultimately happened to OPEC in the 1970s. But it took quite a while for the cartel to break apart; in the meantime, OPEC did very well while the rest of the world suffered immense economic hardship. Why did the cartel last as long as it did? The answer, like our answers to the provision of defense and lighthouses, is that a *political* understanding sustained OPEC's operation. In this case, one petroleum exporter, Saudi Arabia, was dramatically larger than any of the other members of OPEC. Saudi Arabia vigilantly enforced the cartel agreement by using various carrots and sticks to induce compliance by its smaller cartel partners with previously set production quotas. Saudi Arabia (which was intent upon being the dominant state in the Arab world and, not uncoincidentally, also had the most to gain from cartel pricing, given its oil resources) took on the burdens of political leadership to hold the cartel together.[7]

We thus see that public goods will go underproduced, if produced at all, because individuals have private incentives at odds with those required to support their production. Individuals have private incentives to enjoy the benefits of defense and lighthouses without paying for them. Potential producers appreciate this prospect and, consequently, are discouraged

[7] A sophisticated strategic analysis of OPEC, with Saudi Arabia conceived of as a dominant member seeking to preserve its reputation, is found in James E. Alt, Randall Calvert, and Brian Humes, "Reputation and Hegemonic Stability," *American Political Science Review* 82 (1988): 445–66.

from producing them *unless they can find some means by which to elicit contributions*. Potential cartel partners often forgo cartel formation because they can anticipate that their various partners will cheat on the cartel, in effect seeking to enjoy cartel benefits without paying for them. Again, the public good—in this case a higher price for cartel products—will be produced only if members can assure one another that the behavior required to sustain the higher price will be forthcoming. In all these cases the solution, like the solution to the problems of cooperation and collective action reviewed in the two preceding chapters, is political. Perhaps the most common solution of all—the quintessential political solution—is the *public supply* of public goods. This solution requires a section all its own.

Public Supply

I have argued that the provision of public goods is poorly handled by ordinary market means. They are undersupplied relative to the levels that the members of society would prefer. Absent some sort of political intervention, there is, as we have just seen, too little protection from predators and too few lighthouses. Politically enforced feudal arrangements and monopoly rights in ports, respectively, are solutions to these problems (though not perfect solutions). An alternative is to turn to the state for public goods provision. Let the government build lighthouses and raise armies.

In many parts of the world, lighthouses, the protective services of the police and army, judicial services, public utilities like water, sewage, and power, and provision for public health, roads, and other infrastructure are commonly provided by government. Telephone and television are also often provided publicly in many countries. The argument is that, because they are public goods (or at least "publiclike"), private

market actors will not provide them (at least not in sufficient quantities) because they cannot be assured of adequate compensation. The state, on the other hand, may use its authority to *require* payment, either out of general revenue raised by taxation or from user charges of various sorts.[8]

However, there is a paradox associated with the public provision of public goods. Public provision does not just happen. Political pressure must be mobilized to encourage the institutions of government to make this provision a matter of public policy. Bills must be passed, appropriations enacted, and government agencies created. In short, political actors must be persuaded to act. But if the provision of a public good distributes a benefit widely, and if the enjoyment of that benefit is unrelated to whether a contribution has been made toward mobilizing politicians to act, then we may reasonably ask: Why would any individual or interest group lobby the government for public goods? Why wouldn't they, instead, free-ride on the efforts of others, thereby freeing up their own resources either to lobby for some other private benefits or to deploy in the private sector for private gain? That is, if many public services are like public goods, then their supply depends upon individuals and groups successfully engaging in collective action to get the government to provide them. Since magic wands are not available, the "public supply" solution to the provision of public goods becomes a problem in collective action.

[8] The reader should notice that public goods, as we have defined them, and publicly provided goods may not be the same. The latter *may* be public goods, like lighthouses and national defense; but the state provides lots of other goodies—like mail delivery, for example—that are sufficiently like other private goods that they undoubtedly could be provided reasonably well in the marketplace. (Indeed, courier services, overnight mail delivery, and package delivery are provided privately in direct competition with the U.S. Postal Service.) Publicly provided goods and services—the activities in which governments engage—reflect the political advantages possessed by interests in the political process that are sufficient to induce the public sector to do their bidding. Some of these things are public goods, but not all of them.

At this point, the reader may wish to return to Chapter 9 to review various conventional solutions. However, there is a less conventional answer. First, we must distinguish between the *consumption* of a public good and its *production*.[9] When designating a good as public or private, we are really talking about consumption properties—whether you can exclude others from consuming the good or not and whether consumption diminishes the availability of the good. I have not remarked at all about production. In fact, in nearly every instance public goods are produced with substantial private input.

When the U.S. government began constructing the massive interstate highway system in 1956, it was not intended for the government to get into the concrete business, the paint business, the sign- or guardrail-making business, or even the highway construction business. The government would use its taxing and borrowing powers to raise money on the one hand, and its substantive political authority to make choices about highway routes and road attributes on the other. But it would then request proposals for building highways from private contractors subject to these specifications. Successful contractors—actors from the market economy—would then make the concrete, pour it according to design, paint the yellow lines in the middle, assemble guardrails, signage, overpasses, and so on.

The highway system, surely public in consumption, is in fact mostly *private* in production. Various aspects of the production process can be divvied up among contractors. The contract to provide concrete, for example, is excludable (the winning contractor gets the contract and can bar losing bidders from sharing in the associated profit) and is solitarily supplied (giving the contract to *A* eliminates its availability to

[9] This distinction is made persuasively by Peter Aranson and Peter Ordeshook, "Public Interest, Private Interest, and the Democratic Polity," in Roger Benjamin and Stephen Elkin, eds., *The Democratic State* (Lawrence: University of Kansas Press, 1985).

B, C, D, . . .). According to the criteria in Display 10.1, highway construction fits squarely in the private-good category.

So, who do you suppose lobbies for a highway system? On the consumption side, as we have seen, there are collective-action problems. By conventional means they may be overcome to some extent. Thus, the American Automobile Association and the American Truckers Association, representing different segments of the consuming public, undoubtedly brought their political muscle to bear on legislators and executive branch officials on behalf of a highway program. Similarly, there are likely to have been political entrepreneurs taking up the cause—for example, legislators representing districts containing large transshipment centers (Chicago, Denver). But those most likely to gain *directly and immediately* (and less likely to have been as plagued by collective-action problems as groups on the consumption side) are those who would actually *produce* the public good. Concrete producers, highway contractors, makers of heavy equipment, manufacturers of guardrails and steel supports for overpasses, owners of rights-of-way, and many others all stood to make enormous sums of money from this multibillion-dollar project. In short, the politics of public supply is as much about the production of public goods as it is about their consumption.

The lesson here is that the politics of public supply cannot be adequately understood as a collective-action phenomenon among those wishing to *consume* public goods. Consumers of public goods like good highways, clean air, lighthouses, and security from national defense certainly play a role in providing political pressure. They are, however, limited by the collective-action obstacles with which the reader is now familiar. In fact, their interests often never materialize into group action; they remain latent.

On the other hand, for every reference to consumers of national defense, to take one of the most important public goods, there are thousands of references to the "military-industrial

complex," those who profit directly from the production of national defense. They are Olson's "privileged groups" who have the ability to surmount their own collective-action problems and the incentive to do so (profits). They are found in the committee rooms and hallways of the Capitol, testifying, lobbying, and spreading campaign dollars around to any legislator who will take up their cause. Weapon systems constitute an excellent illustration of this phenomenon. In 2009, President Barack Obama sought to eliminate the production of a number of F-22 fighter planes (at a saving of many billions of dollars). Some legislators, like Senator (and former presidential candidate) John McCain, supported the president, arguing that these weapons were no longer necessary for the national defense. But most legislators fought the president tooth and nail. The reason: Businesses in more than forty states and three hundred congressional districts had subcontracts for the production of these planes. These businesses, along with labor unions representing workers and state and local officials concerned with the business climate in their localities, constituted a lobbying force their legislators in the House and Senate found extremely difficult to ignore. In trying to understand the public supply of public goods, then, the astute observer will look at the supply side as well as the demand side of the "market."

Before concluding this discussion let me note several complaints lodged against public supply. The major concern with public supply as a solution to the problem of providing public goods is that public-sector actors may not have "good" incentives. In this version of the "who will guard the guardians" problem, the question is not whether government is capable of supplying public goods but rather how well it does the job.

A classic instance of this involves the production of scientific knowledge. Many kinds of knowledge constitute public goods to the extent that they cannot be patented or copyrighted. Once it is known, for example, that $e = mc^2$, individu-

als cannot be excluded from this knowledge on the one hand, and one person knowing it does not diminish its availability on the other. Scientific knowledge belongs in the public goods cell of Display 10.1.

The production of scientific knowledge is undertaken very substantially by the private sector—in places like California's Silicon Valley, Boston's Route 128, and North Carolina's Research Triangle. But this kind of research tends to be very applied, tied to specific product development, conducted secretly, and often patentable (thereby preventing those who do not "own" it from making use of it). Thus, applied scientific research, to the degree that property rights may be assigned to its products, is essentially a private good. However, basic or fundamental research—research that often does not have immediate application—is not patentable and thus cannot be owned; it therefore tends to be underproduced by the private sector for all the public-goods reasons mentioned earlier.

Consequently, the U.S. government, through various agencies like the National Science Foundation, the National Institutes of Health, the National Aeronautics and Space Administration, the Department of Energy, and the Department of Defense, sponsor basic scientific research—a clear instance of the public provision of a public good. Some of this research is actually done in government laboratories. But much is contracted out to university scientists. Consider now the incentives facing, first, the legislators who provide the financial resources for and oversee the execution of this public good and, second, the bureaucrats who actually administer the programs.

As it happens, the universities that are best positioned to compete for basic research grants are not randomly distributed throughout the territorial United States. While many locations have the capability, there are discernible concentrations of excellence: the Bay Area, Los Angeles, and Seattle on the West Coast; Chicago and Minneapolis in the Midwest;

Chapel Hill–Durham–Raleigh, Miami, and Atlanta in the South; and Washington, New York, and Boston on the East Coast—to name some of the most prominent. If the National Science Foundation (NSF), for example, were to support research proposals strictly on the basis of merit, a disproportionate amount of its budget would be spent in these pockets of excellence.[10] Institutions in a great majority of the legislative districts of the nation would do rather poorly in the competition. And this, in turn, would not kindly dispose their representatives toward NSF. In short, while legislators may generally approve of producing public goods like scientific knowledge, they are much more focused on getting federal dollars for citizens and institutions in *their* districts. A government agency that flouted this concern of large numbers of legislators would undoubtedly not fare well in the annual appropriations process.

The administrators at NSF are not stupid. They can forecast the profound budgetary problems their agency would encounter if it did not attend to the conditions of representative government. So, they arrange for alternatives to the merit-based allocation of their budget. Instead of earmarking their entire budget for basic research—which would end up being spent chiefly in a small number of pockets of research excellence—they invent new categories and new programs in which less-well-endowed parts of the country are competitive. Research in science education (as opposed to pure science), for example, may be quite competently conducted in many places around the country, places that do not require advanced research laboratories and cutting-edge scientists.

Constituency-oriented legislators and survival-oriented bureaucrats and administrators, not philosopher kings, support,

[10] If, instead, we were discussing the production of art and culture as financed by grants from the National Endowment for the Arts, merit-based concentration would be even more extreme, with New York and Los Angeles securing the lion's share of support.

finance, and administer public programs that produce public goods. Their incentives dispose them to move away from what would be optimal if only the most effective production of public goods were motivating them. Public provision, then, is watered down by these competing, indeed distracting, objectives. Thus, while public provision may seem the best way to go in correcting for the underproduction of public goods, it is not without its shortcomings.

A second incentive distortion associated with public provision involves *time horizons.* Many scientific projects are years in the making. The initial phases are often relatively inexpensive and invisible, as ideas are examined, developed, and tested in small ways. Only after these initial hurdles are cleared are greater sums spent on large-scale testing and development. It is the latter, however, that involve new laboratory facilities, expensive high-tech equipment, or advanced testing sites—the sorts of things to which the local legislator can point with pride (and snip the ribbon at the dedication ceremony heavily covered by the local media). The political pressures associated with public provision, as a result, involve truncating the longer incubation and percolation process ideally associated with scientific research into a much shorter time horizon.[11]

To sum up, the production of public goods is a problem for communities because of the very nature of these products. Private incentives are typically insufficient to encourage sufficient production voluntarily. Some sort of political fix is required, examples of which include grants of monopoly privilege, waivers of antitrust laws, public subsidy of private production, and outright public provision. None of these is ideal because each entails the grant of extraordinary privilege or authority to some individual—the lord of the manor, the firm

[11] This argument is elaborated in Linda Cohen and Roger Noll, *The Technology Pork Barrel* (Washington: Brookings Institution, 1991).

granted a monopoly, a public-sector bureaucrat—whose incentives may not be aligned properly to the social objectives being sought. The lord of the manor wants prestige and glory, not public defense; the firm wants profits, not the optimal national highway system; the bureaucrat wants turf and budget authority, not scientific discoveries. Though perhaps an overly cynical view, the public good is the incidental by-product of, not the motivation for, their behavior.

It is, therefore, not surprising that different communities at different times experiment with alternative (imperfect) solutions. In the past few decades, for example, we have witnessed a tidal wave of change in which public sectors that formerly provided public goods directly are abandoning these activities. Under the rubric of *privatization*, both developing political economies and already developed ones are selling off state-owned assets to the private sector, hoping that, imperfect as they may be, private-sector incentives will be better aligned to social objectives than under the former arrangement of direct public provision. This may also entail technological enhancements that mitigate some of the "publicness" of the good.[12]

One of President Obama's early initiatives was a "cap-and-trade" program to control the air pollution that contributes to global warming. The idea is to set a pollution target, issue "pollution permits" (either giving them away initially or auctioning them off), and then allow permit holders either to use them (enabling them to employ production technologies that have pollution as a by-product up to the limit allowed by the pollution permit) or to trade them (sell them) for others to use.

[12] For example, electronic lighthouses emit an electronic signal, rather than a light, which is received only by those ships that *purchase* the special signal detector. Cable television, likewise, requires a cable box and hookup that permits exclusion (thereby privatizing a public good). A public water supply may be metered at each household, thereby permitting user charges; so, too, may a firm's effluent (via sewer or smokestack), thus allowing for the pricing of its use of the environment as a dumping site.

The objective is to limit pollution, as well as to allow the "right" to pollute to gravitate, via a market for permits, to those most needing to use polluting technologies. (For a good source of information on these developments, see the blog of environmental economist Robert Stavins, "An Economic View of the Environment," at http://belfercenter.ksg.harvard.edu/analysis/stavin, and, in particular, his May 29, 2009, entry, "The Wonderful Politics of Cap-and-Trade.")

We also observe the related phenomenon of *deregulation* in which heavy-handed bureaucratic oversight, command, and control are being relaxed or relinquished altogether. The imperfectness of any solution to the production of public goods stimulates this experimentation; but politico-economic change of this magnitude is, as we have emphasized, political through and through, with winners and losers determined at the end of the day in political arenas.

CASE 10.1
PUBLIC GOODS, PROPERTY RIGHTS, AND THE RADIO SPECTRUM

An interesting example of a public good is the radio spectrum. As a public good, the radio spectrum is nonexcludable and jointly supplied. In other words, anyone is physically able to broadcast on the radio spectrum, and my broadcast doesn't prevent you from broadcasting. The problem is that my broadcast interferes with your broadcast if both are simultaneous and on the same (or a closely neighboring) frequency. To make radio transmission coherent, there must be some means for allocating the radio spectrum.

Frequencies on the radio spectrum in the United States are allocated by the Federal Communications Commission (FCC). Different frequency bands have different uses, in-

cluding television, radio, cellular telephones, and radar. Individuals and organizations are given exclusive rights to particular frequencies. Broadcasting on a frequency for which you do not have rights is illegal. (The movie *Pirate Radio* (2009) depicted one such station.) By allocating property rights to the radio spectrum, the public good is made excludable and the crowding that might otherwise result from joint supply is prevented.

The example of the radio spectrum demonstrates that there are numerous approaches to allocating property rights. Historically, the FCC has distributed licenses at no charge, either through application or lottery. The Clinton administration, seeing an opportunity to bring some revenue into the federal coffers, explored the possibility of auctioning radio licenses for new personal communications technologies.* At one point the administration predicted revenues of $4.4 billion over four years. What is common to all of the arguments about plans like this one is their fundamental political nature. Who will benefit from the plan? Who will be hurt? Is the plan fair? What are the values that determine how we manage our public resources? Although discussions of topics like auctions, revenue sources, and externalities often appear purely economic and technical in their nature, it is important to remain conscious of the political issues that lie beneath the surface.

* Edmund L. Andrews, "Radio Rights: A Move to Auction Licenses that Sell," *New York Times* (March 21, 1993), p. E6.

EXTERNALITIES

An *externality* is a special kind of public good. It is typically the unintended by-product of voluntary activity that is imposed on others. Thus, an externality is jointly supplied and, because it cannot be easily avoided, nonexcludable (although here we might more accurately say it is *unavoidable*). Some externalities are valued—the scent and appearance of the roses planted in a neighbor's garden; the freedom from infection others obtain when we innoculate our children against communicable diseases; the protection provided to both partners when one uses a condom in sex—so we call them *positive* externalities. In each case someone *else* benefits, perhaps unintendedly, from an individual's action. Other externalities are loathed—the effects from the burning of high-sulfur coal in a manufacturer's boiler; litter in public parks; the loud music of boom boxes in Harvard Square—thus we call them *negative* externalities. Since externalities are special instances of public goods ("bads"), we may deduce that the positive ones are undersupplied and the negative ones oversupplied, relative to what would be optimal for the community as a whole. Neither the neighbor planting her roses nor the factory burning coal takes our preferences into account. If, as we are often advised, we "stop to smell the roses," we discover that there are too few roses and too many other things to smell.

The phenomenon of externalities is nicely illustrated by an experiment the author regularly runs in an undergraduate class at Harvard University.[13] An even number of students is selected, half of whom are designated as "buyers" and half as "sellers" in a make-believe market. Each buyer is given a schedule informing him how much the experimenter will pay

[13] The experiment is described in great detail by its designer in Charles Plott, "Externalities and Corrective Policies in Experimental Markets," *The Economic Journal* 93 (1983): 106–27.

him at the end of the session for each unit of the product purchased during the experiment. For example, the experimenter may pay 30 points for the first unit, 28 points for the second unit, 25 for the third, and so on. A buyer, then, makes a profit if his first purchase in the market is for less that 30 points, the second purchase is for less than 28 points, the third for less than 25, and so on. Each buyer wants to earn as many points (as much profit) as possible, since these points will be added to the score of his midterm examination. Similarly, each seller is given a schedule informing her of the cost of producing each unit. For example, the first unit may cost 12 points, the second 15 points, and so on. A seller makes a profit if she sells each unit for more than its cost (the first unit for more than 12 points, the second for more than 15, and so on). She, too, wants to earn as many points as possible—for the same reason.

The buyers and sellers sit across a table from one another. When the market opens, bargaining begins with buyers shouting out "bids" and sellers shouting out "asks" in what is known as a *double oral auction*. When a buyer and seller come to an agreement on a price p, the sale of a unit is registered. If the buyer with the schedule given in the preceding paragraph is buying his first unit, then his profit is $30 - p$; if the seller is selling her second unit (having already sold one earlier), then her profit is $p - 15$. (If p lies between 15 and 30, then both make a profit.) The market remains open until no one can agree on a price for consummating any further sales. Since the experimenters have fixed the schedules so that the "ceiling" on acceptable prices for a buyer gets lower and lower with each purchase, and the "floor" on acceptable prices for a seller gets higher and higher with each sale, there will always come a time when it is no longer possible for a buyer and seller both to make a profit.[14] The market closes at this point.

[14] The seller's floor ultimately becomes higher than the buyer's ceiling.

As described, this experimental market is a model of the trucking, bargaining, and haggling that goes on in a bazaar or city market. It is well understood according to the law of supply and demand, and experimental results validate this law quite impressively. But we are not interested in that, since this experimental market setting has a twist. Every time a sale is consummated, *everyone* in the market, both the buyer and seller participating in the particular sale as well as all those buyers and sellers not participating, is charged 1 point each. In effect, the consummation of a sale generates a negative externality, harming participant and nonparticipant alike. The particular buyer and seller can take this "damage" on *themselves* into account. Factoring in the externality, the buyer in the previous paragraph will figure his profit at $30 - p - 1$ (so that p will have to be less than 29, or "no sale"), while the seller will figure her profit at $p - 15 - 1$ (so that p will have to be greater than 16). The effect of the externality is to narrow the bargaining range for this buyer-seller pair.[15] But neither buyer nor seller has an incentive to take into account the impact of the externality on *others*.

And they don't. Even though the experimenter provides each participant with a table informing them of the impact *on the entire market* of each sale they consummate (1 point of "damage" on every buyer and seller per unit sold), the subjects never take this information on board. The only things they care about are their profit thresholds (ceiling and floor for buyer and seller, respectively), the negotiated price p, and the impact of the externality on each of them. Each participant is intent on maxing out on points, thereby raising his or her midterm examination grade (and, presumably, increasing the chances of getting into law school). Nevertheless, on other occasions these very same students are heard denouncing pol-

[15] With no exernality, the bargaining range for p is 15 to 30. With the exernality, this range becomes 16 to 29.

luters of the atmosphere, destroyers of the ozone layer, litterbugs, and producers of secondhand smoke! The fact is that it is easier to see the scoundrel in others than in ourselves.

Public policy economists, at least since Adam Smith, have worried quite a lot about how externalities, both positive and negative, might be taken into account by those who produce them. I cannot review all these solutions here, but will mention a few in passing. Probably the most popular and widely used solutions are *taxes* and *subsidies*, the former to discourage negative externalities and the latter to encourage positive externalities. In the experiment above, suppose the experimenter informed the market participants that there would be a sales tax, t, charged against the seller each time a sale was consummated. The seller two paragraphs back would now earn a profit of $p - 15 - 1 - t$, effectively raising the minimum price she must now secure to show a positive profit.[16] From Econ 101 it is well known that the effect of raising a price is that fewer sales will be consummated (at higher prices), and hence fewer externalities generated. We don't want to eliminate sales altogether (unless the externality were so horrid as to overwhelm the benefits from having this market in the first place). But there is an "optimal" tax, one that internalizes the full effect of externalities. The tax, in this case, implicitly forces the buyers and sellers in a market to take account of the external consequences of their actions, something they were not willing to do unless coerced in this manner.

The argument is exactly analogous when positive externalities are involved. In place of a tax, a subsidy is given to one or the other of the market participants in order to encourage more sales (and more externalities) than would otherwise transpire.

[16] The reader should not think that I am being unfair here in placing the tax only on the seller, since some of it will be passed on to the buyer in negotiating a final purchase price.

Experimentally, taxes and subsidies work as this theoretical argument suggests. And, in the real world, taxes on the sulfur content of coal, on gasoline, and on solid-waste effluents cause their users to internalize the negative social effects of the pollution their activities are producing. Subsidies for innoculating against communicable diseases (available at less than cost), securing a higher education (tuition never covers costs), taking public transport (fares never cover costs), carpooling (designated commuter lanes), using solar power (tax breaks), and moving to the frontier (free or cheap land), in precisely the same fashion, reduce the costs of engaging in these activities, thereby increasing their levels (and the positive externalities associated with them).

There are two major shortcomings associated with this strategy for dealing with externalities. The first is that of setting the appropriate level for taxes and subsidies. In the experiment described above, each sale generated one point's worth of "damage" for every market participant. If there were, say, six buyers and six sellers, then twelve points of externality would be generated per unit sold. As we have already seen, two of these twelve points are taken account of—namely, the one point of "damage" falling on each party to the exchange. It's the ten points falling on those *not* party to the exchange that are ignored by the parties to the deal. Thus, by setting the sales tax at ten points per transaction, the contracting parties are forced to act as though they are considering the external effects of their actions. The equilibrium number of sales in this market now is socially optimal.[17]

The matter of setting the optimal tax rate is quite straight-

[17] The reader should note that in taking account of the external effects of transactions, this solution does not eliminate externalities altogether. Rather, the damage done by the externality is *balanced* against the benefit that accrues from allowing buyers and sellers to capture gains from exchange. In general, we typically do not, as a matter of public policy, want to drive negative externalities to zero because this would mean passing up profitable exchanges.

forward when demand conditions, supply conditions, and externality effects are known with quantitative precision, as in our experimental world. In the real world, however, matters are not so straightforward, since we rarely know everything we need to know (that is, the things provided by the experimental design). The consequence is that tax or subsidy rates are often little better than educated guesses. They may improve the situation, but they may also make matters worse.[18]

The second, more serious drawback to the tax-or-subsidy solution to externality problems involves the matter of exactly what activities should be taxed or subsidized. If one were to survey the activities that are taxed or subsidized in any place at almost any time, it would be impossible to claim that control of externalities had much bearing on these policies. Surely *some* goods are taxed or subsidized to deter negative or encourage positive externalities, and I have given examples of these in the preceding discussion. But many goods are taxed or subsidized because *political machinery* for taxing and subsidizing exists in the first place and comes under the influence of those who benefit from its policies, quite independent of any consideration of externalities. On the other side of the coin, so many other goods are not taxed or subsidized, even though a control-of-externalities case could be made, for much the same reason—political influence. "Optimal" taxes and other ideas from welfare economics theory, even if they might work in principle, get steamrolled in the rough and tumble of politics.

A classic instance is found in America's experience with air

[18] Although I will not trouble the reader with details, in the running example from the experiment, a tax of ten points per sale will still permit some sales to be consummated, though a smaller number than in the absence of the tax. If we had not been sure about the damage done by externalities, and (incorrectly) guessed that instead of one unit per person the damage was two units per person, the tax (now twenty units per sale) would have completely shut the market down. No sales would have occurred. Thus, mistaken guesses about the right tax or subsidy rate may make matters worse than no tax or subsidy at all.

pollution. In the 1970s much pollution was created by stationary sources, like power plants, burning high-sulfur coal. When coal with high sulfur content is burned, sulfur compounds spewing out of smokestacks combine with water in the atmosphere to produce "acid rain," which damages crops, forests, wildlife habitats, and fresh water sources, not to mention human lungs. Much of this dirty coal was (and still is) mined in Pennsylvania, Kentucky, and West Virginia. A clean alternative exists in low-sulfur coal, mined in the western United States. This was a clear circumstance for the imposition of a tax. If coal were taxed in proportion to its sulfur content, then stationary sources would find it in their interest to switch at least some of their energy demand from eastern to western coal: the higher the tax rate, the more the substitution of clean for dirty coal.

Enter politics. The West Virginia coal industry had during this period a very powerful protector—West Virginia senator and the majority leader of the U.S. Senate, Robert Byrd. The Senate is an institution in which well-positioned individuals (especially committee and subcommittee chairs and party leaders) can exercise significant veto power. It is relatively difficult to get a bill through the Senate, and it is considerably easier to *prevent* a bill from passing. And this Byrd did. Despite a powerful environmental lobby, and an administration sympathetic to its preferences, Byrd managed to thwart sulfur-content taxes by acceding to a much milder policy of requiring the installation of pollution scrubbers on smokestacks.[19]

There are countless stories of this sort in which a powerful politician uses his or her position to block either the imposition of taxes on key supporters or the reduction of their subsidies. Only under the direst of fiscal circumstances (like the

[19] The entire story is told in Bruce Ackerman and William Hassler, *Clean Air/Dirty Coal* (New Haven: Yale University Press, 1981).

large federal deficits in the United States during the late 1980s), when the insatiable revenue requirements of government cause it to raise taxes and scale back subsidies wherever it can, is this protection insufficient. Tax-or-subsidy solutions to externality problems are only occasionally effective, because politics constrains their proficiency when the shoe pinches the wrong toes.

Two other categories of solution to externality problems merit brief consideration. We have just seen that Senator Byrd was able to replace what would have been an onerous tax on his dirty-coal constituency with a more tolerable *regulatory regime*. Regulation is a more hands-on approach to the control of externalities. It typically entails the creation of a governmental bureaucracy—an agency, bureau, or commission—charged with setting standards, prices, fees, or practices in consumption or production activities that generate externalities. Statutory authority usually spells out the purposes to which this bureaucratic control should be put and the discretion the bureaucratic entity has in pursuing those purposes. Through administrative procedures, or the civil and criminal court system, the agency has an ability to enforce its commands. Thus, a governmental entity such as the Environmental Protection Agency, with authority granted to it by a law such as the Clean Air Act, can specify the kind of smokestack scrubber required of a stationary-source polluter.

Alternatively, externalities can be contolled by a *respecification of property rights*. Part of the quandary underlying externality problems is poorly specified rights of ownership and use. Since nobody "owns" the air, anyone can use it as a repository for dumping things (like sulfur-based particulates). To take an example a little closer to home, since no one owns or has responsibility for the common room in the dormitory, it is forever a mess. In some situations, however, it is conceivable that one could respecify property rights so that damage done by externalities can be held in check. I pursue this alternative

in more detail in the next section, where I discuss "commons problems." Here, however, I remind the reader of an interesting property-rights solution to air pollution (noted earlier).

Partially in reaction to the poor performance of other methods for controlling externalities, some economists have suggested that there may be a way to allow the atmosphere to be "owned." By "owned" it is meant that someone has the right to use the atmosphere as he or she sees fit on the one hand, and may sell or trade that right instead of using it if that is preferred. This is accomplished by distributing marketable pollution permits, each one entitling the holder to pollute the atmosphere in some standardized quantity. This is the "cap and trade" policy described earlier. A factory in Los Angeles, for example, might hold a 10-dirt permit ("dirt" being a fictitious unit of pollution). If its production process generated only 5 dirts of pollution, then it could sell the remaining 5 dirts on its permit to some other user for cash, for the promise of an 8-dirt permit five years from now, or for something else of value. The Environmental Protection Agency, for example would set the overall quantity of permits available at any one time, after which a market in permits would arise.

Pollution is suddenly *costly* to its producer, because he or she must now devote dirts to it that have alternative uses (like selling or trading them). The Los Angeles factory may now determine whether it is worth its while to retrofit its production process so that less pollution is generated; if the cost of retrofitting is exceeded by the sale of the pollution permits it currently owns or would otherwise have to purchase in the market, this move makes sense. The result, then, of this market for pollution permits is that polluters now have incentives to reduce their pollution and that pollution rights will flow to those that value them the most. These latter polluters are those for whom it is cheaper to buy pollution permits than it is to reduce their emissions.

The key, of course, and the place where politics is central,

is the determination of the aggregate amount of pollution to be permitted on the one hand, and the initial distribution of pollution permits on the other. The first is a straightforward political judgment call of the sort that our political institutions are charged with making all the time. The second is political dynamite, since so much is at stake. But as long as the market works smoothly once an initial distribution is made, the permits ultimately will flow to their highest-valued uses. Even the judgment call on the aggregate amount of pollution to permit in the first place has a certain self-correcting quality to it. If Friends of the Earth or the Audubon Society feels that the political authorities have set the aggregate pollution level too high for, say, the Los Angeles metropolitan area, then these environmental groups can jump into the dirt market there and buy up pollution permits. These they can either permanently retire or resell in some other area of the country with an ambient air quality that can absorb additional emissions.

This section on externalities can be summed up by noting that none of the solutions I have reviewed—taxes and subsidies, regulatory regimes, redefined property rights—are without problems. In each case there are practical or logistical complications that must be overcome. Even putting these difficulties to one side, however, there is always the problem of politics. Once the machinery to tax and subsidize, to regulate, or to redefine ownership is put in place, it may be used or abused. It is absolutely essential to be aware that the problem of externalities is transformed into a problem of providing appropriate incentives to those in charge of the externality-control apparatus. It is the same "who will guard the guardians" problem that we have encountered elsewhere in this volume, a problem I shall examine very closely in Part IV in our treatment of institutions.

The Problem of the Commons

Sitting just outside the office in which these words are being written is the Cambridge Common, a lovely urban public place most famous for the fact that it was there that General George Washington mustered the twelve hundred volunteers of what became the Continental Army in 1776. Publicly owned parks and land reserves are today the object of great passion by those who place significant value on "green space." In an earlier time in Europe (and still today in various parts of the world), commons were valued for more practical reasons—notably as places to graze cattle and to forage.[20] Today, examples of commons include not only green space and sites for grazing and foraging but also bodies of water utilized for commercial fishing, irrigation systems, urban water supplies, and, indeed, even the earth's atmosphere.[21]

A commons is, by definition, owned by everyone (in common), and therefore is the responsibility of no one. Consider a field owned by a village and used by its residents' herds as a grazing commons. Each villager gets to graze his or her cattle "for free." If a villager is contemplating adding a head to his herd, he will take into account his costs of doing so, but this calculation will *not* include the cost of grazing. If the commons is large, and the village demands on it minimal, this will not pose serious problems. But even if demands on the commons grow, no villager has an incentive to restrict his use of this "free" resource, resulting in what Garrett Hardin called "the

[20] Several hundred years ago in England and elsewhere, there were political movements that succeeded in enclosing common lands, that is, dividing them into parcels and distributing or selling them to individuals as private property. The modern counterpart of this practice is the sale of state-owned assets (privatization) in both socialist and capitalist economies.

[21] The most insightful discussion of "common pool problems," of which these are examples, is Elinor Ostrom, *Governing the Commons* (New York: Cambridge University Press, 1990). Ostrom was awarded the Nobel Prize in Economic Sciences in 2009 for this work.

tragedy of the commons."[22] The commons will be overgrazed and ultimately destroyed, inasmuch as its capacity to regenerate itself will have been disabled.

Overgrazing the commons is a metaphor for a host of problems, large and small, in which lack of restraint in using the commons leads to social catastrophe:

- The portion of the North Atlantic off the coast of New England is a common habitat for lobsters. Overgrazing in this instance takes the form of too many lobstermen harvesting too many lobsters (especially small lobsters that haven't reproduced).
- The acquifer under Cape Cod is a commons constituting the source of fresh water for that beautiful strip of land. Overgrazing this commons occurs because of residential and commercial development. With more people on the Cape, pollutants seep into the acquifer, affecting its purity. Perhaps more profoundly, with more people drawing more fresh water from the acquifer, salt water penetration from Massachusetts Bay and the Atlantic Ocean intensifies. Ultimately, rain- and spring-fed renewal will be insufficient, and the acquifer will be destroyed.
- The earth's atmosphere is a commons into which pollutants are dumped. It is replenished by oxygen created as a by-product of photosynthesis. The destruction of vast forests for development simultaneously increases the production of pollution and reduces the atmosphere's capacity to replenish itself.

The problem of the commons, like the problems associated with cooperation, the production of public goods, and the control of externalities, is a problem of private and social incen-

[22] Garrett Hardin, "The Tragedy of the Commons," *Science* 162 (1968): 1243–48. This now classic paper is must reading for the interested student.

tives in conflict. A commons is a free lunch to its common owners. Indeed, each possessor of rights to the commons has a very strong incentive to use those rights. Let us return to the village with a common grazing field. A hundred villagers are each grazing two cows on the commons, a number that the commons can support and still regenerate itself. Each villager considers adding one cow to his herd, concluding that this would be profitable, especially in light of the free grazing privileges. If any one villager were to proceed, the commons would be damaged only marginally, indeed hardly at all, since the herd size will only have increased from 200 to 201. But if all the villagers proceed, there will be a 50 percent increase in grazing, an amount exceeding the carrying capacity of the commons. So, if all proceed, each will be worse off, since they will have destroyed their field. But if any one villager proceeds, he will be better off and all the others will hardly be affected at all. Thus, individual incentives and social necessity clash. Indeed, overgrazing the commons is, in many respects, the large-number analog of the Prisoners' Dilemma and Hume's marsh-draining game that I discussed in Chapter 8.

As the reader is now undoubtedly aware, preservation of the commons is a public good. I will not rehearse again all of the standard methods for its provision, leaving this to the reader as the proverbial homework assignment. I will, however, comment briefly on two aspects of this knotty problem.

First, it is well known that commons problems arise because of imperfectly specified property rights. If a single individual rather than an entire community owned the commons, or if she and her fellow villagers each owned well-defined plots within the commons, then she would have all the incentives associated with ownership of a private good to preserve the value of this asset. An individual would no more overgraze her commons, or overharvest her forest, or overfish her pond than she would abuse any other physical asset she owned. The enclosure movement in England in an earlier era and contempo-

rary experiments with marketable permits in rights to pollute are instances of redefining property rights, reallocating ownership from the community to specific individuals.

Second, as I have emphasized throughout this chapter, political arrangements affect both the solutions selected to deal with commons problems and the likelihood of success. In her pathbreaking study of common pool problems, *Governing the Commons*, Elinor Ostrom makes very clear that humankind has been incredibly inventive over millennia in coping with—and, indeed, sometimes avoiding—the tragedy of the commons. These coping strategies are much like the constitutions (both written and informal) by which communities govern themselves. They involve mechanisms by which collective decisions about the use of the commons are made, monitored, enforced, and changed in an orderly manner. Ostrom provides instances of both successful and unsuccessful "commons constitutions," emphasizing that the successful ones are those with design features possessing:

- clearly defined boundaries;
- congruence between rules for using the commons and local needs and conditions;
- individual rights to formulate and revise the rules for operating the commons;
- monitoring arrangements in which the monitors are ultimately responsible to the community;
- graduated punishments for violation of rules;
- low-cost arenas for resolving disputes; and
- relative freedom of users of the commons from external governmental authorities.[23]

In short, Ostrom has found that the management of a commons is a political problem. If rights over this commons cannot be parceled up into private bundles—the property-rights

[23] Ostrom, *Governing the Commons*, pp. 88–102.

solution—then, to encourage the cooperation required to preserve the commons and to discourage the practice of overutilization, the group of users must enter into a political agreement—a form of self-enforcing self-restraint.

CASE 10.2
FISHING AND THE TRAGEDY OF THE COMMONS

Fishing provides an excellent subject for inquiring into the tragedy of the commons. As we have seen, the tragedy of the commons is a problem when individuals share a common, depletable resource. In their efforts to maximize their individual gains, users often overuse the resource to the detriment of all. Oceans, lakes, and rivers have largely been viewed by fishermen as a commons. The result is overuse: two-thirds of all assessed fish stocks in 1994 were either overexploited or fully to heavily exploited, according to the United Nations Food and Agricultural Association.* Overuse remains a problem today.

Governments have responded to the problem with a variety of approaches. Their responses provide evidence for Ostrom's theory that a commons can be managed through the allocation of property rights or the evolution of self-enforcing restraints. Several nations, including Iceland and New Zealand, have addressed the problem of overfishing by allocating property rights. Their system of individual transferable quotas (ITQs) divides up the catch within national waters among commercial fishermen. Quota owners can either keep or sell their fishing rights. The government sets the total quota to maintain and conserve the resource over time.

* Mark Trumball, "Fisheries Crisis Stretches across the Globe," *Christian Science Monitor* (July 6, 1994), p. 8.

There is considerable debate over the use of ITQs. Many organizations and governmental authorities are seeking alternative mechanisms. In New England, the government, the fishermen, and the fisheries worked to address the sharp decline in fish catches over the course of the 20th century.† The importance of politics is apparent in the case of New England fishing. Government programs and interest group politics accelerated the overutilization of the commons. In 1977, the United States banned foreign trawlers from fishing within 200 miles of the U.S. coastline, partly to prevent overfishing of New England waters. But a federal loan program at the end of the 1970s and the beginning of the 1980s led to a boom in domestic boat construction. Fishermen organized to lobby against catch quotas and fishing limits. In 1982 the New England Fishery Management Council gave in to the pressure from fishermen and dropped the quotas and limits. The result was a rapid increase in overuse, and fish catches declined by over a third in four years. The decline led many fishermen to see the connection between their individual behavior and their collective fate. The vice president of the Atlantic Offshore Fish Association in Newport, Rhode Island, remarked, "I used to be strongly opposed to any kind of limited entry in fisheries. But I've come to feel we have to have some way of rationally allocating fishery resources just as we do other resources."

What happens when fishery resources can't be "rationally allocated"? In other words, what happens when the resource is not conducive to assignment of property rights? Ostrom predicts that users will enter into a political agreement involving self-enforcing self-restraint. We find support for this prediction in the case of "straddling stocks," fish that migrate between national and international wa-

† Lawrence Ingrassia, "Overfishing Threatens to Wipe Out Species and Crush Industry," *Wall Street Journal* (July 16, 1991), p. 1.

ters. Straddling stocks account for about one-fifth of the fish caught around the world each year. Their migration between national and international waters prevents countries from declaring ownership of the stocks and assigning property rights through fishing quotas. Countries have been forced to work cooperatively on the problem. The United Nations has been used as a forum for creating agreement and addressing issues of monitoring and enforcement, just as Ostrom's theory would predict.

The importance of enforcement can be seen in a "natural experiment" created by the fall of the Soviet Union.‡ Ninety percent of the world's sturgeon stocks are in the Caspian Sea, which is bordered by Iran and the former Soviet Union. For decades, the harvest of caviar from spawning sturgeon was tightly regulated by the Soviet government. Quotas for the annual sturgeon catch were established by the Ministry of Fisheries in Moscow and enforced by armed inspectors who kept the lid on poachers and illegal dealers. In 1992, the birth of four new independent states and two new autonomous regions along the spawning grounds of the sturgeon, together with the breakdown of the chain of command out of the Kremlin, led to a marked decline in the enforcement of these quotas. The result was a rapid increase in sturgeon fishing. The director of the Fisheries Research Institute in Astrakkan, at the mouth of the Volga River, said, "Central authority has disappeared. People are living by the law today: Catch whatever you can and don't care about tomorrow. If things are allowed to go on like this, within three to five years sturgeon stocks will be completely depleted."

The importance of reaching an agreement on how to use the sturgeon resource was emphasized by Moscow's chief fisheries inspector: "Either we agree on rules for catching

‡ Michael Dobbs, "A Warning by the Sturgeon General," *Washington Post National Weekly Edition* (June 8–14, 1992), p. 1.

sturgeon or we simply destroy the fish altogether. If we can reach agreement with the United States on limiting production of nuclear missiles, surely we can reach an agreement with other [former Soviet] republics on catching sturgeon." The reader may want to ruminate on this last remark. Knowing what you now know about cooperation, collective action, and problems of commons, is it really as easy to cut a deal on sturgeon among various new states and autonomous regions as it is for two superpowers to sign a bilateral agreement?

CONCLUSION

The problems we have confronted in this chapter are, in many respects, those we met in the previous two chapters. Too little cooperation, too little collective action, too few public goods, too many negative and too few positive externalities, and too much use of common resources are all social dilemmas in which individual incentives are in conflict with socially desirable outcomes. These are summarized in Display 10.2.

The problem of cooperation, as exemplified by the marsh-draining game of Chapter 8, is one that pits the joint benefits of cooperation against the individual motives to defect (since "do not cooperate" is the individually advantageous option whether the other guy cooperates or not). The problem of collective action is the problem of cooperation writ large, where defection takes the form of free-riding on the effort of others. This, in turn, is directly analogous to "not contributing" to the provision of a public good; to defect, in this interpretation, is to withhold payment for a public good, since, if it is provided, noncontributors cannot be prevented from enjoying it. Likewise, paying no attention to the (positive or negative) external effects of your actions is a bit like not controlling your production of public "bads" or ignoring your production of public

DISPLAY 10.2

COOPERATION, COLLECTIVE ACTION, PUBLIC GOODS SUPPLY, EXTERNALITY CONTROL, COMMONS GOVERNANCE: COMPARISONS

Problem	Behavior to Be Controlled	Illustrative Solution
Cooperation	Defection	Repeat play
Collective Action	Free-riding	By-products, political entrepreneur
Public Good Supply	Noncontribution	Public provision
Externality Control	Inattention to external effects	Tax/subsidy scheme
Commons Governance	Overutilization	Property rights regime, governance structure

goods; each is a by-product of your actions for which you shun responsibility. Finally, overutilizing a common resource is "antisocial" in the sense that this action fails to take account of the damage your actions wreak on others.

For each of these social dilemmas, numerous solutions are advocated (a representative one of which is listed in the last column of Display 10.2), and a variety of human experience with all of them. Rarely are the solutions, even those that work tolerably well, ideal. (If any solution were, then we wouldn't be spending so much time writing about them.) One thing is clear, and bears repeating one last time. Solutions are *political*, both in their advocacy and in their implementation. To understand why they work or why they fail, the observer must come to terms with the political ambitions and motives of the actors involved, and with the institutional contexts in which these ambitions and motives get played out. In the concluding section of this text, I turn to an analysis of political institutions.

Experimental Corner

Punishing Free-Riders

Public goods, as we have seen, are underproduced because individual incentives to contribute to their production are weak. Especially in large anonymous groups, individuals are strongly tempted to free-ride on the contributions of others, since they can enjoy whatever public good is produced while avoiding any of its costs. Indeed, if the group is large enough and anonymous enough, their failure to contribute will often go unnoticed. Of course, they risk being punished for their antisocial behavior, but then punishment itself is costly for others so it is unlikely to be much of a detriment to free-riding. But what if, despite its cost, people *did* punish "irresponsible" behavior?

In a wonderful experiment, Fehr and Gachter demonstrate that "free riding generally causes very strong negative emotions among cooperators and that there is a widespread willingness to punish the free riders . . . even if punishment is costly and does not provide any material benefits for the punisher."[a] Moreover, they show that the punishment increases in severity the more the free riding deviates from cooperative levels, so that the opportunity and inclination to punish will have the effect of diminishing free riding.[b]

Their public goods experiment has a no-punishment and a punishment treatment. In the former, theory tells us that there should be widespread free-riding, possibly undermin-

[a] Ernst Fehr and Simon Gachter, "Cooperation and Punishment in Public Goods Experiments," *American Economic Review* 90 (2000): 980–94. Quotation is on p. 980.

[b] A closely related experiment that inspired Fehr and Gachter deals with the problem of the commons described in the text. See Elinor Ostrom, James Walker, and Roy Gardner, "Covenants with and without the Sword: Self-Governance Is Possible," *American Political Science Review* 86 (1992): 404–17.

ing the provision of any of the public good. In the punishment treatment, if punishing is costly, then again we should expect massive free-riding. The possibility of punishment, so the argument goes, is irrelevant because no potential free-rider will expect anyone to engage in this costly behavior. Thus, the theoretical expectation is that the mix of cooperation and free-riding should be the same in each treatment. Surprisingly (from a theoretical perspective, at least), they are not!

Fehr and Gachter's experiment, described below, is quite subtle. They note that in repeated interactions it might be argued that engaging in costly punishment *now* may have material payoffs *later*—that is, that someone could rationally develop a reputation for being willing to punish so as to induce cooperation over the long run. I noted in Chapter 8 that the prospect of punishment in indefinite repeat play of the Prisoners' Dilemma game can induce a positive level of cooperation through reputation-building. Fehr and Gachter, therefore, are careful to remove this material incentive in their experimental design. They do this by having a *stranger* treatment and a *partner* treatment. In the former, each subject plays a public goods game several times with different, randomly selected, subjects; in the latter, he or she plays several times with the same set of subjects.

The experimental design thus has four treatments—the stranger treatment with and without punishment opportunities and the partner treatment with and without punishment. In the partner treatments, it is a certainty that a subject will be matched with the same other players. In the stranger treatments, the probability is less than 5 percent that an individual will be matched with someone with whom he or she was matched in an earlier round.

In each round of the no-punishment treatment of the game, a player is provided with y tokens and makes a

choice of how many tokens, g_i for the i^{th} player, to invest in a public project, where $0 \leq g_i \leq y$. These choices are made simultaneously by the players, and the payoff for Ms. i is $\pi_i = y - g_i + a \Sigma_j g_j$, where $0 < a < 1$. That is, in each period, Ms. i pays in g_i token from her endowment of y tokens but gets back a proportion a of the total contributions made. In this circumstance it is easy to see that Ms. i's dominant strategy is to set $g_i = 0$, thereby free-riding on the contributions of others. Why? Because with $a < 1$ for each unit of contribution she makes, she gets only a units in return from her own investments.

If punishment is available, then the game is the same as in the preceding paragraph, with the following twist. At the end of a round the experimenter announces individual contributions. Subject j can punish subject i by assigning her *punishment points*, p_j^i. For each punishment point assigned to i, her payoff, π_i, is reduced by 10 percent (but not below zero). The *cost of punishment*, $c(p_j^i)$, is strictly increasing in p_j^i. So, the *revised* payoff for Ms i is $\pi_i^R = \pi_i [1 - (1/10) \Sigma_{j \neq i} p_j^i] - c(\Sigma_{i \neq j} p_i^j)$—that is, her original payoff reduced by 10 percent of however many punishment points she receives and also by the cost of her assigning punishment points to others.

The experimental sessions are run in a computer laboratory. Subjects anonymously interact with each other, knowing that it will be the same set of people over multiple sessions in the partners treatment and randomly selected individuals each session in the strangers treatment. Subjects were randomly assigned to the four treatment categories. The experimenters looked at different parameter settings for initial endowment (y), return from total contributions (a), and the cost of punishing ($c(p_j^i)$). All of these details may be found in the original article.

What transpired? The results are quite dramatic. Even in the strangers treatment, where an individual's reputa-

tion could not be developed because his or her cosubjects changed each session, contributions to the public project rose dramatically when the opportunity for punishment existed. Given an initial endowment of twenty tokens, the mean contribution level in the no-punishment treatment is 3.7, a fairly paltry amount. In the punishment treatment, in contrast, the mean contribution level was 11.5, more than triple the no-punishment level. Even in the last period, where everyone knew there could be no future benefit from punishing now, the no-punishment mean was 1.9 tokens and the punishment mean was 12.3. This result quite forcefully rejects the hypothesis that there should be no difference (in the strangers treatment) between a punishment and no-punishment condition. (The existence of punishment opportunities in the partners setting also produces much higher contribution levels than in the no-punishment treatment.) Interestingly, comparing the partners and strangers settings under punishment, in both cases contributions are high and remain high, but in the partners setting the contribution level approaches *full cooperation*, with an average contribution of 17.0.

Fehr and Gachter were quite careful to remove, as much as possible, the possibility of any material gain from punishing. Especially in the strangers condition, where punishing someone this time would not affect a subject's prospects in the next round, costly punishment nevertheless occurred. They conclude that even highly rational people have a consequential *emotional life* in which there is a strong propensity to punish others for inappropriate behavior, even if the punisher must bear a cost to do so. Thus, as they note, we observe drivers expressing their rage when someone butts into line, striking workers conveying strong disapproval of strike-breaking "scabs," students shunning fellow dorm residents for not cleaning up after themselves in common rooms, and so on.

At least two puzzles generated by these experiments are worth pondering. First, why do people come, possibly hard-wired, with the emotional responses leading them to punish as described above? Might an evolutionary story of some sort help explain this? The second puzzle is why people don't *free-ride on punishing*—that is, let someone else punish a transgressor? If Ms. *i* is offended by Mr. *j*'s inappropriate behavior, why doesn't she avoid punishment costs by letting *k*, *l*, and *m* do the punishing? The answer to both puzzles may reside in the neurobiological prospect that we take emotional pleasure in expressing our disapproval of those we believe violate expectations of cooperation—that part of our *identity* is tied up in acting on these emotional impulses.

Problems and Discussion Questions

1. Write out an empty 2x2 chart like that in Display 10.1, and then for each square develop an original illustrative example of the type of good, explaining why your example is either excludable (or not) or jointly supplied (or not). Then, explain what "problems" arise from nonexcludability and from jointness of supply (or lack thereof!).

2. The website YouTube.com hosted approximately 75 billion videos in 2009, charging both uploaders and viewers nothing for the service and placing no restrictions on the quantity of content that it would host (although it does enforce some limits on inappropriate content). YouTube expends hundreds of millions of dollars on bandwidth, as well as infrastructure

and maintenance costs, and earns money primarily by hosting ads on its pages. To date, the company has not turned a profit.[a]

Identify what type of good YouTube is offering based on the categories outlined in Display 10.1, explaining carefully how you reached your conclusion. Is it possible to supply profitably the type of good you have identified? Are there alternative modes of delivery that YouTube could adopt to deliver the same service more profitably?

*3. Five civic-minded patrons of a public library contemplate donations of time to its annual fundraiser. Each individual i bases his or her decision of how much time to donate, x_i, on the following utility function:

$$U_i(x_i) = q^{.25} - .25x_i$$

where $q = \sum_{j=1}^{5} x_j$ (the total amount of time given by all library patrons) and $.25x_i$ is the cost of losing x_i of one's leisure time.

a. What is the socially optimal amount of time donated? Determine this by summing the utility functions of five individuals, and finding the q that maximizes this function.

b. Now consider the case of an individual who assumes that everyone else will contribute no time. How much time will this individual donate, and is it at the socially optimal level?

c. Now assume that each individual assumes that the other four members will donate .8 units of time. Does this individual donate more or less time than before? Why is this?

[a] Malcolm Gladwell, "Priced to Sell," *The New Yorker*, July 6, 2009.

d. Why is a socially suboptimal amount of time donated in parts b and c? Consider the balance between internalized costs and internalized benefits.

e. [Bonus] Repeat the same exercise for the case of ten individuals. What proportion of the socially optimal amount is donated in an equilibrium now? What does this suggest about the difficulties of supplying quasi-public goods as the number of people increases?

4. Perhaps the default solution for the provision of public goods is public supply—by the state. Does public supply happen automatically where markets fail to provide public goods? Explain your reasoning. If not, outline some of the ways in which public supply is secured. What are some of the problems that recur in the state supply of public goods?

*5. A factory located in a small village produces a good with increasing marginal costs, given by equation $MC(q) = 12 + q$, so, for example, the first unit costs 13 to produce, the second 14, and so on. This firm can produce at most 15 units and cannot produce fractional amounts (e.g., 1.5 units). The market price for that good is currently at $p = \$20$, and the firm's level of production does not affect this price. Assume that the factory owner maximizes profit, and her utility is measured in dollar terms. Profit is calculated by summing up the differences between the price and the marginal cost of each unit produced, so the first unit earns a profit of 7, the second of 6, and so on.

Unfortunately, it turns out that the factory is quite noisy and interferes with the practice of a neighboring doctor. In fact, for every extra unit produced by the factory the doctor loses \$2 worth of profits. Just as for the factory owner, assume the doctor's welfare depends only on his profits, which are $50 - 2q$.

- How many units of the good will the factory produce if it ignores the externality imposed on the doctor in its profit maximization? What will be the aggregate social utility (sum the factory's and doctor's total profits)?
- Identify the level of production that is socially most preferred, that is, maximizes aggregate social utility.
- Propose a government taxation scheme that will lead to the socially preferred outcome.

6. Taxes/subsidies, regulation, and respecification of property rights are three canonical solutions to the problem of externalities. Explain the thinking behind each of these solutions and discuss any difficulties with the implementation of such a solution. Then, provide an example, real or of your own devising, of each of these solutions applied to situations where externalities arise.

7. One interesting example of a positive externality is so-called network effects: each additional user of some good or service increases the value of that good or service to all other users. The New York Stock Exchange, telephones when they were first introduced, and Facebook are often cited as examples. Using one of these examples, or one of your own, explain why network effects fit the definition of an externality. Do networks then suffer from the problem of underprovision, as with other positive externalities? at what stage in their development? What are some possible solutions to overcoming these problems?