



CONGESTION AND THE

What happens when some resources are enclosed and

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anaging traditional commons like fisheries, grazing lands, and antibiotic effectiveness have a lot in common. For example, environmental economists have long known that private ownership is an effective way to solve the problem of congestion on grazing lands. When

there is no owner controlling access, farmers will continue to turn out their cattle or goats, not taking into account the effect that will have on others.

However, when a single owner is in charge, use of the resource pool can be optimized by setting an entry price that takes into account the cost imposed on all other users. Therefore, the number of goats grazing on a commons with a single owner is such that the marginal benefit of grazing an additional goat is equal to the marginal cost imposed in terms of less grass for all other goats.

But things don't quite work that way when there are two resource pools and one is owned while the other is not. Economists have long known that partial ownership can lead to an outcome that is worse for society as a whole compared with either complete ownership, when every resource has an owner, or complete open access, where there are no owners.

In the case of fisheries, regulating any single fishery may displace fishermen who may move to (and congest) other fisheries that are open-access, potentially leaving society worse off. The regulatory problems associated with effort displacement are familiar to those charged with regulating fisheries. For example, concerns that imposing gear restrictions on pelagic or long-line fisheries would encourage fishermen to relocate to other sensitive fishing areas, jeopardize sea turtles and dolphins, or increase bottom-line fishing of grouper, snapper, and tilefish, dominated the comments sent in response to a recent National Oceanographic and Atmospheric Administration ruling.

Congestion "spillover" across resources is also a problem in the case of antibiotic effectiveness, because the evolution of bacterial resistance is directly correlated with the quantity of antibiotics used. Patents can protect or "enclose" the effectiveness of new antibiotics but also confer monopoly rights. Other antibiotics have long been in use and are no longer under patent and essentially in an open-access regime. Although patents could give a single firm the incentive to care about resistance to a new drug, the patent holder is likely to

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ignore the effect of pricing decisions on exacerbating resistance to antibiotics that may be in the generic domain. As a consequence, the firm may overprice or underuse the new drug relative to the socially optimal level.

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A possible regulatory response to this cross-resource spillover problem may be to subsidize the use of patented drugs that might otherwise be underused, or to tax the use of generic drugs to ensure that they are not overused. Alternatively, quantity instruments can be used to ensure that patented drugs are used more often; for example, quotas are already being used in the form of formulary restrictions on antibiotic usage imposed by hospitals. Paradoxically, though, such formulas restrict the use of powerful, patented antibiotics to a second line of defense—a backup should all cheaper drugs fail—even though they are already potentially underused because of their high cost.

In fact, it wouldn't much matter which form of regulation we decide to impose on the unprotected resource if we knew how the addition of more users would affect congestion. But if we are uncertain about the costs or effects on congestion, the decision is not as easy.

In a recent paper, we looked at whether it is better to use a price regulation or a quota system to deal with this problem of congestion spillovers between protected and unprotected resources, when there is this form of uncertainty. The question is akin to that of a well-known 1974 article by Martin Weitzman on the optimality of regulating emissions with prices or quantities when the actual costs of compliance or environmental damages are unknown (► *Prices vs. Quantities*, *Review of Economic Studies*, 41 (4): 477-91). He finds that if the marginal damages are steep relative to



the marginal costs of control, a quota is preferred because it's better to err on the side of certainty in emissions. On the other hand, if marginal damages are relatively flat, a tax is preferred, erring on the side of cost certainty.

In contrast, what we find is that price mechanisms are always the superior option in terms of economic efficiency for dealing with congestion spillovers. And this holds whether the demand for the antibiotic is steep or flat. The reason is that we have two interrelated markets, not just one as in the Weitzman pollution problem, so an error in regulating the open-access resource also spills over into the enclosed resource. For example, suppose the production costs of or resistance in the patented antibiotic turns out to be higher than expected; ideally, one would shift some of the market demand toward generics, but a quota on those open-access drugs would prevent this reallocation, leaving greater pressure on the enclosed resource. However, a tax on generics would signal a reasonable approximation of the congestion costs, while still allowing some reallocation of market demand. In other words, a tax allows both markets to adjust to an unexpected cost shock, while the quota does not.

This preference for prices also does not depend on market structure cost shock (that is, the extent of the monopoly power of the owner of the enclosed resource). A firm that holds an antibiotic patent will restrict the use of its own drug to raise prices and its revenues, putting additional pressure on the unenclosed, generic alternatives. The optimal tax on generics is then higher (as would be the implicit quota value) to reflect this additional pressure, but the tax still retains the benefit of flexibility in the face of uncertainty.

Without the spillovers from partial enclosure, we find that taxes and quotas can perform equally well for dealing with open-access problems under uncertainty. For example, if antibiotic prices are fixed, either by competition in global markets or simply by regulation, then extraction in one resource pool does not affect the market prices faced in the other.

Congestion spillovers thus pose different challenges than traditional environmental problems requiring regulation. Because regulating one resource pool affects the exploitation of the others, regulators must be aware of these interactions and consider policies that allow flexible responses among all resource pools. These lessons are no less relevant for regulating the use of resistance-prone drugs such as antibiotics—their effectiveness should be considered an important public health resource. ■

This article is based on a longer version by the authors, ► Managing Partially Protected Resources Under Uncertainty, by Ramanan Laxminarayan and Carolyn Fischer (forthcoming).

The Perils of Partial Protection

The "tragedy of the commons" even applies to burglar alarms. If no house in the neighborhood has an alarm, then a single homeowner's decision to install one may reduce that homeowner's risk of being burgled, but could leave everyone else worse off by diverting burglars to unprotected houses. The best outcome that either all houses have alarms or that none have alarms, and any intermediate solution may be inferior to these extremes.