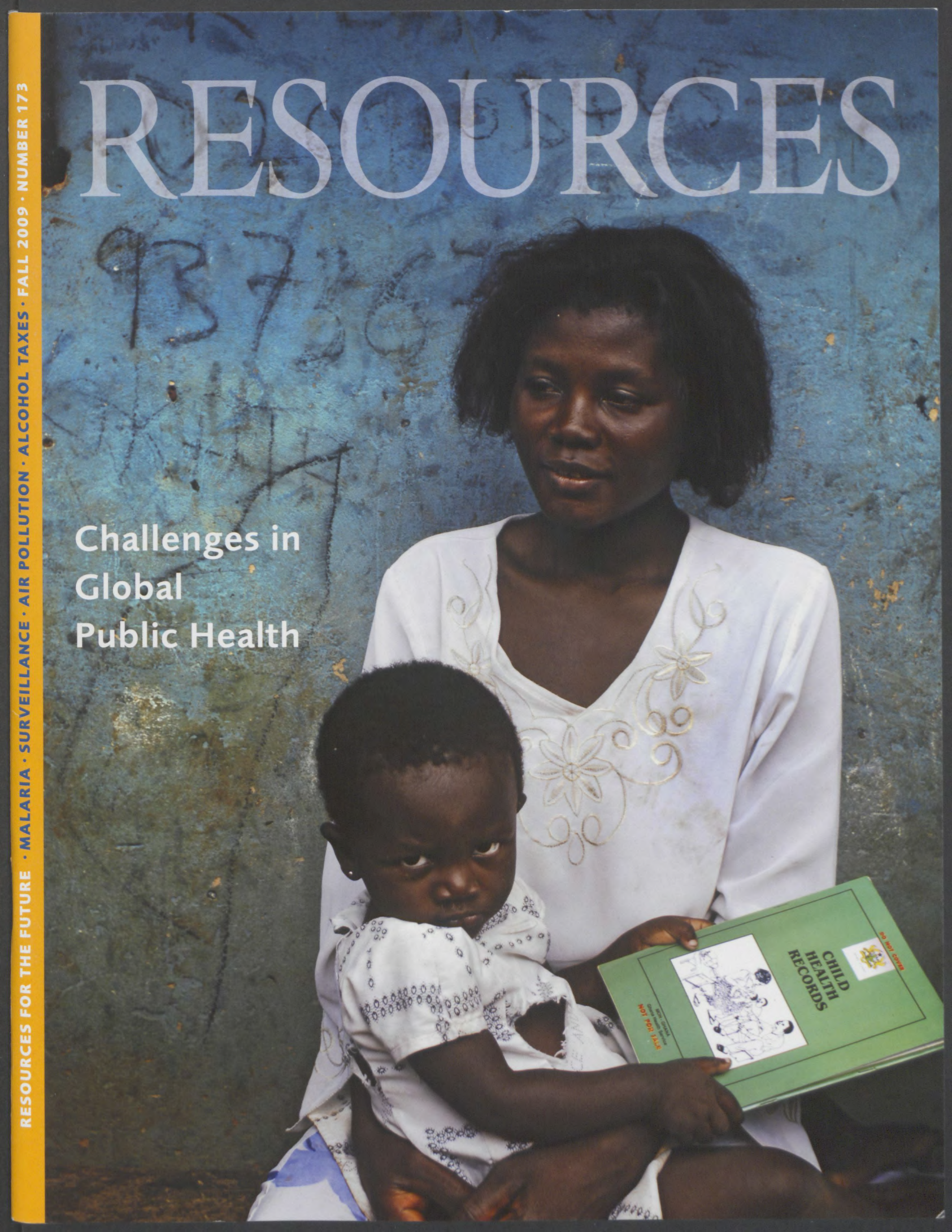
RESOURCES

Challenges in Global Public Health



RESOURCES FOR THE FUTURE · MALARIA · SURVEILLANCE · AIR POLLUTION · ALCOHOL TAXES · FALL 2009 · NUMBER 173

RFF's Expanding Focus on Public Health

PHILIP R. SHARP, PRESIDENT

This issue of *Resources* highlights ongoing work at RFF on public health. Malaria control and eradication, the effectiveness of antibiotics, alcohol taxation, the detection and reporting of emerging pandemics, and the health impacts of air pollution in developing countries are just some of the issues being addressed at RFF's newly established Center for Disease Dynamics, Economics, and Policy (CDDEP), led by Senior Fellow Ramanan Laxminarayan.

This center is bringing together economists, epidemiologists, ecologists, legal scholars, and experts from other disciplines to develop novel approaches to understanding and crafting policy solutions for some of the most urgent challenges facing the United States and the world.

Although CDDEP is new, work on health at RFF is not. Decades ago, RFF researchers worked on diverse health topics such as schistosomiasis control in China and fertility issues in Asia. One of the earliest and most famous epidemiological studies in air pollution was by Lester Lave and Eugene Seskin in 1970, whose influential work linked air pollution to mortality. And epidemiological studies, using the relatively advanced statistical tools of economists, were used in the 1980s to support standard setting under the Clean Air Act.

In fact, the underlying structure of many current global public health challenges is very similar to the environmental and natural resource issues that RFF has focused on throughout its history. The problems of common property and open access resources are as pervasive in public health as they are in the environmental domain. RFF's traditional strength in economic analysis is generating important insights for public health policy.

One of the contributors to this issue is Senior Fellow Maureen Cropper, a former lead economist at the World Bank, who describes her recent work on air pollution in China. Maureen is one of many scholars joining RFF. We recently launched a program to expand our research base with the addition of established scholars based at other institutions, whose work complements our core mission. Our new nonresident fellows, who are all at the top of their fields, are profiled in these pages; they include John List, University of Chicago; James Sanchirico, a former member of the RFF research staff and now at UC–Davis; and Stephen Salant, University of Michigan.

In addition, we are very happy to welcome new Fellows Carolyn Kousky and Shanjun Li, and Senior Fellow Roberton Williams, along with Visiting Scholar Sheila Olmstead.

Great institutions export talent and we have recently done our fair share, with numerous RFF alumni taking senior positions in government. But new scholars and initiatives like CDDEP are ensuring that RFF remains a vital, dynamic institution.

Phil Sharp

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Lori Snyder Bennear is an assistant professor of environmental economics and policy at Duke University's Nicholas School of the Environment. Her research focuses on evaluating innovations in environmental policy and improving methods and techniques for conducting these evaluations.

Maureen L. Cropper is a senior fellow at RFF, a professor of economics at the University of Maryland, and a former lead economist at the World Bank. Her current research includes work on energy efficiency in India, the impact of climate change on migration, and the benefits of collective action in pandemic flu control.

RFF Senior Fellow **Carolyn Fischer** studies policy mechanisms and modeling tools that cut across environmental issues, including environmental policy design and technological change, international trade and environmental policies, and resource economics. Her latest work investigates and compares policies to mitigate emissions leakage.

Ramanan Laxminarayan is a senior fellow at RFF, where he directs the Center for Disease Dynamics, Economics, and Policy, and a visiting scholar and lecturer at Princeton University. His research deals with the integration of epidemiological models of infectious diseases and drug resistance into the economic analysis of public health problems. He has worked to improve understanding of drug resistance as a problem of managing a shared global resource.

Anup Malani is a professor of law at the University of Chicago. He is also an RFF university fellow, a faculty research fellow at the National Bureau of Economic Research, and an editor of the *Journal of Law and Economics*. His research examines the control of infectious diseases, placebo effects, antibiotic resistance, medical malpractice liability, and conduct of and inferences from medical trials.

RFF Visiting Scholar **Sheila M. Olmstead** is an associate professor of environmental economics at Yale University's School of Forestry and Environmental Studies. Her primary research interests include water resource economics and policy, including urban water demand management, market-based approaches to water conservation, drinking water quality regulation, access to drinking water among low-income populations, and the efficient allocation of water across sectors.

Ian W.H. Parry is an RFF senior fellow and holds the Allen Kneese Chair. His research focuses primarily on environmental, transportation, tax, and public health policies. Parry has analyzed environmental tax shifts and how other emissions-control policies interact with the broader fiscal system, the incidence of environmental policies, and the implications of technological progress for the design of environmental policies.

David L. Smith is a visiting scholar at RFF and associate director of disease ecology at the University of Florida's Emerging Pathogens Institute. His research covers mathematical epidemiology, emerging infectious diseases, infectious disease ecology, the evolution of antimicrobial resistance, and the bioeconomics of infectious diseases.

Andrew J. Tatem is an assistant professor at the University of Florida's Emerging Pathogens Institute and Department of Geography. His recent work is focused on the application of optimized population and urbanization mapping for malaria burden estimation, the dispersal of diseases and their vectors through global transport networks, and quantifying population movements in relation to local malaria elimination planning.

BIOGRAPHY LINKS

Detailed profiles of researchers are available on the RFF website.

RFF Scholars Testify before Senate Finance Committee

Bringing their analysis to bear on current energy issues before Congress, two RFF researchers recently presented testimony to the Senate Finance Committee.

President Obama's budget for the fiscal year 2010 calls for the elimination of a number of tax breaks for domestic oil and gas production, raising federal revenue by $31.5 billion over the following nine years. Stephen P.A. Brown, an RFF nonresident fellow, in testimony before the Subcommittee on Energy, Natural Resources and Infrastructure, pointed out that most projections show oil and gas prices rising to near-record levels in those years, and the loss of the tax breaks would amount to less than one percent of the value of the oil and gas produced.

"Tax preferences are instruments of policy," he wrote. "Their use should be limited to activities that need more encouragement than is provided by free market forces." In this case, he said, free markets are likely to provide "sufficient encouragement."

The impact on production would be small, he told the committee, and the impact on consumer prices would be even smaller. Ending the tax breaks would cost the average consumer about $1.40 a year more for oil products and natural gas, Brown concluded, compared with increased revenue to the government that would be about $10.70 per consumer.

"The change in consumer prices is very small," he noted, "because oil prices are determined on an international market in which the United States accounts for less than 10 percent of production."

Dallas Burtraw, a senior fellow at RFF, addressed the provisions for distribution of emissions allowances and revenue under the climate legislation pending before the committee. The purpose of the legislation is to reduce the amounts of greenhouse gases emitted into the atmosphere, where they contribute to warming. The most common of those gases is carbon dioxide, most of which is generated by burning fossil fuels.

The bill that the House of Representatives passed in June 2009 would require every major energy producer—for example, an electric power generating plant—to have a government-issued allowance for every ton of carbon that it emits into the air. To protect consumers from the impact of the resulting price increases, the bill would require the government to allocate a large share of those allowances—initially, more than half—to local electric power distributing companies for the benefit of electricity consumers.

The formula is complex and yet, Burtraw warned the committee, it leaves the outcome vague. "State public utility commissions," he said, "will play the determining role in how households are affected, not Congress, and this will be done in 50 different ways. In fact, there is great uncertainty about how the allowance value directed to local distribution companies will flow back to consumers."

There's a simpler and better way to do it, Burtraw suggested: the federal government could itself auction off the allowances and rebate the resulting funds, in cash, directly to households.

Allocating free allowances to electric companies raises another issue as well. To the extent that companies use the allowances to reduce consumer prices, they will encourage consumers to use more electricity. That runs counter to the whole purpose of the bill, to push the economy to use less energy through greater efficiency.

Some free allocation to electric companies may be justified, Burtraw argued, to offset regional disparities that arise because some regions are much more heavily dependent on coal than others. But, in his view, it is best limited to that narrow purpose.

He also observed that the allowance allocation provisions in the House bill do not deal equally with all levels of family income. They lead to "an inverted 'U' with respect to the distribution of costs across household income groups, doing a good job of protecting the bottom 20 percent of households and the top 10 percent. The increase in costs associated with the inefficient allocation to local distribution companies falls hardest on the middle range of household incomes. In contrast, direct dividends to households allocate the value of allowances in a way that does not disadvantage the middle class, is less costly and administratively simpler. Furthermore, in a profound way, direct dividends avoid the appearance of favoritism, by distributing to households an equal share of the value of a new property right that is created under a cap-and-trade program."

Burtraw also told the committee that the phaseout schedules for the free allocations to benefit consumers were too long. Households will need some time to adjust to rising electricity costs, he said, but the schedules in the House bill continue for decades. ■

RFF Research Ranks Bolstered by New Personnel Additions

Senior-level staffing changes have augmented RFF research programs in recent months—bringing new talent to bear on a wide range of policy issues, including expertise in such areas as consumer behavior, industrial organization, environmental economics, water quality, and tax policies.

New researchers recently affiliated with or in residence at RFF include Visiting Scholar Sheila M. Olmstead, Fellows Carolyn Kousky and Shanjun Li, Senior Fellow Roberton C. Williams III, and Nonresident Fellows John List, Stephen W. Salant, and James Sanchirico.

"We are gratified that such exceptional academicians have joined RFF's research program," said Mark Cohen, RFF vice president for research. "Not only are they distinguished by their academic accomplishments but they will offer a wealth of collaborative potential to our current research agenda."

Most of the new staff members will divide their research agendas between work at RFF and ongoing activities at their home institutions.

SHEILA M. OLMSTEAD

CAROLYN KOUSKY

SHANJUN LI

Sheila M. Olmstead is associate professor of environmental economics at Yale University's School of Forestry and Environmental Studies. Her research focuses on natural resource management and pollution control, and current work centers on the economics of water supply and demand, particularly in urban settings. She seeks to measure the effectiveness of policy instruments that deal with urban water scarcity, as well as determinants of access to clean drinking water among low-income populations in the United States and developing countries.

A 1992 graduate of the University of Virginia, she received her master's in public affairs from the University of Texas and her Ph.D. in public policy from Harvard University.

Carolyn Kousky's research focuses on natural resource management, decisionmaking under uncertainty, and individual and societal responses to natural disaster risk. She has examined how individuals learn about extreme event risk, the demand for natural disaster insurance, and policy responses to potential changes in extreme events with climate change. She is also interested in ecosystem services policy and has examined the design of incentive-based mechanisms to supply ecosystem services and the use of natural capital to reduce vulnerability to weather-related disasters.

She earned her B.A. from Stanford University in 2002 and her Ph.D. in public policy from Harvard University in 2008. She is co-author with Roger Cooke of "Are Catastrophes Insurable?" in the summer 2009 issue of *Resources*.

Shanjun Li, an assistant professor of economics at the State University of New York at Stony Brook from 2007 to 2009, examines practices that influence consumer behavior. Much of his recent study has explored how some factors—such as vehicle safety, gasoline prices, tax incentives, and obesity—have affected demand for automobiles. He has conducted research on a set of diverse microeconomic topics including the impact of gasoline price changes on fleet fuel economy, peer effects in group lending in developing countries, and the consequences of free antibiotics on antibiotics usage.

Li earned his B.A. in international economics from Nankai University in Tianjin, China; his master's in agricultural economics at Michigan State University; and his doctorate in economics from Duke University.

Roberton Williams is on leave from the University of Texas at Austin and is a visiting associate professor at the University of Maryland, College Park. His research examines the impact of taxes on environmental policy. He has served as coeditor of the *Journal of Environmental Economics and Management* and is currently coeditor of the *Journal of Public Economics*. He is a member of the editorial board of the *B.E. Journal of Analysis & Policy*.

He received his A.B. in economics from Harvard in 1994 and his Ph.D. in economics from Stanford University in 1999.

ROBERTON WILLIAMS

STEPHEN SALANT

JAMES SANCHIRICO

New Nonresident Fellows

John List is a professor of economics at the University of Chicago. Known for his innovative use of field experiments in economics, he seeks insights into such areas as social preferences, prospect theory, environmental economics, marketplace effects on corporate and government policy decisions, and multi-unit auctions.

Stephen Salant, a professor of economics at the University of Michigan, is an applied microtheorist with a specialization in the fields of industrial organization and natural resource economics. Among the subjects he has addressed in his research are the appropriate interpretation of government statistics on the duration of unemployment, the effects of anticipated and actual government policies on the price of gold, and the economic aftermath of decisions by such groups as agricultural marketing boards, cartels, and international commodity organizations.

James Sanchirico is a professor in the Department of Environmental Science and Policy at the University of California at Davis, who primarily focuses on the economic analysis of marine policies, especially the effects of individual transferable quotas and marine protected areas. His other research interests include spatial and intertemporal management of biological resources, the interface between land use and biodiversity conservation, and the economics of invasive species management. He was an RFF fellow for nine years before joining the Davis faculty in 2007.

In addition, over the past year, several RFF researchers have taken positions within the federal government. They include the following:

- Joseph E. Aldy, special assistant to the president for energy and the environment in the White House, working with both Carol Browner and Lawrence Summers.
- Richard G. Newell, administrator of the federal Energy Information Agency (EIA), part of the Department of Energy. He replaced acting administrator Howard Gruenspecht, also a former RFF senior researcher.
- William A. (Billy) Pizer, deputy assistant secretary for environment and energy at the Department of the Treasury, where he has responsibility for work on creating markets for emissions trading and related policies.
- Shalini Vajjhala, deputy assistant administrator for international affairs at EPA, where she will be play an important role in adaptation efforts for the U.S. government and participate in international negotiations.

Information Disclosure and Drinking Water Quality

Lori Snyder Bennear and Sheila Olmstead

In the United States, nearly 270 million people (about 95 percent of the population) obtain piped water from regulated community drinking water systems. The quality of drinking water from these community systems, which may serve anywhere from 25 to several million people, is regulated by the federal government under the Safe Drinking Water Act (SDWA). The SDWA regulates chemical, microbiological, radiological, and physical drinking water contaminants by enforcing 90 different maximum contaminant levels (MCLs), which limit the amount of contaminants that can legally be present in drinking water. For some pollutants, the SDWA also establishes treatment protocols that must be followed to reduce contamination.

U.S. taxpayers heavily subsidize compliance with the SDWA. Between 1995 and 2003, Congress appropriated $1 billion each year for grants and below-market loans to states (which then distributed funds to water supply systems) for treatment and distribution infrastructure improvements. Nonetheless, U.S. community water systems incur tens of thousands of SDWA violations each year. For example, between 1997 and 2003, U.S. water suppliers incurred about 9,900 violations per year of the total coliform rule—the main rule governing the presence of bacteria in drinking water and the most frequently violated of the MCLs.

In 1996, the SDWA was amended, mandating, among other things, that community drinking water systems disclose information about such violations to their consumers every year, in a standard format called a consumer confidence report (CCR). This report must provide information on the source of drinking water, any detected contaminants (even if levels are within legal limits), and any violations of drinking water standards. The CCRs were first issued in 1999, reporting violations from the 1998 calendar year. While all community water systems must compile a CCR, the method of distribution to consumers varies by system size. Suppliers serving 10,000 or more people must mail their CCRs directly to households. Those serving more than 100,000 people must mail their CCRs and make them available online. In contrast, suppliers serving fewer than 10,000 households must post hard copies of the CCRs in a public place and make them available on request, but they are not required to mail them.

The CCR rule was one of many environmental "right-to-know" provisions enacted during the 1980s and 1990s. The primary public policy goal of these right-to-know rules is to provide the public with important information about environmental quality and health. But information disclosure requirements can be seen as de facto direct environmental regulatory instruments—that is, the requirement to disclose information about environmental performance may induce improvements in environmental performance.

Our recent research suggests that information disclosure may actually accomplish this goal. In analyzing whether community water suppliers in Massachusetts incurred fewer water quality violations when they were required to issue CCRs to their customers, we examined trends in violations separately for large suppliers that are required to mail their reports and for smaller suppliers that must only compile the data and make it available to households upon request. There is strong evidence that those water suppliers required to mail CCRs directly to customers had lower violations after the CCR rule took effect. The magnitude of this effect is quite significant. On average in Massachusetts, large water suppliers violated the SDWA about once every two years before 1998. Mailing CCRs reduced total violations for this group by between 30 and 44 percent, and reduced more

serious health violations by 40 to 57 percent.

Proponents of "information as regulation" argue that there are at least three mechanisms through which information disclosure might affect environmental quality. The first is the market mechanism: if information about firms' environmental performance is known by consumers, investors, or employees who value environmental performance, firms can face market pressure to improve. The second is the political mechanism: people may use the political system to lobby for more stringent regulation or to protest particular production practices. Finally, information disclosure programs can affect the internal decisionmaking of an organization. The act of measuring and reporting data on environmental performance may itself generate internal changes at firms that lead to improvements in environmental performance.

While our research does not directly test any of those three mechanisms, our results are consistent with the hypothesis that the political mechanism is at work. Water suppliers required to directly mail CCRs may experience, or expect to experience, a political response and may respond by lowering violations. We would not expect the market mechanism to work in this case. There is essentially no market through which consumers can respond to information, aside from either moving to a different town (a high-cost response) or purchasing bottled drinking water, a substitution that would have only a minimal impact on demand, because drinking water constitutes a tiny fraction of household piped water consumption in the United States. The internal mechanism is unlikely, as well; water suppliers are already required to monitor and report any violations to the state, so compiling these data for their customers provides no new information to the supplier.

The evidence suggests that information disclosure requirements associated with the 1996 amendments to the SDWA resulted in substantial decreases in drinking water violations among regulated water suppliers. In this context, mandatory information disclosure complements, but does not supplant, existing pollution control regulations. However, recent research in developing countries suggests that consumers also respond to information disclosure, potentially improving health outcomes by substituting safer water supplies. These behavioral changes occur even in the absence of mandatory water quality standards. Information disclosure can be a useful complement to more traditional environmental regulatory instruments in some settings, but further research is necessary to determine whether it may also serve as a substitute for these regulations. ■

▸ **Further readings and additional commentaries are available at www.rff.org/weekly-commentary.**

RFF and Human Health

RAMANAN LAXMINARAYAN

This issue of *Resources* highlights ongoing work at Resources for the Future's newly launched Center for Disease Dynamics, Economics, and Policy (CDDEP). To some readers, it may come as a surprise that RFF has been involved in work on issues of human health, for many know us for our research on climate change, environmental problems, and energy alternatives.

But there's more to the environment than just air and water quality. A person living in the middle of high mosquito density and malaria prevalence lives in an "environment" of high malaria. Similarly, living in a built environment with few recreational activities can have significant impacts on obesity and cardiovascular disease. Moreover, much like our atmosphere and the ozone layer that protects us from harmful ultraviolet radiation, effective drugs to cure infectious diseases, such as malaria and tuberculosis, are global resources, with actions in any single country or region having global consequences.

The interrelatedness of global challenges of food, energy, environment, and health are widely recognized. Addressing these challenges from a research standpoint requires us to ask questions that transcend the boundaries that separate these areas, and to go beyond economic analysis alone. A key feature of CDDEP is the serious attention paid to science while working on the economics and policy. The center is building a team of disease modelers led by David Smith, an RFF visiting scholar. His article on the policy implications of bioeconomic modeling describes how the combination of disease modeling and economics continues to be useful in informing policy in malaria control and management of drug resistance in malaria infections.

The challenges of common property and open access resources are as pervasive in public health as they are in the environmental realm. Resource economists are familiar with the problem of exhaustion of global fisheries or ozone because no single actor has an incentive to care about these global commons. Similar problems exist in public health: work at CDDEP has focused on managing the shared resource of antibiotic effectiveness, in the United States in the context of the Extending the Cure project (extendingthecure.org) and globally through our Global Antibiotic Resistance Partnership (resistancestrategies.org). Carolyn Fischer and I discuss these problems in a related article.

We tend not to think of reporting of disease outbreaks by countries as a global public good, but the earliest international agreements were the Sanitary Conventions in the mid-19th century in the wake of a succession of global cholera outbreaks that particularly devastated Europe and the United States. These conventions called for all countries to report outbreaks of plague, cholera, and yellow fever but were difficult to enforce in much the same way as today's environmental agreements. Individual countries

that reported an outbreak would face trade and economic sanctions and therefore had every incentive to remain quiet. Anup Malani and I discuss incentives for countries to look for and report disease outbreaks as a means to control epidemics in another article.

Not all our work is on infectious diseases; after all, externalities are a problem in the case of alcohol and tobacco as well. When individuals choose to drink and drive or smoke in the presence of others, they impose costs for which they do not bear the consequences. In an article on optimal alcohol taxes, Ian Parry discusses the relative importance of various sources of economic costs associated with alcohol consumption.

Finally, CDDEP researchers are continuing our long tradition of work on environment and health in China, an example of which is the article by Maureen Cropper. She develops careful estimates of the impact of air pollution on human health and the associated economic consequences, all of which are central to determining what level of effort China should put into controlling emissions.

Of course, the ultimate goal of all CDDEP's research is improved policy. The center's team of economists, epidemiologists, disease modelers, and policy analysts has played a key role in the establishment of the Affordable Medicines Facility–malaria (AMFm), a novel financing mechanism for lowering the cost of effective antimalarials in endemic countries and decreasing the likelihood that resistance to the anchor drug will emerge. The *Extending the Cure* report has informed legislative efforts at both state and federal levels in the United States to improve infection control in hospitals and manage antibiotic effectiveness as a shared societal resource. And work on the Disease Control Priorities Project (dcp2.org) has influenced changes in tobacco policy in Kenya and health priority setting in India.

You may sign up for updates and follow our work at cddep.rff.org. We also look forward to hearing from you.

This Could Be the Last Time

THE BIOECONOMICS OF ERADICATING MALARIA

David L. Smith
and
Andrew J. Tatem

Each year, malaria kills approximately one million people and causes approximately 500 million clinical episodes, but today's outlook for doing something about malaria is cautiously optimistic. New funding and attention are available from international donor agencies to attack malaria with powerful new tools. After a lapse of nearly 40 years, malaria eradication again defines the long-term global agenda.

But barely a decade ago, malaria was one of the world's most neglected diseases. How did this happen? When malaria eradication failed the first time, funding and interest reached a low ebb. Resistance evolved to the cheap and effective first-line antimalarial drug chloroquine, and a bad problem got even worse.

The tide began to roll back when the leaders of nearly all the African countries still plagued by malaria met to determine how to stop it once and for all. These countries changed their drug policies and began to adopt artemisinin-based combination therapy, the most powerful antimalarial drug options ever. Large trials demonstrated that insecticide-treated nets were effective, and compared to most other public health interventions, they were extremely cheap. The stage was set for a new attack on an old enemy.

First, some history

The end of World War II was an era of unprecedented optimism about infectious diseases, including malaria. Two important developments literally made all the difference in most parts of the world. Before the war, malaria was treated with quinine, made from the bark of the cinchona tree. In 1946, mass production of chloroquine made cheap and effective drugs widely available. And before the war, vector control focused on larval mosquitoes but then DDT and other contact pesticides made it possible to kill adult mosquitoes and thereby halt transmission. There had never been anything that worked like DDT.

Optimism about malaria and other infectious diseases led to the formation of the World Health Organization (WHO), where malaria was recognized as a top public health priority. In 1955, the WHO coordinated a DDT spraying program and, in the first decade, the global burden of malaria was sharply reduced: 24 countries that eliminated malaria during this era remain malaria-free today.

By the mid 1960s, however, progress had slowed. The mosquitoes that transmit malaria had evolved resistance to DDT, and the low-hanging fruit had been plucked, leaving a set of harder problems to solve.

Over the next 25 years, donor fatigue set in and other public health priorities, including smallpox eradication, competed for funds. Meanwhile, environmentalists increased efforts to ban DDT. WHO abandoned the long-term goal for malaria eradication and, without clearly defined goals, international donor funding for malaria dried up.

The funding drought and DDT resistance left many countries vulnerable. Some countries, such as India and Sri Lanka, were on the brink of elimination, but then malaria came roaring back. In Madagascar, a plan to keep malaria from resurging was inadequately funded and poorly implemented, and malaria killed approximately 40,000 people. These are cautionary tales if malaria eradication should fail again.

The turning point

The seeds of today's optimism can be traced to a summit of African leaders in Abuja, Nigeria in 2000 to set new goals for malaria eradication in Africa. For the first time, Africans—not Europeans—were making decisions. The Abuja Summit generated political momentum, institutional synergy, and technical consensus on malaria. Summit participants, all high-level officials from 44 African nations and all of the major international donor organizations, signed a declaration and committed themselves to an intensive effort to halve the rate of malaria by 2010.

Malaria garnered the United Nation's attention and was given its own UN Millennium Development Goal. In the fall of 2007, Melinda and Bill Gates announced that their foundation's policy was to support malaria eradication as a long-term goal. Margaret Chan pledged the support of the WHO in her role as the director general. Malaria efforts have indeed come full circle.

For malaria eradication to succeed, what is needed is a strategic plan that builds on past efforts. Stable financing is critical, and a strategic plan must anticipate the evolution of drug and pesticide resistance. Meanwhile, investment is needed now to develop the tools of the future, including new drugs, public health pesticides (products that are safe, can touch skin, are noncarcinogenic, and so on), and vaccines.

Knowing the history of malaria eradication efforts merely keeps us from repeating past mistakes. A truly effective plan must be based on a combination of good medical intelligence and careful and quantitative logic.

Strategic planning for malaria control has one strong advantage over the efforts of the past—the information age has made it easier to assemble and analyze vast databases. The first global, evidence-based map of malaria, produced by the Malaria Atlas Project, provides a basis for large-scale malaria control planning and regional coordination.

Opposite: Women and children wait at a makeshift village health clinic in Madagascar. (AP Photo/Jerome Delay)

Mathematical models have been developed in conjunction with these maps to answer basic questions (Figure 1). What are the likely outcomes of scaling up malaria control? What coverage levels are required to achieve elimination and how long will it take to get rid of malaria?

Mathematical modeling is also playing a role in developing strategies to delay the evolution of drug or insecticide resistance by using combinations of drugs or pesticides, or by using multiple drugs or pesticide combinations in the same population. These strategies make it harder for resistance to evolve, because resistance must evolve to all the agents simultaneously in order to thrive. Other questions remain to be addressed, such as how different modes of malaria control can be used synergistically to make the tools last as long as they are needed.

Most of the countries that eliminated malaria during the first eradication program managed to keep it out. The take-away here is that an elimination strategy that works like a ratchet, forcing movement in one direction—eliminating malaria country by country—could shrink the malaria map in a sustainable way. Countries will find it easier to eliminate malaria if they import fewer cases from their neighbors, so regional coordination is essential.

Malaria control may not be a funding priority for some countries, however, so donors such as the United States should be ready to provide financial mechanisms, such as subsidies, to help countries cooperate. The endpoint of all this bioeconomic analysis must be a strategic plan that is solidly grounded in malaria epidemiology and economics.

The first steps in this next—and possibly final—malaria eradication campaign, however, will correct another big mistake of the past: Africa was overlooked the last time malaria eradication was attempted. This time, Africa is scaling up vector control and access to effective drugs following the spirit of the meeting in Abuja. As countries reach their goals, the theory supporting global eradication will have its first big test.

Now is the time to think ahead and to make the most of this big push. If these gains can be solidified and extended, then it might be possible to shrink the malaria map until the last parasite is gone. ■

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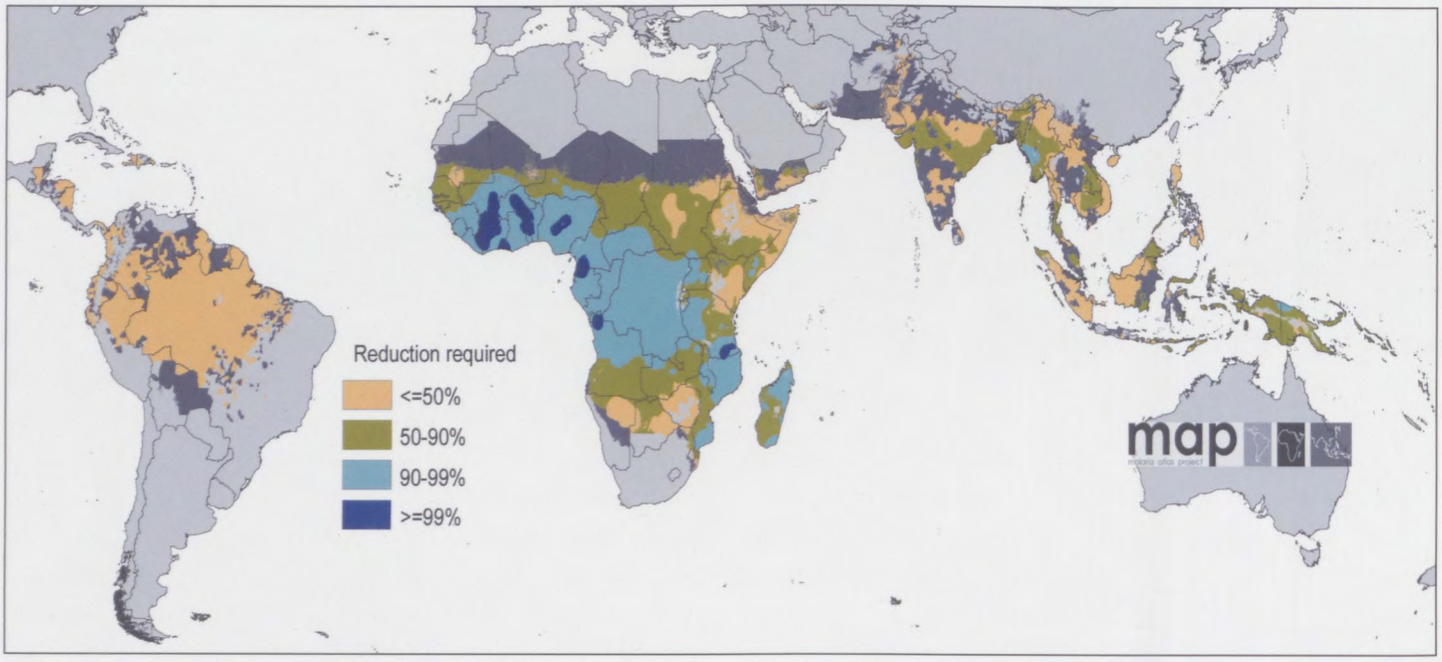

Figure 1: A key piece of information for strategic planning is the reduction in transmission intensity required to eliminate malaria, which is described by the number of new malaria cases per case. This map is based on a global map of malaria endemicity. It shows the proportional reduction in transmission intensity that would be required to interrupt transmission and serves as a basis for long-term regional coordination and planning. (Malaria Atlas Project)

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The Right Combination of Carrots and Sticks

ENCOURAGING SURVEILLANCE AND REPORTING OF EMERGING PANDEMICS

Ramanan Laxminarayan and Anup Malani

THE H1N1 "SWINE FLU" VIRUS OUTBREAK THIS YEAR HAS GENERATED a strong response from governments and public health agencies around the world. Travel advisories and restrictions have been put in place in many countries, and deaths have been reported from around the world. As of August 2009, 182,000 laboratory-confirmed cases of pandemic influenza H1N1 and 1,799 deaths, in 177 countries and territories, have been reported to the World Health Organization (WHO). Although H1N1 has proved to be less deadly than was initially feared, it is an example of prompt disease reporting by the country of origin, quick response by public health authorities and the media, and the rapid development of a potential vaccine.

Contrasting the H1N1 timeline of events with the story of Severe Acute Respiratory Syndrome (SARS) only a few years ago offers useful insights into how not to react to the threat of an epidemic. In November 2002, local authorities in China's Guangdong Province reported a cluster of atypical pneumonia cases to China's health ministry. In late February 2003, an infected man from Guangdong spent a night in a Hong Kong hotel, where he infected at least 16 other people, including a tourist from Toronto, a flight attendant from Singapore, and a businessman going to Vietnam. By May, SARS had infected 8,000 people in 32 countries. By June, when the contagion was brought under control, more than 800 people had died.

China failed to report the outbreak promptly and allow WHO experts to help contain it, but luckily, biology intervened. A pathogen that was more virulent and transmissible than either SARS or the recent H1N1 could have done far more damage. However, current strategies to contain a potentially deadly influenza pandemic similar to the one experienced in 1918 are contingent on recognition of human-to-human transmission within approximately three weeks

Mathematical models have been developed in conjunction with these maps to answer basic questions (Figure 1). What are the likely outcomes of scaling up malaria control? What coverage levels are required to achieve elimination and how long will it take to get rid of malaria?

Mathematical modeling is also playing a role in developing strategies to delay the evolution of drug or insecticide resistance by using combinations of drugs or pesticides, or by using multiple drugs or pesticide combinations in the same population. These strategies make it harder for resistance to evolve, because resistance must evolve to all the agents simultaneously in order to thrive. Other questions remain to be addressed, such as how different modes of malaria control can be used synergistically to make the tools last as long as they are needed.

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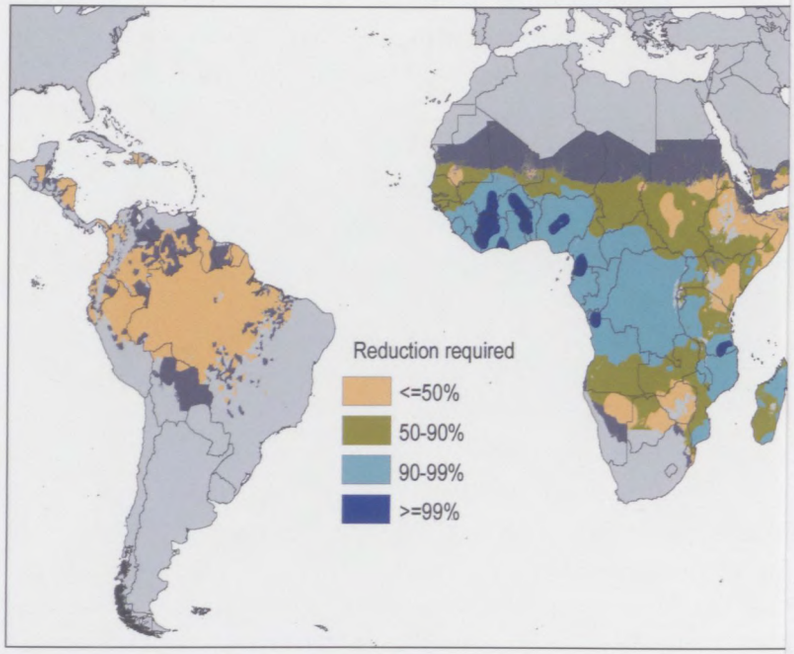

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The Right Combination of Carrots and Sticks

Encouraging Surveillance and Reporting of Emerging Pandemics

Ramanan Laxminarayan and Anup Malani

THE H1N1 "SWINE FLU" VIRUS OUTBREAK THIS YEAR HAS GENERATED a strong response from governments and public health agencies around the world. Travel advisories and restrictions have been put in place in many countries, and deaths have been reported from around the world. As of August 2009, 182,000 laboratory-confirmed cases of pandemic influenza H1N1 and 1,799 deaths, in 177 countries and territories, have been reported to the World Health Organization (WHO). Although H1N1 has proved to be less deadly than was initially feared, it is an example of prompt disease reporting by the country of origin, quick response by public health authorities and the media, and the rapid development of a potential vaccine.

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of the initial case. Next time, it may not be so easy to quickly get the genie back in the bottle. It is therefore vitally important to understand what factors motivate or discourage government reporting of disease outbreaks.

Incentives and Disincentives

WHO TRIES TO CONTAIN EPIDEMICS THROUGH RAPID VACCINATION AND QUARANTINE—AN APPROACH that presupposes early detection of an outbreak. Unfortunately, many countries, including Iran, Nigeria, Sudan, Tunisia, and Turkey, do not abide by the recently strengthened WHO International Health Regulations that require countries to promptly report disease outbreaks. Even signatories to the regulations may not be entirely forthcoming in reporting outbreaks or may play them down.

When a country uncovers evidence of an outbreak within its borders, it faces the decision whether or not to report it. By reporting an infectious disease outbreak, a country may obtain international medical assistance. But it also faces a disincentive to look for and report outbreaks: trading partners may impose trade and travel sanctions in hopes of stopping the disease at the border. These "reporting sanctions" can impose large economic costs on the reporting country.

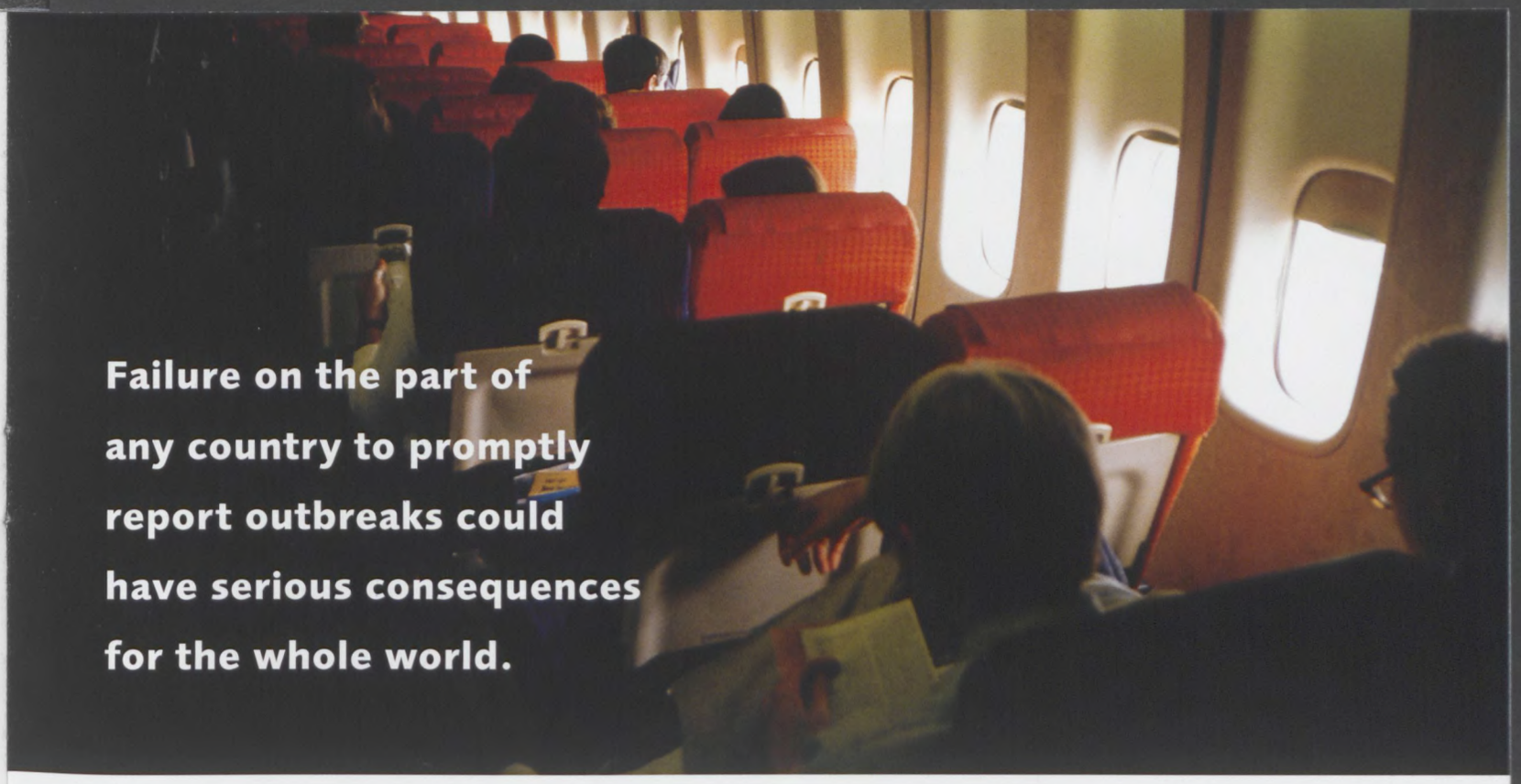
Incentives to report an outbreak, however, are only half the story. A country must first detect an outbreak and it can improve the probability of detection by investing in disease surveillance. The types of incentives a country faces with respect to the reporting of disease outbreaks will affect its decision on how much to allocate to surveillance. The greater the return for reporting an outbreak, the greater the return will be for detecting the outbreak in the first place.

In order to better understand the incentives for countries to report disease outbreaks, and how these incentives are influenced by factors such as the speed of transmission of the disease, the quality of surveillance data, and availability of vaccines, we built a game-theory model to capture those basic dynamics that are common to many other dilemmas. It applies to the case of a hospital deciding whether to report medical errors to public health authorities. Reporting may reduce patient demand or decrease insurance reimbursements, but facilitate efforts by the medical staff to reduce errors. Our work also applies to the decision of individuals to disclose a disability or mental illness. Disclosure may invite discrimination but it also facilitates accommodation.

We arrived at three conclusions. First, not all sanctions discourage reporting. If countries expect that a trading partner is not likely to reliably report an outbreak, they are likely to contract or limit their trade in expectation of an unreported outbreak—in other words, they impose a kind of preemptive sanction. With such a measure in place, sanctions in response to a positive report of an outbreak are likely to be less onerous and therefore less likely to discourage reporting.

Second, improving the quality of detection technology may not promote the disclosure of private information about an outbreak because more informative reports also trigger harsher sanctions. Third, an important source of information about disease outbreaks is rumors. WHO, in fact, actively monitors rumors, even though this so-called rumor surveillance is prone to error, especially false positives. We find that informal surveillance can be an important supplemental channel or backstop for detecting outbreaks. It serves as an independent public signal that is less likely to discourage disclosure than better technology. Informal surveillance can also correct false positives by pointing out that there was no outbreak to begin with.

Our findings shed light on why countries have failed to cooperate fully on surveillance and reporting, and also point the way toward better cooperation. More valuable medical assistance and perhaps financial transfers to offset the cost of reporting sanctions would be useful; limits on sanctions, especially sanctions based on fears of undetected outbreaks, are not. Public health organizations—WHO, the UN Food and Agriculture Organization, the U.S. Centers for Disease Control and Prevention—have called for improved diagnostic technologies, especially the sensitivity of tests, to identify and contain



Failure on the part of any country to promptly report outbreaks could have serious consequences for the whole world.

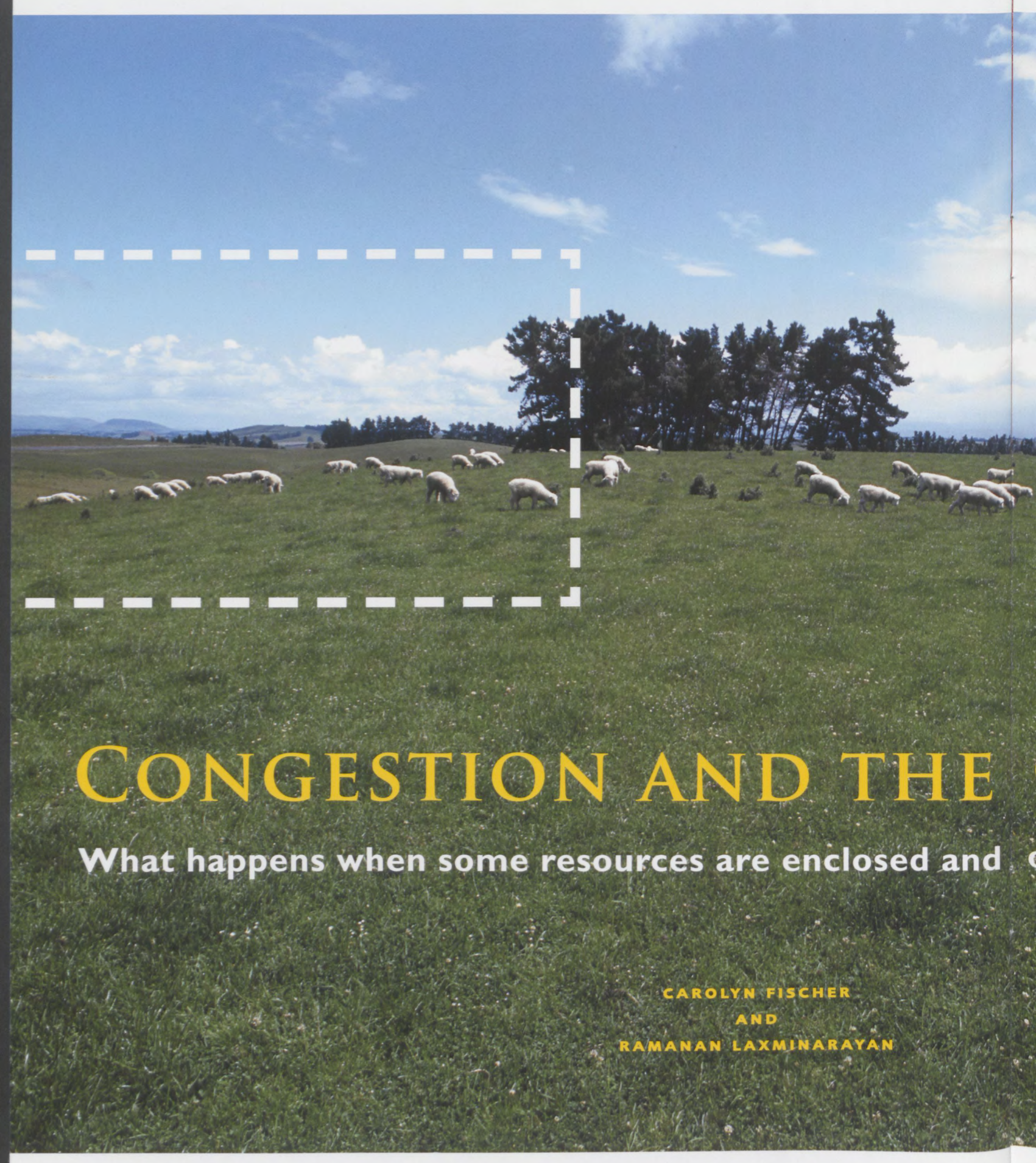
avian flu outbreaks. WHO's strategy of improving detection technology and using rumor surveillance has both pros and cons. More informative signals of disease outbreak are, naturally, more informative and helpful to the country in accessing international medical assistance. But more revealing signals can increase sanctions and reduce countries' incentives to look for and report outbreaks.

Sanctions and the Public Good

IN A SEPARATE PAPER, WE USED A BIOECONOMIC MODEL TO STUDY THE EFFECT OF INCENTIVES ON surveillance and reporting. Sanctions that are proportional to the size of the outbreak at the time of reporting could improve surveillance by rewarding timely reporting. Similarly, increasing the capacity for outbreak control either with domestic resources or with external assistance can encourage reporting because countries are more likely to invest in surveillance for diseases that they can control. However, when the capacity for outbreak control is high, countries are less likely to take preventive measures. Outbreak control capacity can create the risk of moral hazard in the same way that bailing out banks can encourage excessively risky lending. Finally, the speed of disease transmission can influence optimal surveillance investments. Countries are less likely to invest in surveillance for diseases that are likely to spread either rapidly or very slowly because there is less pay-off either way. Enhancing countries' capacity for outbreak control expands the range of transmission intensities over which countries will invest in surveillance.

To summarize, our work indicates that international institutions should take into account the incentives that countries have to look for and report disease outbreaks, notwithstanding legal obligations. As with other global public goods, failure on the part of any single country to act promptly could have serious consequences for the whole world. ■

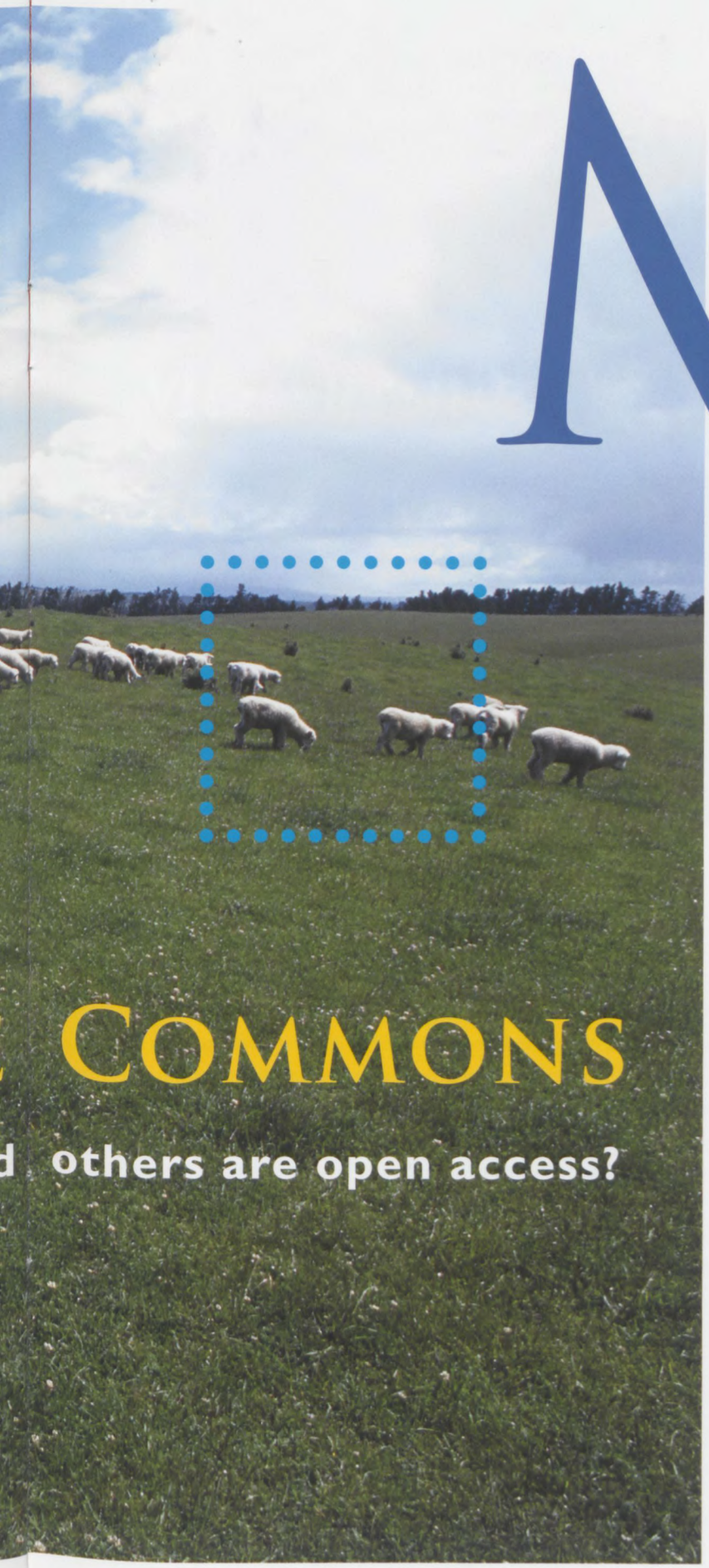
This article is based on Incentives for Surveillance and Reporting of Infectious Disease Outbreaks, by Anup Malani and Ramanan Laxminarayan (2009. Incentives for Surveillance of Infectious Disease Outbreaks. September 14. Available at SSRN: ▸ ssrn.com/abstract=1473481); and Surveillance and Reporting of Emerging Pathogens, by Ramanan Laxminarayan, Eili Klein, Anup Malani, and Alison Galvani (unpublished working paper).



CONGESTION AND THE

What happens when some resources are enclosed and

CAROLYN FISCHER
AND
RAMANAN LAXMINARAYAN



Commons

d others are open access?

Managing 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

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.

Mending Fences

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.

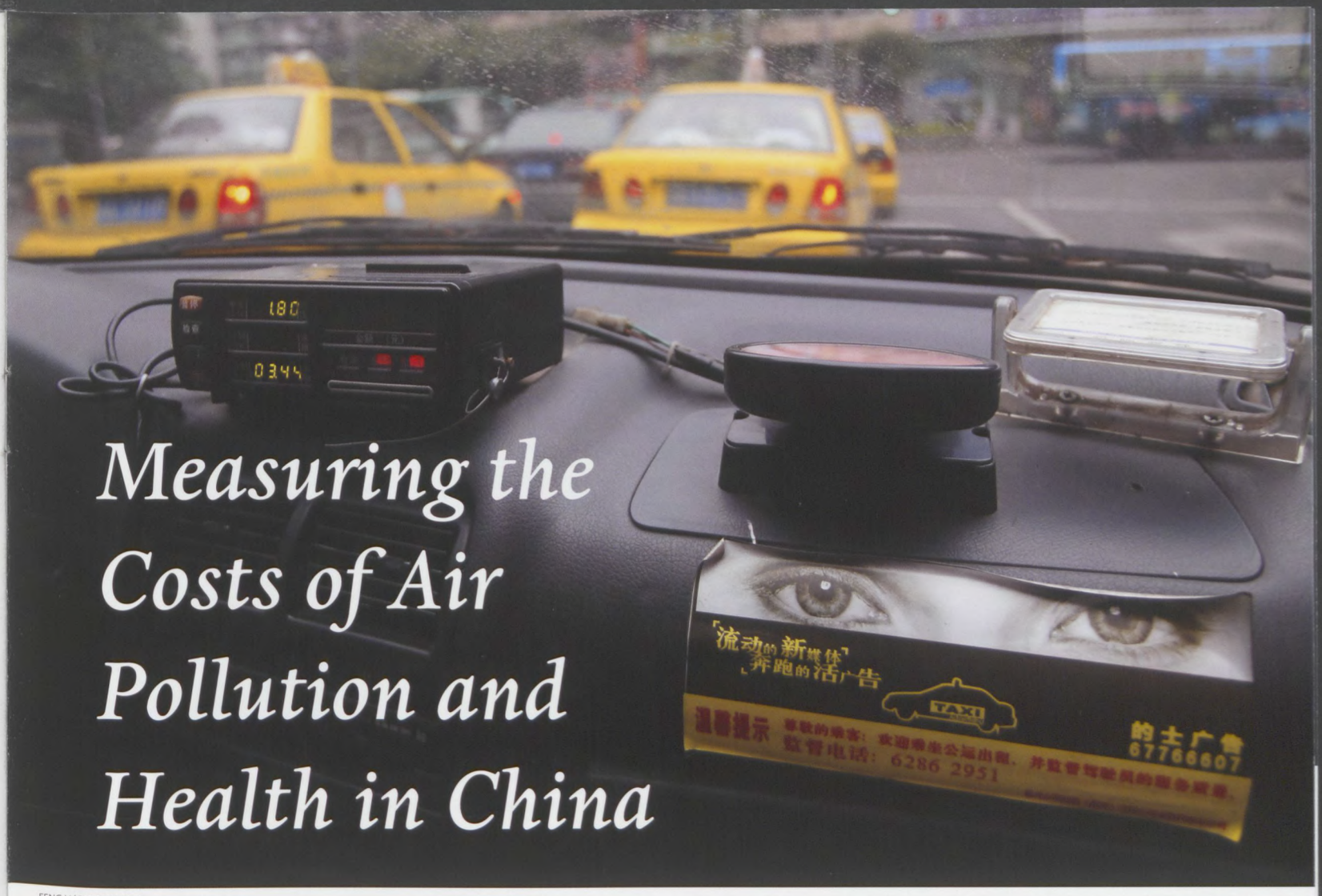
Without the spillovers from partial enclosure, we find that taxes and quotas can perform equally well for dealing with open-access problems under uncertainty. For example, if antibiotic prices are fixed, either by competition in global markets or simply by regulation, then extraction in one resource 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, forthcoming in the Journal of Environmental Economics and Management.

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.



Measuring the Costs of Air Pollution and Health in China

FENG LI/GETTY IMAGES

Maureen L. Cropper

China's rapid economic growth, accompanied by industrialization and rapid urbanization, has come at a high social cost: over 50 percent of China's urban population is exposed to annual average levels of particulate matter (PM) that are over four times the annual average levels in U.S. cities. Chronic exposure at these levels is likely to produce significant long-term health effects, including respiratory illness, heart disease, and premature mortality.

The findings from a recent study by the World Bank that involved researchers from China's State Environmental Protection Agency, the Chinese Academy for Environmental Planning, two Norwegian research institutes (CICERO and ECON), and RFF reveal the serious nature of the problem along with the potential benefits of reducing PM levels in China.

The study estimated that approximately 350,000 lives were lost due to air pollution in Chinese cities in 2003 and that air pollution resulted in over 250,000 new cases of chronic bronchitis. The value of lives lost was equivalent to 4 percent of China's GDP. Reducing air pollution levels to those experienced in the United States 20 years ago would save over 200,000 lives annually.

The purpose of the study was to apply international methods of estimating the health effects of air pollution to cities in China. Specifically, the study estimated premature deaths and cases of chronic bronchitis associated with PM levels in Chinese cities in 2003, compared to background levels. One reason for doing this was to establish a framework that could be used to make similar computations in future years. These could be used, for example, as an input to China's Green National Accounts—accounts that consider the negative externalities associated with production as well as the value of goods and services produced.

A second reason was to compute the benefits of reducing air pollution to lower levels, specifically to the World Health Organization's (WHO) interim annual average PM10 (particles 10 micrometers or less) standard for developing countries and to the Chinese Class I standard in 2003. (Please see the sidebar below for a more detailed description of the study process.)

The Social Costs of Pollution

The study findings showed that between 120,000 and 560,000 deaths in urban areas of China in 2003 were attributable to air pollution, with a mean estimate of 350,000 deaths. To put this number in domestic perspective, this is over twice the number of deaths from lung cancer in the United States in 2008. But the social costs of air pollution extend beyond mortality: between 240,000 and 300,000 new cases of chronic bronchitis were associated with 2003 air pollution levels, compared with background air pollution concentrations.

The Hard Findings from a World Bank Study on Air Pollution in China

In 2003, an international team of researchers from China, Norway, and the United States was formed with the intention of assessing current environmental damages from air and water pollution in China and developing the tools that would enable these damages to be calculated on a continuing basis, at both the national and provincial levels.

The study began by estimating the air pollution exposure of over 500 million people living in 660 Chinese cities in 2003. According to study estimates, 63 percent of the urban population was exposed to annual average PM10 greater than 100 μg/m³ (micrograms per cubic meter) and 13 percent to annual average PM10 greater than 150 μg/m³. (In contrast, in the United States in 2002, 90 percent of monitoring stations reported annual average PM10 levels below 35 μg/m³.)

The map below shows, by province, the number of people and the percent of the population exposed to annual average PM10 greater than 100 μg/m³. Provinces with the highest percent of the urban population exposed to PM are also the provinces with the highest ambient PM10 levels. PM levels are higher in the north of China (that is, north of the Yangtze River) than in the south, due to reliance on coal for home heating and also for meteorological and topographic reasons.

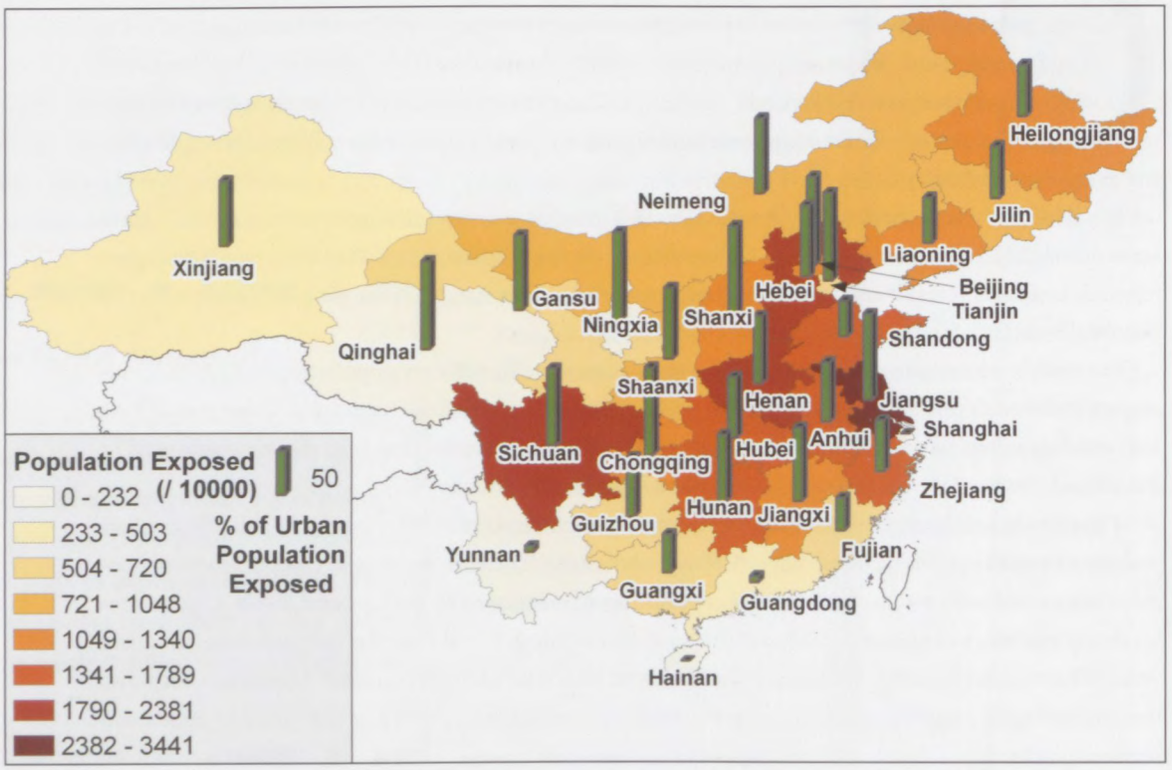


FIGURE 1.
Urban population exposed to annual average PM10 greater than 100 μg/m3 in 2003. (Courtesy World Bank/DECRG)

FENG LI/GETTY IMAGES

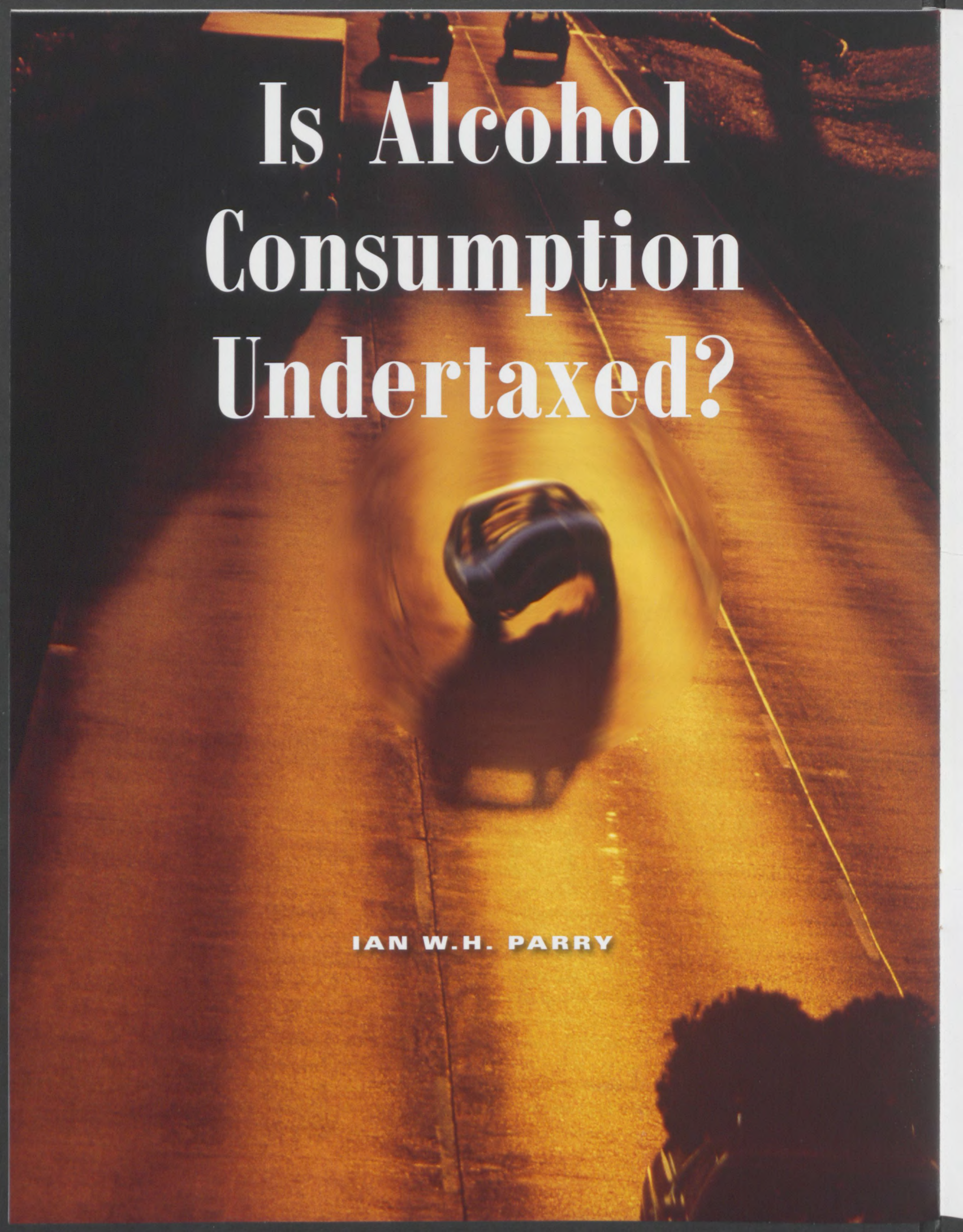
The study also computed the benefits of reducing 2003 pollution levels to lower levels—to 70 $\mu g/m^3$ (the WHO interim standard for developing countries) and to 40 $\mu g/m^3$ (the Chinese Class I standard in 2003). We estimate that reducing annual average PM_{10} to 70 $\mu g/m^3$ in all cities above that level would save about 100,000 lives and result in 140,000 fewer cases of chronic bronchitis annually. Reducing annual average PM_{10} to 40 $\mu g/m^3$ would save about 200,000 lives and result in 215,000 fewer cases of chronic bronchitis annually.

Comparing the benefits of pollution control to the costs requires "monetizing" the benefits (giving them a dollar value). In cost-benefit analyses of environmental programs conducted in the United States and the European Union, mortality risks are typically valued using the "value of a statistical life" (VSL)—the sum of what people would pay to reduce their risk of dying by small amounts that, together, add up to one life saved. Part of RFF's contribution to this study was to conduct original research to estimate what people in China would pay to reduce their risk of dying.

Studies conducted in Shanghai, Nanning, and Jiujiang estimated that the VSL in China is approximately 1.5 million yuan, or about $220,000 at current exchange rates. Using this number to value the 350,000 lives estimated to be lost due to air pollution suggests that this amounts to about 4 percent of GDP. Reducing air pollution levels to 70 $\mu g/m^3$ (the interim WHO standard), would yield benefits equivalent to 1 percent of GDP in terms of reduced premature mortality as well as yield benefits from reduced chronic bronchitis, as well as heart attacks and strokes, which we did not quantify.

Which pollution control measures should be adopted in China and where they should be adopted should depend in part on a comparison of costs and benefits. The contribution of this study was to estimate the health impacts of air pollution in China using a bottom-up analysis, which can be used to compute the benefits of pollution control measures at the city level, as well as produce national results.

There are significant social benefits to be gained from controlling PM in China. As the country moves forward in developing effective air quality policy, studies like ours can provide a means of benchmarking this progress. ■



Is Alcohol Consumption Undertaxed?

IAN W.H. PARRY

Due to the failure to increase nominal rates in line with inflation, federal and state alcohol taxes have fallen from about 22 percent of the pretax retail price of alcoholic beverages in 1980 to about 10 percent at present. Is it time to reverse this declining trend and substantially raise tax rates?

Alcohol taxation is warranted if its consumption causes broader societal costs that are not taken into account by individual drinkers. The main categories of such costs are medical treatments for alcohol-related illnesses, reduced workplace productivity, and accidents caused by drunk driving.

The costs of medical treatments for liver cirrhosis and other alcohol-induced problems are largely borne by third parties and not the drinkers themselves. Studies suggest that the annual medical burden from these patients is roughly equal to federal and state revenues from alcohol excise taxes (about $15 billion a year).

On the other hand, heavy drinkers tend to die younger, which lowers medical costs over their life cycle. Based on evidence that accounts for this, the appropriate tax to address medical burdens seems to be, at most, a few percent of pretax alcohol prices. Moderate consumption may also have health benefits, though whether this implies lower or higher life cycle medical costs is unclear, if moderate drinking increases life expectancy.

Alcohol abuse may also impair workplace productivity. Heavy drinkers themselves bear much of this cost in terms of less take-home pay, and should take this into account, but the government also bears a cost from forgone income and payroll tax revenues. However, disentangling the productivity impacts of alcohol consumption from other factors that affect productivity has proven difficult.

For example, for some people higher wages (which are a proxy for productivity) may be positively associated with alcohol consumption, if they drink more when they have more money. Based on available studies, the appropriate tax to reflect productivity impacts could be anywhere between zero and about 40 percent of pretax alcohol prices.

Drunk Driving

Alcohol-related crashes account for around 40 percent of the 40,000 or so people killed each year on U.S. highways. However, most of these fatalities occur in single-vehicle crashes where risks should be taken into account by individual drivers. Broader costs from accident risks that drunk drivers do not take into account include injury risks to other road users, third-party medical burdens for treating injuries, and property damages to automobiles. Accounting for these factors, the risks to society from drunk drivers appear to warrant an alcohol tax of about 30 percent of pretax prices.

A more direct response is to penalize drunk drivers themselves and devote more resources to their apprehension, rather than taxing all drinkers. According to our calculations, the average (14-mile) trip by a drunk driver should ideally be taxed at about $20. Unfortunately, however, only an estimated 1 in 1,500 trips by drunk drivers results in a police-reported accident and subsequent court conviction.

This low detection rate for intoxicated trips implies that, on average, the optimal fine for convicted drivers (that is, the fine that, when multiplied by the probability of actually paying it, results in an expected penalty of $20 per trip) would be about $30,000. This level of fine is well beyond the means of many people; in fact, the average fine per conviction is only about $300 at present. Moreover, a dramatic increase in the fine for a conviction would likely protract the judicial process, which already imposes significant costs in judges' time, for example.

Alternatively, the expected drunk-driver penalty could be increased by raising the likelihood of apprehension (through sobriety checkpoints and Breathalyzer testing, for example), although this involves significant policing costs. Netting out policing and judicial costs lowers the optimal fine by about 25 percent (implying an optimal expected penalty of about $15 per drunk-driver trip).

Convicted drunk drivers may also receive nonmonetary penalties like license suspensions and jail terms (or community service in lieu of jail). Averaged across first-time and repeat offenders, the typical license suspension is about 6 months and jail terms are about 10 days (or alternatively, about 40 days of community service). Still, when valued in monetary terms, these penalties imply an expected cost of only about $3 per drunk-driver trip. Moreover, unlike fines,

Unfortunately, only an estimated 1 in 1,500 trips by drunk drivers results in a police-reported accident and subsequent court conviction.

The practical difficulties of imposing stiff drunk-driver penalties, and the resource costs involved in implementing them, suggest that alcohol taxes still have a valuable role to play in deterring drunk driving.

nonmonetary penalties impose an extra cost on society because the loss of utility to the individual from the penalty is not offset by a corresponding gain in revenue to the government.

The practical difficulties of imposing stiff drunk-driver penalties, and the resource costs involved in implementing them, suggest that alcohol taxes still have a valuable role to play in deterring drunk driving. Based on the discussion so far, it seems that an alcohol tax of roughly three times the current level might be justified on economic efficiency grounds, and perhaps more if workplace productivity impacts are important.

Fiscal Considerations

Are even higher levels of taxation warranted on fiscal grounds? Leaving aside broader societal impacts, whether it is better to finance some of the government's budget through alcohol taxes depends on the economic costs of alcohol taxes compared with other policies, such as income taxes. Taxes on labor income cause economic costs by distorting the overall level of employment (for example, by reducing take-home pay they deter labor force participation, particularly for secondary workers in the family). Product taxes also cause economic costs by inducing people to consume less of the taxed product than they would otherwise prefer. They can also reduce (albeit slightly) labor supply by raising the general level of product prices and lowering the real returns to work effort.

Up to a point, product taxes are warranted on revenue-raising grounds when they have less impact on economywide employment than the employment effects of raising an equivalent amount of extra revenue from labor taxes. Our work suggests that alcohol is one of these cases. In fact, fiscal considerations may contribute as much to the optimal alcohol tax as drunk driving and other societal costs.

This assumes productive use of alcohol tax revenues, in particular, using them to reduce distortions created by income and payroll taxes. If instead revenues are wasted in pork-barrel spending projects, the fiscal argument for alcohol taxes is undermined. In short, the fiscal rationale for higher alcohol taxes really hinges on revenue-neutrality provisions requiring automatic and offsetting reductions in other taxes (or alternatively, spending on projects with favorable cost-benefit ratios).

Impacts of Higher Taxes

Summing up, the case for substantially higher alcohol taxes is nuanced as it depends on the continued failure to severely punish drunk drivers as well as the productive use of revenues. Suppose, for the sake of argument, that alcohol taxes were tripled? Ideally, the tax would be levied on alcohol content as this is what matters for the ability to drive and the broader societal costs of alcohol abuse. Current (federal and state) taxes amount to about $20 per gallon of alcohol for beer, $18 per gallon for wine, and $35 per gallon for spirits. This kind of increase would add roughly $1.20 to the price of both a six-pack of beer and a bottle of wine.

Empirical studies suggest that each 1 percent increase in price might reduce nationwide alcohol consumption and drunk driving by about 0.4 to 0.7 percent. This implies that tripling alcohol taxes from 10 to 30 percent would reduce consumption by about 8 to 15 percent. This would raise about $20 billion a year in extra government revenue and, according to our estimates, generate annual net economic benefits of at least $10 billion if the revenue displaces other distorting taxes. Even higher taxes might also be warranted if people misperceive the risks of alcohol addiction, though evidence on this is mixed. ■

Further Reading

Parry, Ian W.H., Ramanan Laxminarayan, and Sarah E. West. 2009. Fiscal and Externality Rationales for Alcohol Taxes. *B.E. Journal of Economic Analysis & Policy/Contributions*. 9. Article 29. 1-45. Related RFF Discussion Paper 06-51.

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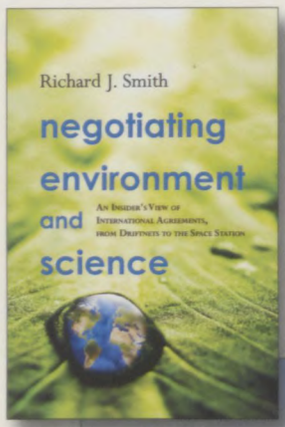

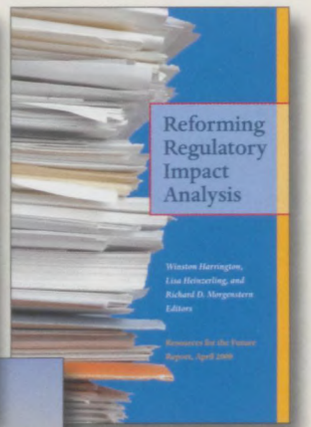

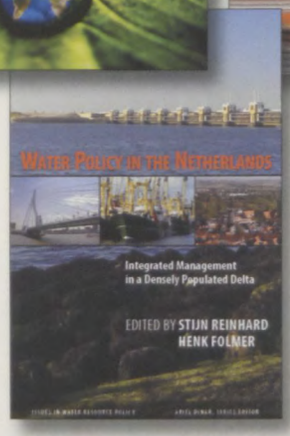

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