Resources for the Future

Fall 1990 No. 101

RESOURCES®

What do we know about energy security?

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Iraq's invasion of Kuwait and the resulting jump in petroleum prices have rekindled interest in energy security. Despite years of research, however, there is a disturbing lack of understanding of many basic issues concerning the workings of petroleum markets and the design of energy policies. Recognition of what we do and do not know about energy security may help avoid the policy mistakes of the past, and give new impetus to filling important gaps in our knowledge about the economic aspects of energy security.

Petroleum issues become highly politicized whenever there are disturbances in the oil market. Although equity is an important concern of public policy, when it comes to oil, visceral concerns about fairness emerge so strongly that they sometimes threaten to obscure how markets actually work and what can be done to change their outcomes without imposing large costs on the country as a whole.

Recent events in the Persian Gulf have resurrected many of the same myths and misunderstandings about energy security that have been around since the oil price shock of 1973. One poorly understood issue is the pricing of oil. Like the price of other commodities, the price of oil is governed by market forces that reflect changes in demand and supply. Thus price movements such as those observed after the Iraqi invasion of Kuwait are neither inexplicable nor inherently irresponsible.

Observed market prices for petroleum depend not just on production costs, which influence supply behavior, but also on willingness to pay on the part of petroleum demanders. A shortage in the market causes the price to rise so that less valuable uses of petroleum are curtailed, and substitutes are sought where possible. Just as important, the anticipation of future scarcity will cause an increase in current petroleum prices. Expectations of impending scarcity register in the market right away, as they did after the Iraqi invasion. If oil prices are expected to rise in the future, inventory holders will bid up current prices as they seek to acquire additional stocks in order to hedge against higher petroleum costs or to profit from the anticipated price increases. (U.S. petroleum product stocks were higher in September 1990 than the year before.) Such a market response serves a useful social function by transferring supplies from periods of lesser scarcity to those of greater scarcity, thus spreading the burden of expected scarcity over time. It is not simply "unwarranted speculation," as the Bush administration has alleged.

In an integrated world petroleum market, price adjustments will occur for

both crude oil and petroleum products without regard for national boundaries, import dependence, diversity of supply sources, or the size and historical cost of existing petroleum stocks. Even if a country has enough indigenous oil supplies or inventories to completely negate any shortfall of normal deliveries, current or expected scarcity elsewhere would cause petroleum prices in that country to rise immediately. Such price responses are frequently observed in grocery markets, where a crop freeze or a fad-induced surge in demand can raise prices overnight. And certainly no one expects all prices in residential housing markets to automatically equal historical acquisition costs. We should not expect price behavior in petroleum markets to be fundamentally different.

Although markets are fairly effective at allocating scarce petroleum resources, even in a crisis, there are often cries for government intervention when prices rise quickly, as they did at the onset of the recent troubles in the Persian Gulf. However, past experience shows that intervention in the market allocation of petroleum is risky and unwise, except perhaps in the gravest of national emergencies. This point is amply illustrated by the U.S. government's retention of price controls on domestic oil supplies after the 1973 price jump, which retarded adjustment to the increases in world prices. The point is even more starkly illustrated by the efforts to allocate oil supplies outside the market in 1979, which simply created shortages rather than avoiding them. These experiences provide convincing proof that government authorities do not have the information necessary to supplant market allocations without imposing enormous economic costs.

Another misconception is that world petroleum markets are governed exclusively by a powerful cartel of the Organization of Petroleum Exporting Countries (OPEC) or by international petroleum companies who engineer scarcity at will. While these markets are certainly not textbook examples of perfect competition, viewing them as driven by supplier manipulation is fundamentally inaccurate. Despite popular belief, the oil price shocks of the 1970s had little to do directly with drops in oil supplies; they resulted primarily from turmoil in the market, which caused rapid jumps in demand. While OPEC seems to have some control over petroleum markets (for example, oil prices fell more slowly in the early 1980s than one might have expected in a perfectly competitive market), the limits of OPEC market power are illustrated by OPEC's inability to sustain higher prices after the 1973 disruption or to reverse the 1986 collapse in oil prices.

The ability of international oil companies to control the market is even more limited. Diversification of crude supplies, nationalizations, and the entry of new companies—state-owned and private—have eliminated control of the market by a few large firms. Moreover, buyers and sellers have ready access to a large spot market in which individual cargoes of oil can be bought or sold anonymously, rather than being limited to trade with a few partners through long-term contracts. This spot market has further limited the market power of the major oil companies and OPEC.

Quickly rising oil prices bring cries for government intervention, but intervention in the market allocation of petroleum is almost always unwise.

Another point about which there seems to be confusion is the difference between dependence on oil imports and vulnerability to energy disturbances. Import dependence can impose long-term costs on the economy. These costs stem from the transfer of wealth abroad for oil purchases, whether or not petroleum markets are disrupted. In contrast, the costs of short-term petroleum market disturbances depend on the importance of energy in economic activity and the sensitivity of economic activity to relative changes in energy costs, not on imports per se. Hence it is not that useful to address market disturbances by attacking imports and seeking to expand long-term U.S. oil supplies, as the Bush administration has recently proposed. The differences in the costs of short-term petroleum market disturbances and the costs of long-term import dependence are illustrated by the sharp recession Great Britain experienced after the 1979 oil price shock, even though it was rapidly approaching oil self-sufficiency, while Japan experienced virtually no economic downturn in 1979 and has continued robust growth, even though it is totally dependent on petroleum imports.

A related misconception is that energy security problems associated with petroleum market disturbances are directly linked with the physical availability of oil supplies. While people still refer to the disturbances of the 1970s as embargoes, such events are impossible—the market widely shares any imbalance between demand and supply. Nor are petroleum market disturbances driven just by supply changes, as already noted. Above all, the economic consequences of oil price shocks depend on petroleum prices, not just physical availability. This point seems to be missed by the Bush administration in its insistence that use of the U.S. Strategic Petroleum Reserve (SPR) is unnecessary because no physical shortages are being detected. Significant shortages never will be detected in a well-functioning market, but price increases signaling increased resource scarcity can be. These price changes should be the focus of policy.

Finally, it is generally not recognized that energy security is an international problem that transcends any one country's supply situation or energy policy measures. Effective measures to countervail energy disturbances require at least some international cooperation. For example, the SPR's maximum current release rate of roughly three million barrels per day could easily be overwhelmed in the oil market by a worldwide surge of panic buying. Only a concerted effort to release stocks or curb surges in demand by other countries, notably the industrialized nations belonging to the International Energy Agency (IEA), could make a significant impact in this situation given the relatively small share of any country in world oil consumption (see table 1).

Gaps in knowledge

In spite of considerable research undertaken since the 1973 oil price shock, there are critical gaps in knowledge about

the behavior of the petroleum market and the costs and risks of disturbances in the market. Current ability to accurately project longer-term changes in petroleum supply and demand—especially OPEC behavior and technical change—is woefully limited. The same is true of current ability to understand or predict short-term responses during a crisis (particularly panic-driven inventory changes) and to gauge in advance the probabilities of oil market disturbances of various magnitudes and duration. These points are illustrated by the surprise that greeted the marked decline in the ratio of energy use to GNP after the price increases of the 1970s and the abrupt decline of petroleum prices in 1986.

The costs of both long-term oil import dependence and short-term energy price disturbances are also unclear. For example, increased petroleum imports by a large buyer like the United States may increase the cost of all petroleum imports due to a bidding-up of world petroleum prices. However, there is considerable disagreement about the magnitude of such a cost. Still more disagreement surrounds other possible social costs associated with expanded petroleum imports—costs that result from the effects of oil imports on inflation, the trade balance, and vulnerability to future shocks.

Regarding short-term energy price disturbances, it has long been an article of faith among most energy security analysts that such shocks cause considerable economic losses through unemployment, lowered productivity, and reduced capital formation. Some macroeconomists have disputed this view, however. In a recent study, Douglas R. Bohi of Resources for the Future finds that the evidence does not support a strong connection between energy prices and the macroeconomic performance of several industrial countries. He concludes that misdirected macroeconomic stabilization policies may be the real culprit behind the poor macroeconomic performance many countries suffered after the oil price disturbances of the 1970s. Thus it seems clear that analysts can no longer uncritically postulate large macroeconomic losses from energy price disturbances.

Uncertainties about petroleum market behavior and the costs and risks of disruptions make consensus on the resolution of policy issues difficult.

As a consequence of the uncertainties concerning long-term changes in petroleum supply and demand, short-term responses during a crisis, and the probability of oil market disturbances, as well as the costs of long-term oil import dependence and short-term energy price disturbances, there is no analytical consensus to support the resolution of key policy issues. In the United States, such issues include the size of the Strategic Petroleum Reserve and the timing and pace of its use, the structure of energy taxation, and the long-term support of research and development.

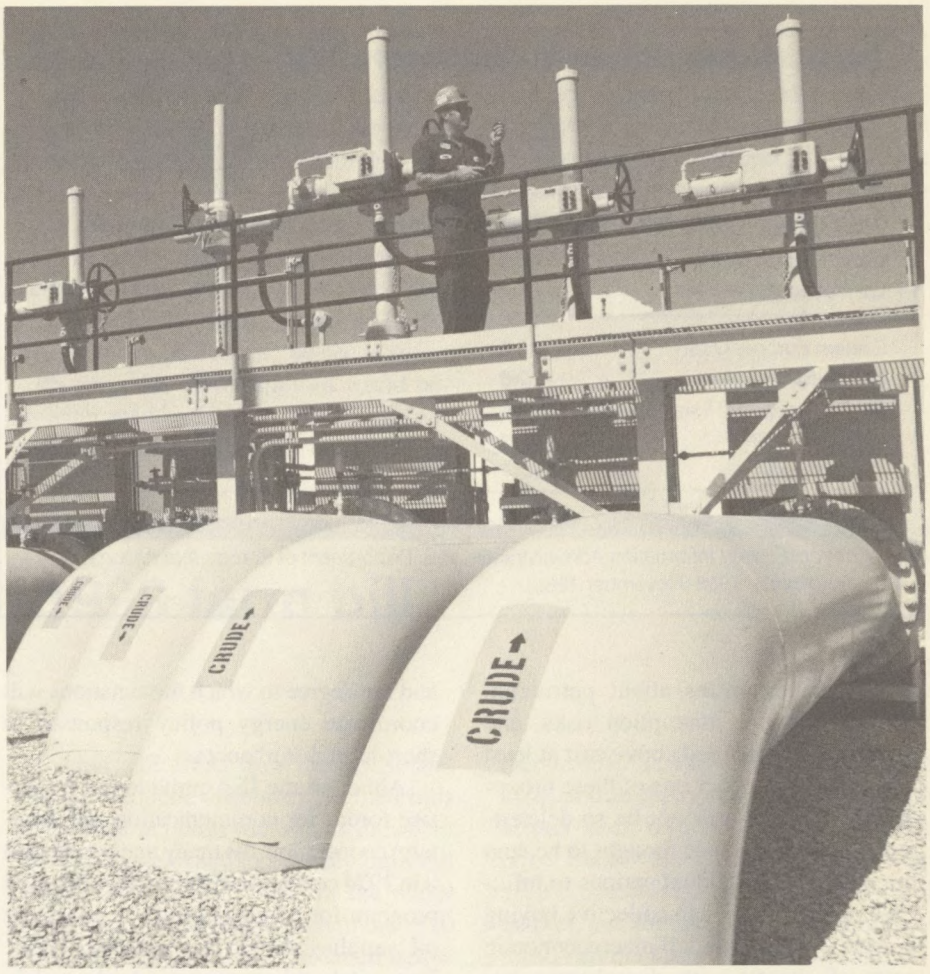

Photo courtesy of the U.S. Department of Energy

The Strategic Petroleum Reserve could provide over three million barrels of oil daily; surprisingly little is known about when and how to use it.

Recommending a bundle of security policies for petroleum markets used to be fairly easy. The standard view was that petroleum imports should be lowered significantly through a sizable tariff—except in a crisis—to lower world oil prices and lessen the economy's exposure to future crises. The only concern about the size of the SPR was that the target size of 750 million barrels was too low given the usefulness of stocks for ameliorating disruption costs. In addition, it was thought that stocks generally should be used early and aggressively in a crisis to forestall panic buying, a spiraling macroeconomic problem, and a ratcheting of oil prices to a new plateau. It was also thought that long-term research and development policy should make a concerted effort to develop conservation methods and to find other supply options, even if these options were not currently cost-effective. The belief was that they probably would be in the future.

Table 1. Regional Petroleum Consumption, 1987

Region	Amount (million barrels/day)	Percentage of total
United States	16.7	26.6
Other North America	3.0	4.8
Central/South America	3.6	5.7
Western Europe	12.6	20.1
Eastern Europe/ USSR	10.8	17.2
Middle East	2.8	4.4
Africa	1.8	2.9
Far East/ Oceania	11.4	18.2
World total	62.7	100.0[a]

[a]This figure has been rounded off.

Source: Energy Information Administration, U.S. Department of Energy, *International Energy Annual 1988* (November 1989).

The uncertainties about petroleum market behavior, disruption risks, and disruption costs noted above cast at least some doubt on every one of these propositions. Imports may not be so deleterious as they were once thought to be, and the ability of individual nations to influence oil prices through collective buying power may be limited. If macroeconomic costs of energy price disturbances are less serious than had been thought, then the argument for reaching a strategic petroleum reserve of 750 million barrels—let alone increasing it—is weakened. The increased liquidity of the oil market and the growth of spot trading also weaken the case for rapidly draining the reserve in a crisis, since there is less cause for panic—that is, sources of supply will be available for those willing to pay the price. Moreover, the fact that oil prices are not on an inexorable climb, as demonstrated by the 1986 collapse in oil prices, means that the market will not inherently forgive mistakes in estimating the cost and performance of new energy supplies or conservation methods. This complicates the job of picking winners in energy research and development policy.

As noted above, any effective energy security policy actions will require some international cooperation. Despite the existence of the International Energy Agency, there is profound uncertainty about the potential responses of other industrialized nations to changing oil market conditions and the degree to which these nations will coordinate energy policy responses to short-term disturbances.

Although the IEA provides an important forum for communication and long-term cooperation, the treaty that established it in 1974 contains an extremely misguided program for bureaucratically reallocating oil supplies during a short-term crisis. Fortunately this program is fairly widely perceived as counterproductive and probably will not be exercised. However, there are only limited measures for effective cooperation in its place. There are understandings among the United States, Japan, and West Germany for coordinating the use of strategic oil stocks in a crisis, but the strength or scope of these understandings is unclear. The official IEA position continues to be that countries may pledge to pursue a variety of different responses to a disturbance, including restraints on oil demand, as well as the use of stocks. Yet little has been done—at least publicly—to create a sense of mutual assurance that concerted and productive policy actions will be undertaken. Even if such assurances did exist among governments, their practical effects would be muted if the private sector did not believe them.

As long as the economic dimensions of the market disturbance arising from the invasion of Kuwait remain limited, policy responses should be restrained.

The degree to which developing countries might be expected to cooperate on long-term oil market issues is even more uncertain. While the current share of total world energy used by these countries is fairly small, this share is likely to grow significantly in the future. Thus cooperation on long-term energy policies that includes the developing countries may be of substantial value. However, such cooperation now appears elusive, particularly in light of disagreement over what common interests need to be addressed.

Policy options

The uncertainties described above highlight the need for economic policies that may provide benefits under a wide variety of circumstances and that avoid doing significant harm. In the context of the market disturbance arising from the Iraqi invasion of Kuwait, it is important to allow market adjustments without bureaucratic intervention and not to overreact as long as the economic dimensions of the disturbance remain limited.

As of mid-September, oil prices had risen considerably from their pre-crisis levels and the U.S. economy was showing some signs of weakening. However, there was no outbreak of panic petroleum buying, and other oil producers appeared ready to offset part of the drop in supply that occurred after the invasion of Kuwait. Moreover, the macroeconomic indicators were disconcerting but not yet disastrous.

Under these circumstances the best policy response may be to undertake some accommodation in macroeconomic policies while otherwise awaiting developments. The Strategic Petroleum Reserve could be used in an effort to offset part of any macroeconomic costs from the oil price increases, particularly if macroeconomic policies are hostage to the federal budget crisis. But using the SPR at this juncture may be of limited value. Any psychological advantage from its

use probably was lost after the first few days following the invasion; the SPR's effect in lowering oil prices now would be limited, particularly in the absence of international cooperation. Any price effects from the five-million-barrel total sale of oil from the SPR, announced by President Bush in September, will be especially modest, since this quantity represents less than one-third of U.S. oil consumption each day. The only significant value from the sale will be in assessing how the drawdown system works. To have a significant effect on oil prices, a much higher drawdown rate probably would be needed. This might be imprudent given the limited current dimensions of the crisis and the risk of the crisis worsening if tensions grow further in the Persian Gulf.

In the future a different set of policies may be needed. But this point only underscores perhaps the most important lesson for energy policy imparted by the latest Persian Gulf crisis: the need to cope with pervasive uncertainty in world petroleum markets. In the face of this uncertainty, the difficulties of designing energy policies are only compounded by the continuing lack of knowledge about how petroleum markets operate and about the potential benefits or costs of different energy security measures. Despite the large volume of research on energy security since the early 1970s, much remains to be done. ■

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Prospects for the 1990 farm bill

Kristen Allen

As Congress prepares to pass the 1990 farm bill, it will attempt to address a number of issues of interest to those outside the agricultural community as well as those within it. Among the issues are the equity of the current distribution of farm program payments, the effect of agricultural practices on the environment, and the enhancement of food safety. Given the present budget crisis, cost may be the ultimate determinant of whether various agricultural programs and policies are terminated, initiated, or reformed.

Every four or five years the U.S. Congress writes legislation that has come to be known as the farm bill. Typically, farm bills cover the price and income support programs for certain commodities; conservation programs; agricultural trade and aid programs; domestic food distribution programs, including food stamps; some credit programs; some marketing programs for fruits, nuts, and vegetables; some forestry programs; and agricultural research. The House of Representatives and the Senate have each passed their own version of a new farm bill to replace the last one, the Food Security Act of 1985, which expires at the end of 1990. While these proposed bills have similar overall goals and approaches, they diverge in many details. One of many factors that will affect how the House and Senate reconcile differences in their bills is the federal budget deficit, as President Bush has threatened to veto any farm bill that is over budget. Some of the major issues involved in preparation of the 1990 farm bill legislation are presented below in question-and-answer format.

Will the 1990 legislation continue to pursue the goal of making U.S. grains and cotton more competitive while protecting farm income?

The new bill will follow a path similar to that set by the Food Security Act of 1985 (FSA) for keeping U.S. agricultural commodities competitive and for protecting farm income; however, some subtle but important moves away from the strong market orientation of the 1985 act have been proposed. One such move is the Senate's proposal to establish minimum floor prices for wheat and feed grains (corn, oats, barley, and sorghum). The Bush administration has criticized this proposal as being a move away from competitive, market-driven safety nets.

Congress has also proposed extending marketing loans, currently used only for rice and cotton, to other grains and oilseeds. Marketing loans allow producers who receive a price-support loan from the government to sell their crop at the market price (rather than default on the loan) and to repay the government loan at that price if it falls below the floor price. Such loans could potentially help keep U.S. grains competitive on the world market, but are opposed by the administration on the basis of potential cost.

Guaranteed prices, or target prices, for grains and cotton will likely be kept at or near current levels at least in the early years covered by the new farm legislation, unless they are forced down by a budget agreement. Guaranteed prices are the prices used to determine direct, or deficiency, payments by the government to farmers. These payments affect farm incomes but not do not directly affect the prices paid by consumers for agricultural commodities.

To encourage foreign buyers to purchase U.S. agricultural commodities and to counter export subsidies used by other countries, the U.S. Export Enhancement Program (EEP) has offered commodity bonuses to American exporters; several export credit and promotion programs have also been authorized. Given the EEP's considerable support in Congress and in the U.S. Department of Agriculture (USDA), it seems certain that the EEP will be retained in the 1990 farm legislation, and may possibly be expanded to cover exports of higher-valued products such as processed foods.

How much farm production flexibility does the new legislation incorporate?

Many aspects of the agricultural subsidy programs have been criticized for being unnecessarily rigid and for imposing penalties on farmers who attempt to alter their plantings to respond to market signals or who experiment with alternative crop management practices. Removing some of these rigidities and disincentives would allow producers to make changes in their production patterns in response to market conditions, and to establish crop rotation practices that might yield environmental benefits by reducing the need for chemical applications to protect crops or to boost yields.

Subsidies are based on a farm's planting record, or base acreage, which is established over several years of specific crop plantings. Farmers who switch to alternative crops lose some base acreage and hence some subsidies. In the context of the 1990 agricultural legislation, flexibility has come to mean allowing producers more latitude in their planting decisions without losing base acres in later years.

Both the House and Senate bills have proposed allowing producers to shift up to 25 percent of their base acreage (the House included oilseed acreage) into other crops, including experimental and industrial crops, without losing any acreage base in future years. The USDA has proposed allowing much greater flexibility; 100 percent of a producer's base plus oilseed acreage could be shifted to other crops. Under all three proposals, farmers who took advantage of the flexibility provisions would forgo deficiency payments on the acreage planted with alternative crops.

With the threat of serious spending cuts, a compromise option has resurfaced. Known as the "triple base," this plan has been discussed as a means of adding flexibility to the programs while yielding budgetary savings. Under the triple base, producers would receive full program benefits (price supports and deficiency payments) for the production from a portion of their base, would comply with any acreage reduction (land idling) requirements, and would be free to use the "third base"—the remaining portion of their base acreage—for any crop or other approved use, such as pasture or hay production. The respective portions of the base could vary from year to year, but farmers would not lose base acreage and would continue to receive program payments on some portion of their production each year.

What is the new legislation likely to cost? Will agriculture contribute to the deficit reduction efforts?

The estimated cost of the commodity programs in both the Senate and House bills is between $55 billion and $57 billion over the next five years, compared with about $80 billion over five years under the Food Security Act of 1985. More relevant, however, is the estimated cost of the new bills as compared with the baseline cost under current law—that is, what it would cost simply to extend the FSA for another five years. Such estimates vary among sources. By congressional estimates the House bill would cost between $3.5 billion and $4.6 billion more than the baseline, and the Senate bill between $2.2 billion and $3.3 billion more. By USDA estimates the bills would result in outlays of $5 billion to $6.5 billion above the baseline over five years. The differences in the cost estimates arise because of different assumptions about the expected conditions in the agricultural sector over the next five years, and because of differences in what is included in the baseline cost.

Further, spending on agricultural programs may have to be reduced to well below the baseline levels. The United States is facing a severe budget deficit at a time when the size of future demands on government spending, such as the bailout of savings and loans institutions, are uncertain and potentially very large. Congress is now working on a five-year, $500 billion deficit reduction package. Although the details are still sketchy, it seems that the agricultural programs will be cut from the baseline level by about $1 billion in 1991 and by about $13.6 billion over five years. Spending cuts of this magnitude could mean quite significant changes in agricultural programs.

Do the richest farmers get the lion's share of farm program payments? If so, will the new farm bill change the way these payments are distributed?

The program payments that have generated the most controversy are the so-called deficiency payments, which would be the main target of budget cuts. These are direct payments from the government to farmers and farmland owners—payments that make up the difference between the guaranteed commodity prices and the price received when the commodities are sold or turned over to the government in lieu of loan repayment. Farmers and farmland owners can receive deficiency payments for only a few commodities—wheat, cotton, rice, and feedgrains.

To be eligible to receive deficiency payments, a producer must comply with land idling requirements—that is, take a portion of farmland out of production. The percentage of a farm's base acreage to be idled may vary each year. As deficiency payments are based indirectly on the number of acres in a producer's base, the larger the base is, the larger the payment.

According to a recent study, in 1988 the USDA paid $14.5 billion in direct payments, of which farm operators received an estimated $9 billion. Based on data from the USDA Farm Costs and Returns Survey, James D. Shaffer of Michigan State University has inferred that about one-third of all direct payments go to landowners who are not primarily farm operators and about whom few economic characteristics are known. Shaffer has also noted that only about 36 percent of the farms included in the survey received any direct payments, and that those payments were generally made to farms with higher average farm incomes. For example, the 3.6 percent of the farms with the highest average payments had average net cash farm incomes exceeding $96,000 and received average payments from the government of $61,623. Payments to this 3.6 percent of farm operators accounted for almost 43 percent of the total amount of direct payments disbursed (see table 1). Sixty-four percent of farms received no direct payments in 1988.

Statistics such as these, together with periodic media exposés of wealthy individuals who have been the recipients of large government payments under farm programs, raise several questions important to the issue of targeting payments. Are the recipients of payments farmers, or are they landowners who rent their land to farmers and who may have other sources of income? Among those who are farmers, how many are wealthier than the average taxpayer who foots the bill for these direct payments? These questions prompted amendments to the House and Senate bills that would impose an income limit on individuals eligible to receive payments. These amendments failed to pass Congress.

One reason the targeting amendments failed was that many members of congressional agricultural committees believe that the commodity programs have other goals in addition to that of maintaining or bolstering farm incomes. These members are particularly concerned that targeting direct payments to smaller producers might cause larger producers to drop out of the programs. Nonparticipation by larger farmers, who are responsible for most of the nation's agricultural production, could undermine the government's ability to ensure a stable food supply and stable food prices and to realize many of the environmental benefits now linked to program participation. Perhaps the greatest opposition to targeting payments, although not necessarily voiced, comes from farm and commodity interest groups, which now consider direct payments to be entitlements that are not subject to conditions (such as capping and phasing out) that are imposed on many other federal payments. Despite this opposition and other concerns, the issue of targeting farm subsidies may arise again, especially if the cost of commodity programs is not reduced and the public perceives that mainly relatively wealthy individuals are benefiting from direct payments.

Table 1. Distribution of Direct U.S. Government Payments to Farm Operators in 1988

Percentage of farms receiving payments	Average payments to farm operators ranked by level of direct payments[a]	Share of total direct payments (percentage)	Average net cash farm income (thousands of dollars)	Average net worth per farm (thousands of dollars)
3.6	$61,623	2.9	96	804
3.6	28,034	19.8	41	514
3.6	17,831	12.5	34	383
3.6	12,584	8.9	25	380
3.6	8,932	6.3	19	316
3.6	6,112	4.0	21	320
3.6	4,014	2.9	12	233
3.6	2,331	1.7	11	244
3.6	1,230	0.9	6	218
3.6	432	0.3	7	222
64.0	none	none	12	283
All	14,257	100.0	27	362

Note: Data are from the USDA Farm Cost and Returns Survey of more than 13,000 farm operators. The definition of a farm in this survey excludes some units that would be included under the census definition of a farm.

Source: James Duncan Shaffer and Gerald W. Whittaker, "The Distribution of Direct Payments to Farm Operators in 1987 and 1988: Some Questions About Policy Objectives," Discussion Paper FAP90-08, National Center for Food and Agricultural Policy, Resources for the Future, May 1990.

[a] Direct payments include deficiency, conservation reserve, and disaster payments.

Will the 1990 legislation offer new solutions to or exacerbate the environmental problems associated with agricultural practices and policies?

Agriculture's perceived detrimental effects on the environment arise in part from the use of agricultural chemicals, which can contaminate water, and from the cultivation of fragile lands and wetlands. In addition, some cultivation practices cause or accelerate soil loss, and the use of land for agricultural production can eliminate some wildlife habitat. The farm bills passed by both houses of Congress address these concerns by proposing incentive (and disincentive) programs aimed at promoting more environmentally benign agricultural production; requirements for pesticide record-keeping, laboratory certification, and product quality standards; research on low-input agricultural systems and sustainable agriculture; and bans on exports of pesticides not registered for use in the United States, on imports of foods that do not meet U.S. pesticide residue tolerance standards, and on USDA funding for herbicide-resistant plants.

The proposed incentive programs would encourage conservation and farming practices that are less damaging to the environment. Several are aimed at protecting water quality in particular. Proposed incentives include direct payments and government sharing of costs for practices such as the planting of tree and cover crops and land restoration. Incentives would also be provided by protecting base acreages and yields and, in some circumstances, by continuing deficiency payments when the cropland base is put into a conserving use such as pasture or cover crops. Conversely, the loss of some program benefits has been proposed as a disincentive to producers to engage in practices that are damaging to the environment.

It seems certain that the 1990 farm legislation will continue the long-term land retirement program, the Conservation Reserve Program (CRP), as a means of protecting highly erodible land from damage due to annual cultivation. The current enrollment of 36 million acres is expected to be increased by an additional 4.4 million acres. The program may be

Photo courtesy of the U.S. Fish and Wildlife Service

The Conservation Reserve Program may be extended to include wetlands and other lands on which crop production could pose an environmental threat.

expanded to include the protection of water quality, as well as the preservation of wetlands, windbreaks, shelterbelts, filterstrips, and other lands on which crop production could pose an environmental threat.

One criticism leveled at agricultural programs is that they provide an incentive for overproduction by guaranteeing prices well above market levels (the target prices). As a consequence, the programs encourage farming on fragile lands unsuitable for intensive crop production. They may also encourage the excessive use of agricultural chemicals. This criticism is not addressed explicitly in the proposed farm bills. Target prices are frozen at the 1990 nominal levels, however, and payment yields (the amount of production from an acre of land that is eligible to receive the guaranteed price) will likely remain frozen at 1990 levels as well. Together, these provisions mean that as actual yields continue to increase and inflation pushes the general price level higher, the incentive to overproduce will diminish. Nevertheless, environmental interest groups may look for other chances to write stronger environmental legislation. Of importance for the agricultural community, some of these chances will likely come outside of congressional agricultural committees, in other congressional committees, in the regulatory practices of the Environmental Protection Agency and the Food and Drug Administration, and, increasingly, in state governments.

Even though farm incomes have been protected under the Food Security Act, reports suggest that many rural areas still are not thriving. Are there any provisions in the 1990 legislation that address the problems of rural America, as distinct from American agriculture?

Views differ on whether rural development properly belongs in agricultural legislation. Historically, the terms "agricultural" and "rural" have been considered to mean the same thing. Even though most agricultural production still occurs in rural areas, it is no longer accurate to equate the two. The entire population of the nation's agricultural-dependent counties (those counties in which 20 percent or more of the labor force is in agriculture) is less than 7 percent of the total non-metropolitan population. The total farming population is less than 8 percent of the non-metropolitan population. Nevertheless, rural development issues often are used to justify commodity programs and are addressed explicitly in agricultural legislation.

The health of rural communities is often cited as a reason for continued or increased support for agricultural commodities, drawing on the assumption that higher prices for, or transfers to the producers of, certain agricultural commodities will trickle down and vitalize rural towns. There has been little systematic assessment of the effects of these programs on rural communities, but in the absence of clear evidence of what does help rural economies, it is likely that the agricultural commodity programs will continue to be promoted for what is viewed as their contribution to rural development.

The rural development provisions of the bills passed by the House and the Senate cover investment in rural areas, credit, public works, development of human resources, health care facilities, technical assistance, and information systems. These issues are crucial to rural communities; the decline in non-farm job opportunities, health care, education, and the availability of essential services have contributed substantially to the poor economic showing of rural communities over the last decade. However, rural development issues should probably be addressed in a legislative setting other than the congressional agricultural committees, where any rural development programs must compete for funds with the programs favored by politically powerful commodity interests.

Is there anything in the proposed farm legislation that is aimed at relieving hunger and poverty in the United States?

Despite the commonly used term "farm bill," U.S. agricultural legislation does contain provisions for domestic (and foreign) food assistance through food stamps and commodity donations, as well as for a variety of other hunger- and nutrition-related programs. In fact, as the cost of commodity programs has declined and the number of people receiving food program benefits has increased, the cost of federal food programs has exceeded that of commodity programs in recent years. Food programs will most likely be continued in the new legislation, and some small increases in funding and system improvements have been proposed. Among the changes recommended for the food stamp program are increases in

the limit on income deductions for shelter and in the allowed value of cars owned by recipients; redefinition of what is meant by a household; changes in provisions for homeless people; and changes in the method of benefit disbursement. In addition, a number of provisions are aimed at strengthening the integrity of the food stamp program—that is, at getting tough on those people who abuse the program.

The House proposes to make the Temporary Emergency Food Assistance Program (TEFAP) permanent and to require the secretary of agriculture to make available to emergency feeding organizations the surplus commodities not required for other programs. However, there are two related threats to the food assistance programs. One is the federal budget deficit. Without a vocal, politically powerful constituency, these programs may well be among the first to take cuts in the effort to reduce the deficit. The other threat is that one of the needs that the programs addressed has been reduced. When the government was acquiring and storing large quantities of surplus commodities—especially dairy products—food assistance programs were a convenient means for getting the products out of storage. However, since surplus stocks have been drawn down over the last five years, it may be difficult for the government to continue food donation programs if doing so means purchasing more commodities on the open market.

Consumers rank food safety as a high priority. How does the proposed legislation address this concern?

Much of the food safety focus in the House and Senate bills seems to be on broadening knowledge about pesticide use in food production and food processing. The bills call for such measures as record-keeping by people using pesticides for agricultural use, worldwide notification of changes in the registration status of pesticides, reports on and notification of pesticide use in other countries and the use of pesticides on foods imported into the United States, certification of laboratories that perform residue tests, and certification and labeling of organically produced agricultural products.

The prohibition of exports of pesticides not registered in the United States is an attempt to break what has become known as the circle of poison, wherein pesticides not permitted for food use in the United States are exported to other countries, where they are used on food crops. Some of these crops are then imported for consumption in the United States.

One proposed study, which could have implications for food quality and food safety in the long term, would examine the effect that USDA grade standards have on the production of perishable food commodities. In particular, this study would be aimed at ascertaining whether the standards encourage farmers to use chemicals on commodities purely to produce a product that meets some appearance standard, rather than to protect against yield losses or to improve nutritional quality.

Are the GATT negotiations and the U.S. farm bill on the same track?

At the launching of the Uruguay Round of negotiations under the General Agreement on Tariffs and Trade (GATT) in September 1986, the United States (supported by a number of other countries) broke new ground with its bold proposal to eliminate all agricultural subsidies within ten years of the end of the round. In the intervening years the goal has become the more pragmatic one of progressive and substantial reduction in trade-distorting subsidies over time. The negotiations are due to conclude at the end of 1990, so any changes in agricultural policy agreed to in the negotiations would probably have to be implemented during the life of the 1990 farm bill.

It has sometimes appeared that the farm bill was being written as if the Geneva negotiations did not exist. Many observers, including Secretary of Agriculture Clayton Yeutter, the former U.S. trade representative, seem to agree that the United States should not rush to reduce or eliminate its agricultural subsidies, as they are bargaining chips for persuading other countries to reduce their own agricultural subsidies.

If an agreement is reached on reducing agricultural subsidies in the GATT negotiations, and the U.S. Senate approves the GATT agreement, it is likely that changes in U.S. agricultural commodity programs—dairy and sugar programs in particular—will be necessary. However, any changes would be phased in over a period of years, and might not take effect for several years. In addition, some form of adjustment assistance might be needed for regions and industries hit hardest by the changes. Thus the GATT and U.S. farm bill negotiations are not on the same track. However, they are not as yet diverging, nor are the differences between them irreconcilable.

How important will the new legislation be for the U.S. agricultural sector in the coming decade?

Commodity programs have long been assumed to be the major policy factors influencing the well-being of the U.S. agricultural sector. In fact, these programs are becoming less the primary instrument and more the safety net for agriculture. With the world market now taking about 23 percent of U.S. agricultural production, compared with 11.5 percent in 1930 (before the programs were initiated), conditions in the rest of the world have a profound impact on the economy of the U.S. farm sector. If the countries that now import U.S. agricultural products cannot afford to buy them—because of debt servicing problems, because they must pay more for other commodities such as oil, or because they cannot sell their exports and earn foreign currency—the demand for and price of U.S. commodities will likely drop. If the costs of producing agricultural commodities rise—because the cost of a key input such as oil rises, because some inputs are banned, or because interest rates rise—and there is no concomitant rise in the price of agricultural products, returns to farmers will decline. If other countries subsidize their agricultural exports and thus force U.S. products out of markets, the price of U.S. commodities will fall. Such events and conditions as these are often little affected by U.S. farm programs, yet their impact on U.S. farmers can be profound.

Certainly the agricultural programs influence U.S. agriculture, but other

policies and actions, both in the United States and abroad, will increasingly affect the health of the U.S. agricultural sector more. To ignore the changing position of the sector in the global economy would be to make it all the more vulnerable to changes in that economy. A healthy U.S. agriculture depends on healthy economies at home and in other countries as much as it depends on the farm programs legislated every four or five years, and amended, adjusted, or fine-tuned almost annually. ■

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Comparing environmental regulation in the OECD countries

Raymond J. Kopp, Paul R. Portney, and Diane E. DeWitt

Among OECD countries, differences in environmental standards and their enforcement could affect a country's competitiveness in the international marketplace. With respect to control of air and water pollution, it appears that policy differences between the United States and other developed countries are relatively minor. Yet in the management of hazardous wastes, laws such as Superfund may put the United States at a disadvantage in international trade.

Ten years ago discussions of the economic effects of environmental regulation centered almost exclusively on domestic concerns. Analyses were typically aimed at uncovering the effects of particular air pollution regulations on electricity prices or unemployment in the coal mining industry, or at determining the increase in local taxes required to finance a new municipal waste treatment plant to preserve water quality. Only in the occasional macroeconomic analysis of the impacts of federal environmental regulation was an international concern like the balance of trade even discussed. Yet it is important to know something about the competitive effects arising from the environmental programs that each country puts in place on its own.

In the United States, annual environmental compliance expenditures are on the order of $90 billion. Of this total, approximately $30 to $35 billion results from regulations under the Clean Air Act, $30 billion from regulations under the Clean Water Act, and $30 billion or so from a variety of laws covering drinking water contamination, pesticides and herbicides, chemical production and use, and solid and hazardous waste disposal.

If Congress approves proposed amendments to the Clean Air Act, which seems likely, clean air spending will increase by about $30 to $35 billion annually by the year 2005. Annual compliance expenditures for water pollution control will likely remain relatively steady during the 1990s, unless controls are tightened on non-point sources of water pollution such as farms and feedlots, urban streets, and storm sewers.

Environmental compliance expenditures are growing most quickly in the hazardous waste area. Total expenditures necessitated by federal hazardous waste laws such as the Resource Conservation and Recovery Act of 1976 and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980—better known as Superfund—are probably in the vicinity of $10 to $15 billion annually. It appears that these expenditures will continue to grow rapidly for several reasons. First, the average cost of a cleanup at one of the 1,200 abandoned hazardous waste sites on the Environmental Protection Agency's National Priority List is now about $30 million. By some estimates, there may be as many as 400,000 possible candidates for that list. In addition, according to a report released by the Congressional Budget Office (CBO) in 1990, costs to the federal government of complying with relevant state and federal hazardous waste laws could exceed $150 billion. Moreover, the Environmental Protection Agency (EPA) is on the verge of issuing new regulations pertaining to the cleanup of wastes at currently operating hazardous waste sites. If these regulations are approved, compliance costs will be in the tens of billions of dollars.

What about the share of the gross national product (GNP) that goes to environmental protection? If the United States now spends about $90 billion annually for environmental protection, this amounts to about 1.7 percent of the GNP. This figure is consistent with recent data from the Organization for Economic Cooperation and Development (OECD) that compares the U.S. share of gross domestic product (GDP) devoted to environmental compliance with that of several other western countries. According to the OECD, the United States spent 1.65 percent of its GDP on environmental expenditures in 1985. By comparison, France spent 0.86 percent; West Germany, 1.52 percent; the Netherlands, 1.33 percent; Norway, 0.82 percent; and the United Kingdom, 1.25 percent. While Japan was not included in this analysis, earlier comparisons suggest that Japan's environmental spending is 1 to 2 percent of its GDP.

Air and water pollution control

Most of the information available on differences among countries in environmental regulation pertains to air and water pollution control. Yet it is difficult to compare water pollution control standards in the United States with those in other countries. This is because the Clean Water Act of 1972 shifted the U.S. federal focus away from water quality standards and toward the establishment of technology-based effluent guidelines or limits for particular classes of pollution sources. As a result, individual states are empowered to establish their own ambient water quality standards. These standards are based on desired uses and vary from state to state. In the absence of national water quality standards, there seems little point in selecting individual state standards for comparison with water quality standards in other countries.

However, the United States does have national ambient air quality standards. The two pollutants for which it is easiest to make international comparisons are sulfur dioxide (SO_2) and total suspended particulate matter (TSP). Data are sometimes available for nitrogen dioxide (NO_2) as well. In 1985 the Congressional Budget Office assembled data on comparative ambient standards for these three pollutants. Based on data compiled by the OECD in 1977, the CBO found that U.S. ambient standards were comparable with, although generally more lenient than, those of Japan, West Germany, and Canada.

More recently, the Environmental Protection Agency reviewed ambient air quality standards for sulfur dioxide and nitrogen dioxide in the United States, France, West Germany, the United Kingdom, Japan, and Canada. The United States appeared to have somewhat less stringent standards for sulfur dioxide, although differences in the way these air pollutants are measured often make reported standards difficult to interpret. Gaps in the data notwithstanding, U.S. standards for nitrogen dioxide were comparable with those of the other countries.

Although a country may have very stringent standards, it may do little to enforce them. Thus actual air quality may provide a better picture of the commitment of individual countries to environmental protection. In 1988 the Environmental Protection Agency collected data on average ambient sulfur dioxide concentrations in several countries in order to compare national environmental efforts. According to the survey, the United States had lower levels of SO_2 than the United Kingdom, Japan, and Canada in 1975. Due to greater efforts by the last three to reduce SO_2 emissions, the average concentrations of SO_2 in all four countries were similar by 1984.

Ambient standards represent the *goals* of environmental policy. These goals are pursued through a set of individual source discharge standards—that is, limits on the amount of pollution that factories or other sources may emit. Thus it is useful to examine what is known about comparative differences in the way similar sources are regulated.

In 1984 the Organization for Economic Cooperation and Development compared emissions standards for particulates and sulfur oxide from electricity generating plants in the United States, Canada, Japan, Australia, New Zealand, and seven European countries. For total suspended particulate matter, the U.S. emissions standard was among the most stringent examined. However, the OECD's comparison of emission standards for sulfur oxide from electricity generating plants in the United States, Canada, Belgium, West Germany, the Netherlands, Sweden, and Japan showed that U.S. emission limits were among the most lax.

In contrast to the United States, other OECD countries take a more cooperative approach to the enforcement of environmental regulations.

More recently, the EPA surveyed sulfur dioxide and nitrogen dioxide emissions limits for large, new combustion facilities (such as power plants or industrial boilers) in the United States, France, West Germany, the United Kingdom, Japan, and Canada. With the exception of the United Kingdom, which has no formal SO_2 and NO_2 emissions limits, the agency found the United States to have the least stringent sulfur dioxide and nitrogen dioxide emissions limits among the countries surveyed. In the same survey, the EPA also compared emissions standards for mobile sources of nitrogen oxide (NO_x) such as cars and light-duty trucks. According to this survey, which was based on comparisons of different model years, the U.S. standard for NO_x is slightly less stringent than Japan's but much more stringent than that of Europe and that of Canada, which only recently imposed an NO_x emissions limitation on vehicles sold within its borders. Should proposed amendments to the Clean Air Act be passed, emissions of all mobile source pollutants will be further reduced in the United States over the course of the next fifteen years.

Regulatory approaches

All the OECD countries have air and water pollution control policies based on ambient environmental standards, and all use specific source discharge standards to achieve environmental goals. Variations in ambient standards and source discharge standards are important in understanding how environmental policy can affect the competitive positions of firms in different countries, but they do not tell the whole story. It is also important to consider the overall approach to regulation in various countries, including enforcement styles.

Most analyses of international environmental policies call attention to the differences among countries in the degree of cooperation between regulators and the entities being regulated. In the United States, an adversarial relationship exists between the two. This often results in inflexibility in interpreting or enforcing rules, which can raise the expense of compliance. It can also lead to time spent in litigation, significantly increasing the total cost of environmental protection.

In other countries, a more cooperative approach to enforcement is taken. In Japan and the United Kingdom, for instance, there appears to be more room for negotiation between regulated firms and offi-

cials responsible for ensuring compliance. This may mean that additional time is provided for meeting source discharge standards if a firm encounters difficulty in installing required pollution control equipment. In Japan, however, this cooperative spirit does not extend to the perpetual avoidance of environmental controls. Air and water pollution sources in that country are fully expected to meet any and all environmental standards. In fact, according to the Congressional Budget Office, Japanese air and water pollution sources are likely to bear higher pollution control costs than their counterparts in the United States, Canada, or West Germany.

Adversarial relationships between U.S. regulators and regulated entities often result in inflexible interpretation or enforcement of rules, and may raise compliance costs.

Another feature of environmental regulation peculiar to the United States is the more stringent regulation of new, as opposed to existing, technologies and pollution risks. Many experts suspect that this bias in environmental regulation may be retarding development of innovative technologies that might be more efficacious from an environmental standpoint than the technologies they would replace. Some evidence suggests that the European Community is moving toward stricter regulation of new air pollution sources and possibly of new chemicals. However, there is little information available on the way individual countries treat new versus old pollution sources and risks, even though this distinction is critical to understanding the effect of regulations on international competitiveness.

Although there are gaps in data, it appears that policy differences in the control of air and water pollution among the OECD countries are relatively minor, and they also appear to be growing smaller. While the ambient and source discharge standards differ somewhat from country to country—Japan's standards tend to be more strict and those of the United Kingdom, and several other European countries tend to be more lax—the differences are not particularly great and will probably narrow with economic and environmental integration in Europe. In fact, environmental policy in Europe will increasingly be dictated by the European Community (EC) as a supranational entity, rather than by individual countries acting unilaterally. Thus differential treatment of capital investment in air and water pollution control is steadily narrowing. This is not necessarily the case for all aspects of hazardous waste policy.

Regulating hazardous waste

There is no generally accepted definition of hazardous waste. Because each country chooses its own definition, hazardous waste regulations vary. Indeed, in many cases the precise definition of hazardous waste is left purposefully vague; in lieu of a rigorous definition, a list of substances deemed hazardous is often specified.

The type of system that a country develops to identify, transport, and control and monitor hazardous wastes depends, in large measure, on its regulatory approach. As noted above, differences in regulatory styles are not nearly as great among European countries as they are between the United States and Europe. As a result, regulation of hazardous wastes in the United States differs somewhat from that of European countries. Whereas European governments and industries work together in the formulation and implementation of hazardous waste regulations, the strict federal command-and-control procedures used to regulate hazardous wastes in the United States provide relatively little flexibility or interaction among regulators and those being regulated.

Differences in U.S. and European hazardous waste regulations are clearly evident in the nature and form of liability for injury caused by improper shipment, treatment, or disposal of hazardous substances. For example, under the Resource Conservation and Recovery Act the EPA can bring legal action against anyone who handles wastes in a way that presents an imminent hazard; therefore, site operators, landowners, transporters, and generators are all potentially liable. In European countries, liability for environmental or public health damages is narrowly defined and does not usually cut across generators, transporters, and disposers.

In the next few years, however, European countries can be expected to make more direct use of liability for hazardous wastes damage in their regulatory strategies. A proposed directive from the European Community would create civil liability for damage caused by existing hazardous waste sites. Strict liability for damage to the environment would be attributed to the producer of the hazardous waste. In addition, West Germany will probably adopt a law to address the problems of environmental liability, and the United Kingdom will take the first step toward liability for damages by requiring producers of hazardous waste to exercise a duty of care.

Regulatory differences

Generally speaking, the laws regulating the current generation, transportation, and disposal of hazardous waste in the United States and Western Europe do not seem to be so different as to impart a competitive trade advantage to Europe. While European regulations are somewhat more flexible and less strict than those in the United States, it is hard to imagine that this translates into observable competitive advantage. Moreover, future hazardous waste regulation in Europe will probably become more inflexible as European countries strive for regulatory uniformity and rely more on command-and-control approaches similar to those of the United States. However, the United States has one law aimed at cleaning up hazardous waste sites for which there is no equivalent among its trading partners. In particular, the Comprehensive Environmental Response, Compensation and Liability Act, or Superfund, imposes regulatory burdens that other OECD countries do not.

Along with the Resource Conservation and Recovery Act (RCRA), Superfund

governs most hazardous waste regulation in the United States. The two laws have very distinct purposes. Superfund is intended to ensure that potentially harmful abandoned hazardous waste sites are identified and cleaned up. RCRA is concerned with the generation, transportation, treatment, and disposal of newly created wastes. In a sense, Superfund is a backward-looking law that addresses the environmental and health risks associated with past disposal practices, while the forward-looking RCRA prescribes and ensures the safety of future hazardous waste generation, transportation, storage, and disposal activities.

Many European countries have laws similar in intent to RCRA, but none of these laws are as restrictive and comprehensive. Moreover, no European country has a Superfund law. If differences in competitive advantage exist between the United States and Europe because of environmental protection legislation, it is probably due to the fact that the United States has a Superfund law and its trading partners do not.

Superfund is considered a bill collector's statute. Its provisions for strict liability and for joint and several liability are designed to make it easy for the federal government to find a private party to pay for a site cleanup. (Strict liability holds a party liable for damage regardless of how prudent its waste disposal practice may have seemed initially if that practice is now considered harmful; joint and several liability holds that all contributors to a disposal site could be held responsible for clean-up costs and that any one contributor could be held responsible for the entire cost of cleanup, no matter how small its contribution.) These liability provisions are not necessarily designed to provide efficient incentives for generators, transporters, and disposers to take due care in waste management activities; rather, they are designed to ensure that clean-up costs are not borne by the federal government. Disputes over responsibility for clean-up costs have led to substantial expenditures on litigation, costly site remediation, and slowed cleanup. Although data are limited, it has been estimated that 30 to 70 percent of all current expenditures related to Superfund take the form of legal fees, as opposed to expenditures for the actual removal or stabilization of hazardous substances at waste disposal sites.

While the high cost of litigation and site remediation is clear, the costs of the natural resource damage provisions of Superfund, which hold all potentially responsible parties liable for damage to natural resources, as well as clean-up costs, may not be so apparent. Since such natural resource damage cases are just being initiated by federal and state trustees, the potential size of damage costs is not yet evident. However, the costs associated with one of Superfund's provisions—that the size of damage awards be at least equal to the cost of fully restoring a site to its undamaged state—could be very large.

Europe currently has few plans for cleaning up abandoned hazardous waste sites. Moreover, it is unlikely that the European Community will enact a law with the provisions of retroactive, strict, joint and several liability with the intention that federal governments would find private parties to pay for the cleanup of abandoned hazardous waste sites. The EC argues against the retroactive nature of strict liability, claiming that it is impossible to link environmental damage to the party or parties who caused that damage. Furthermore, no European policymakers have made any move toward enacting joint and several liability to finance cleanups. Instead, some European countries plan to raise funds for cleanups by levying taxes on some chemical products or on special types of wastes, which would be selected, in part, on the basis of their toxicity. Policies aimed at cleaning up abandoned hazardous waste sites will no doubt be enacted in Europe in the future, but having had the opportunity to study the performance of Superfund, it seems doubtful that Europeans will adopt a similar law. Thus if the United States is at a competitive disadvantage as a result of Superfund, it can expect to remain so in the foreseeable future.

It is unlikely that European countries will adopt legislation with the same liability provisions that have made Superfund so costly.

The fact that the United States is the only country with a comprehensive, strict, joint and several liability-based system to provide for the cleanup of sites on which hazardous wastes were stored or disposed of in the past may prove costly to U.S. businesses. In view of the impending expansion of natural resource damage suits under Superfund, as well as corrective action requirements about to take effect under the Resource Conservation and Recovery Act, the United States can be expected to increase considerably its annual expenditures on hazardous waste management. The higher costs that the United States pays for managing hazardous wastes, as compared with other OECD countries, could begin to have noticeable negative effects on some U.S. firms and on entire U.S. industries.

While air and water pollution control and some aspects of hazardous waste management are similar in the United States and in other western democracies, there are greater differences in the environmental standards of these countries as compared with the standards in rapidly developing countries such as Taiwan, South Korea, and Brazil. As developing countries move to improve their environments, it will be important to see if they adopt the same sorts of environmental protection measures as the OECD countries have. Also ripe for research are the environmental fates of East Germany, Poland, Romania, Czechoslovakia, and the other newly democratizing countries of Eastern Europe. In time, these countries could become worthy economic competitors; thus it is incumbent upon U.S. policymakers to monitor whether these countries continue to sacrifice environmental quality in order to become, and then remain, competitive in international markets. ■

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Information theory and food safety issues

Carol S. Kramer

Consumers often assess food safety risks and their acceptability differently than experts do. The result can be the diversion of limited public health resources from public health hazards that pose known serious threats. More efficient provision of food safety information could lessen, although probably not eliminate, the gap between the risk perceptions of consumers and those of experts.

An apparently widespread uneasiness persists among consumers concerning food safety—an uneasiness marked by wariness of pesticides and other chemical residues in food and their cancer-causing and neurotoxic potential. Yet what consumers perceive to be the greatest food safety risks are not always the risks ranked highest by food safety experts. To the extent that consumers minimize known serious public health risks, they may emphasize less important risks at the cost of neglecting more important ones, sending confusing signals to the food industry in the process. They may also encourage the diversion of public resources away from more serious public health problems.

The risk assessments of consumers and those of experts often deviate because experts fail to credit all of the many factors that influence the public's perception of the acceptability of various risks. Even if consumers had access to all of the food safety information that experts possess, as well as a scientific understanding of that information, they might judge the acceptability of various risks differently than experts. However, more efficient provision of food safety information could lessen the divergence between the food safety concerns of consumers and those of food safety experts.

Apart from the social values that color the public's perception of risk, there are scientific grounds for concerns about food safety assessments by experts. Major uncertainties exist regarding the identification and characterization of food safety hazards and the risk these hazards pose for public health. Scientists lack a full understanding of dose-response relationships and the complex biological, biochemical, and toxicological mechanisms by which a toxin or pathological microorganism acts within the body. Interpretation of animal or cell culture studies that are used to assess these relationships and mechanisms is often controversial. In some cases, scientists are even uncertain about which animal species make the best test subjects for indicating effects on human biological systems. Nor do they agree on the appropriate analytical models to estimate the correspondence between high doses of chemicals administered for relatively short times to relatively small samples of test animals, on the one hand, and the typically lower doses of chemicals to which broader human populations are exposed over longer periods of time, on the other.

Consumers and experts often rank food safety risks differently.

Analysis of human epidemiological data can complement or serve as an alternative to toxicology-based risk assessment in evaluating food safety hazards, but data limitations—compounding influences such as lifestyle and environmental factors, and long time lags between exposure and potential effects—cause problems in teasing out correlation and causality. Moreover, attempts to assess the magnitude of various food safety risks are hampered by underreporting of foodborne disease outbreaks and a lack of understanding about how the effects of chemical and microbial contaminants vary among high-risk population groups such as infants, children, pregnant or lactating mothers, and people with impaired immune systems.

Perhaps the major differences between expert and public assessments of current foodborne risk in the United States concern the pesticide issue. A variety of consumer polls indicates that consumers rank pesticide residues, followed by environmental contaminants, as the food safety risk of most concern. At the same time that consumers are exerting economic and political pressure to reform pesticide regulation and protect the public from pesticide exposure, however, many government and private experts are minimizing the risks attributable to manmade pesticides. These experts indicate that the major and most urgent known foodborne risks stem from pathogens (disease-causing microorganisms), followed by nutritional imbalance or deficiency and toxic natural constituents of foods. They also emphasize that risk of disease for individuals is linked more closely to lifetime dietary patterns than to occasional encounters with individual toxicants.

One explanation for the disparity in perceptions of foodborne risk is that the American consumer is poorly grounded in basic scientific principles. This is manifested by a lack of appreciation that, in many cases, the toxicity of a particular substance is a function of dosage; that differences exist between agents that initiate cancers and those that only promote their progress; that natural substances are also "chemicals" and that some may be as toxic as synthetics; and that pesticides may provide health benefits as well as economic benefits. Experts in consumer behavior also report that many consumers misunderstand and mistrust basic concepts of statistical probability and inference that can be involved in inspection sampling and the interpretation of epidemiological evidence.

On the other hand, many scientific experts are criticized for not better characterizing dimensions of risk of particular concern to consumers. If exposure is involuntary, is manmade, is viewed as unnecessary, could result in a dreaded

condition, or otherwise seems unfair, the risks are considered by consumers to be more important and less acceptable than other risks. In addition, consumers observe that experts often do not agree among themselves about the importance of different risks. For example, scientists have not been able to establish threshold levels for many carcinogens—a particular concern of consumers. Nor is their knowledge of the neurotoxicity of chemicals complete. Disputes on these matters among experts are common, and expert opinion has sometimes proven wrong in the past. Consumer activists are also aware of criticism by experts of the adequacy of sampling methods currently employed by food safety regulators. In many cases, critics argue, sampling sizes are extremely small. In others, gaps in sampling occur due to the lack of assay methods, regulatory protocols, or funds.

Economic theories of information

Better understanding of how and when different types of consumers and producers search for, receive, and use information about various food safety risks is important in narrowing the gap on risk assessments among food safety experts, the general public, and business interests that are in a position to generate and pass on food safety information. Economic theories of information help to explain the efficiency with which consumers and others acquire and use such information.

Food safety experts in both private and public sectors presumably have greater incentives and resources than consumers to invest in specific scientific knowledge and to use this knowledge relatively efficiently. Because they are able to integrate food safety information within a scientifically based conceptual framework, experts are better equipped than consumers to balance the costs of acquiring information, which may be extremely high, with the benefits of having or using it, which may be less certain for consumers than for experts. Because the private sector has problems in realizing the benefits of providing food safety information, such information tends to be undersupplied to consumers.

Food safety information tends to be undersupplied to consumers because the private sector has problems appropriating the benefits of providing it.

Photo courtesy of Brigitte Coulton

Consumers rank pesticide residues as the food safety risk of most concern, yet many experts minimize the risks attributable to manmade pesticides.

Frequently, food producers and processors have more information relating to the safety of a food product than the consumer has. They possess relevant data about agricultural inputs such as fertilizers and pesticides applied, production methods employed, and food manufacturing techniques used to bring a food product to market. They may also be aware of the health characteristics of agricultural labor, slaughterhouse personnel, or food handlers, and the sanitary conditions of food processing plants—all of which influence the safety of foods.

How producers' greater access to food safety information translates into market behavior and whether consumers benefit or suffer from that behavior depends, in part, on the incentives that public policies provide to producers to use and transmit this information. The economics literature shows that high-quality products may not be supplied in markets in which consumers have limited information. In these markets some of the desirable effects of competition vanish, and producers may have an incentive to reduce not only information provided to consumers but

product quality. Adulteration of products for economic purposes (for example, watering of wine or shorting of weights) may be one consequence, as may be unsafe products (spoiled meat disguised with additives or packaging, for example). So while much food safety information can provide health or economic benefits to consumers, markets frequently fail to offer sufficient incentives for individual firms to generate such information.

In general, economic theory suggests that incomplete and asymmetrically held information leads to one of two outcomes: either a market does not exist and goods that consumers prefer are not provided, or competition leads to lower-quality products because firms cannot capture the benefits of their efforts to provide additional food safety information when selling apparently homogenous products. Therefore, public policies aimed at improving the availability of safety information—such as setting uniform final product standards for foods or standards for food production and processing—are desirable if the social benefits outweigh costs. Product performance standards refer to regulations that set specific requirements or limits for product attributes. These may include chemical tolerance levels (maximum limits) for pesticide or animal drug residues in food products, ingredient standards, maximum filth standards, and so on. Production or processing standards refer to direct regulation of the food production process. Examples include banning or regulating the use of irradiation technology and particular agricultural chemicals and food additives. Policy instruments to enhance the efficiency of information processing—that is, the use of information in making production or purchasing decisions—include product labeling provisions and requirements that producers report specific information such as pesticide application rates.

Disparity in perceptions of foodborne risk may be due to consumers' poor grounding in scientific principles and experts' failure to explain dimensions of risk of concern to consumers.

Some evidence suggests that public policies that permit food suppliers to have advertising or information disclosure rights may encourage socially desirable competition in the area of food quality. For example, if scientific consensus points to the desirability of lowered saturated fat intake or increased fiber in the diet, then allowing firms to compete on the basis of these product characteristics may lead to a greater supply of desirable products. This theory is given credence by a Federal Trade Commission (FTC) study of the cereal market that was released in October 1989. The study showed that producer health claims were a significant source of information regarding the potential benefits of fiber consumption. Furthermore, the study demonstrated that the number and proportion of new high-fiber cereals increased considerably during the years 1985 to 1987, when some cereal companies began advertising and labeling campaigns stressing the high-fiber content of their products. This evidence suggests that health claim advertising and labeling rights may be important to the development of healthier food products. It should be noted, however, that health claims are extremely controversial, especially in cases in which no scientific consensus exists about the desirability of the claim being made. Examples include claims that food products are organic or pesticide-free, thus implying that they are healthier.

Judging acceptable risk

Because of production, resource, and knowledge constraints, it is not possible to have risk-free food. Choices are and must be made as to the kinds and levels of risk acceptable at any given point in history. The determination of acceptable risk, as many have noted, is not a definitive economic or a scientific determination. Rather it is a result of a set of social judgments, reflecting the interplay (in different situations) of political, social, economic, scientific, ethical, legal, and psychological forces. Social judgments about acceptable risk vary among societies and in relation to different products over time.

Economic analysis provides one important input into the social determination of acceptable risk. Its major contribution in the food safety policy area, as in most other policy areas, is to provide an understanding of and a framework for evaluating tradeoffs implicit in alternative public and private choices. In particular, economic analysis can lessen the divergence between the food safety concerns of consumers and those of experts by identifying the determinants—such as cost and convenience—of information acquisition and use by consumers, producers, and other groups under varying circumstances. It can also contribute to a growing understanding of the likely behavior of market participants in different markets under conditions where quality and safety information is uncertain and asymmetrically held. Finally, economic analysis can assist in identifying not only socially desirable but cost-effective policies and policy instruments to enhance food safety understanding in both public and private sectors and to improve market food safety performance. ■

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A correction

A photo caption accompanying the article "Emissions trading in the electric utility industry," by Alan J. Krupnick, Douglas R. Bohi, and Dallas Burtraw (*Resources* no. 100, Summer 1990), stated that acid rains kill spruce trees in the Camel's Hump forest in Vermont. In fact, scientists disagree about what role acid rain may play in the decline of forests.

Environment prize awarded to Kneese and Krutilla

Two senior researchers for many years at Resources for the Future were jointly awarded the 1990 Volvo Environment Prize. John V. Krutilla and Allen V. Kneese were named recipients of the prize, which honors and supports technical and scientific innovation in the study of the environment, for their pioneering work in environmental and natural resource economics. They will share a $250,000 monetary award that accompanies the prize, which is to be conferred during a formal ceremony in November at the University of Gothenburg in Sweden.

The two RFF economists were selected by an international committee appointed and chaired by Dr. Mustafa Tolba, director of the United Nations Environment Programme. The committee noted that Krutilla and Kneese had established resource and environmental economics as a respectable and comprehensive research discipline and that they were the first to apply economic principles to the study of environmental issues.

John Krutilla joined RFF in 1955. At various periods during his thirty-three year tenure, he served as associate director of the Water Resources Research Program and as director of the Natural Environments Program. Formerly a senior fellow in the Quality of the Environment and Renewable Resources divisions, he retired in 1988. One of his books, *The Economics of Natural Environments: Studies in the Valuation of Commodity and Amenity Resources,* coauthored with Anthony C. Fisher, is among RFF's most requested publications. Originally published in 1975, it was revised and reissued as a paperback in 1985. His latest book, *Multiple-Use Management: The Economics of Public Forestlands,* coauthored with Michael D. Bowes, was published by RFF in 1989. A collection of essays in Krutilla's honor was published by RFF in 1988 under the title *Environmental Resources and Applied Welfare Economics.*

Currently a senior fellow in the Quality of the Environment Division, Allen Kneese joined RFF in 1960. He has served as director of the Quality of the Environment Division and of RFF's former Water Resources Program. His most recent book, *Measuring the Benefits of Clean Air and Water,* was published by RFF in 1984. With senior fellow Walter O. Spofford, Jr., he is presently overseeing the translation into Chinese of fifteen RFF books to be published in Beijing by the People's University of China. ■

Applicants sought for RFF award programs

Resources for the Future is seeking applicants for four of its award programs—the Gilbert F. White Postdoctoral Fellowship Program, the RFF Small Grants Program, the Dissertation Prize in Environmental and Resource Economics, and the NCFAP Resident Fellowship Program.

Two resident fellowships will be awarded for the 1991-92 academic year under the Gilbert F. White Postdoctoral Fellowship Program. They are intended for postdoctoral researchers who wish to devote a year to scholarly work related to natural resources, energy, or the environment.

The RFF Small Grants Program provides funding for new research projects or supplementary support to complete specific aspects of ongoing research related to the environment, natural resources, or energy. Grants are made only to individuals through universities or other tax-exempt institutions.

A third program for which RFF seeks applicants is the Dissertation Prize in Environmental and Resource Economics. The prize is $10,000. All dissertations in environmental and resource economics (theoretical and applied) submitted for the Ph.D. or its equivalent and certified as completed between January 1, 1990 and December 31, 1990 are eligible for nomination. All manuscripts submitted for the dissertation prize must be accompanied by a formal letter of nomination from the chair of the university department in which the dissertation was completed. Each department may nominate only one dissertation.

Applications for the Gilbert F. White and the Small Grants programs are due by March 1, 1991. Awards will be announced in April 1991. Manuscripts for the dissertation prize must be received by RFF by March 1, 1991. The award will be announced in September 1991.

For more information about any of the three award programs described above, write to Christine A. Mendes at the Office of the Vice President, Resources for the Future, 1616 P Street, N.W., Washington, D.C. 20036. Telephone (202) 328-5022.

A fourth award program, the NCFAP Resident Fellowship Program, is sponsored by RFF'S National Center for Food and Agricultural Policy. Up to three fellowships are awarded, each for a period of six to twelve months, to young professionals who wish to pursue scholarly work on current or emerging national issues related to food and agricultural policy.

Individuals who are living in the United States, are employed by universities, governments, and the private sector, and will have completed their doctoral requirements in any discipline by the beginning of the 1991-92 academic year are eligible. Professionals who will be on sabbatical leave

(continued on page 18)

Applicants sought *(continued)*

during the fellowship period are encouraged to submit an application.

Applications for NCFAP resident fellowships are due by April 1, 1991. Awards will be announced in May 1991; an earlier decision may be made in the case of an applicant interested in beginning a fellowship during the summer. For more information, including applications, write to Linda G. Gianessi, National Center for Food and Agricultural Policy, Resources for the Future, 1616 P Street, N.W., Washington, D.C. 20036. Telephone (202) 328-5135. ■

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To order discussion papers, send a written request, accompanied by a check, to the Publications Division at the same address.

New book

World Metal Demand: Trends and Prospects,
edited by John E. Tilton

In the early 1970s, the post–World War II boom in world metal consumption came to a halt. It has since become clear that what was thought to be a cyclical downturn was in fact a long-term, substantial decline in world metal demand. In this volume, editor John E. Tilton and four fellow scholars of mineral economics analyze the causes and consequences of this decline and the prospects for growth in world metal demand. A major purpose of their study is a more accurate anticipation of future changes in metal consumption through better understanding of past trends, so that costly and disruptive imbalances between demand and the capacity to mine and process metals can be avoided.

Focusing on the world's six major metals—steel, aluminum, copper, lead, zinc, and nickel—the volume presents independent studies of trends in metal demand during the period between 1960 and 1987 in the countries of the Organization of Economic Cooperation and Development (OECD), in the developing nations, and in countries with centrally planned economies. The authors suggest that although the OECD countries largely determined past trends in world metal demand, the developing and centrally planned countries will play an increasingly important role in shaping future trends.

The authors also consider changing trends in the intensity of metal use and the similarities and differences in metal demand among specific regions. Two case studies of material use in the automobile and packaging industries provide insights into the evolving nature of metal demand, particularly in the industrialized countries.

October 1990. 364 pp. $45.00 hardback.
ISBN 0-915707-56-X

Discussion papers

RFF discussion papers convey the early results of research for the purpose of comment and evaluation. Cost includes postage and handling. Prepayment is required. The following papers have recently been released.

Energy and Natural Resources Division

- "Taxation, Depletion, and Welfare: A Simulation Study of the U.S. Petroleum Resource," by Robert T. Deacon. (ENR90-10) $5.00

- "Population Growth, Soil Fertility, Nonconvexities, and Agricultural Intensification," by Jeffrey A. Krautkraemer. (ENR90-11) $5.00

- "Continuous and Cyclical Farming Strategies for Soil Management for Sustainable Agriculture," by Jeffrey A. Krautkraemer. (ENR90-12) $5.00

- "Rent-Seeking and the Common Pool," by Robert T. Deacon and Jon C. Sonstelie. (ENR90-13) $5.00

- "U.S. Wastepaper Recycling Policies: Issues and Effects," by A. Clark Wiseman. (ENR90-14) $5.00

- "Prospects for Reduced CO2 Emissions in Automotive Transport," by Joel Darmstadter and Andrew Jones. (ENR90-15) $5.00

Quality of the Environment Division

- "The Estimation of Consumer Preferences for Attributes: A Comparison of Hedonic and Discrete Choice Approaches," by Maureen L. Cropper, Leland Deck, Nalin Kishor, and Ted McConnell. (QE90-20) $2.25

- "Risk Communication and Attitude Change: Taiwan's National Debate Over Nuclear Power," by Jin Tan Liu and V. Kerry Smith. (QE90-21) $2.25

- "International Comparisons of Environmental Regulation," by Raymond J. Kopp, Paul R. Portney, and Diane E. DeWitt. (QE90-22-rev) $2.25

- "The Use of Production Indices in Planning and Evaluating Fisheries Management Programs," by Danny C. Lee. (QE90-23) $2.25

- "A Test for Cross-Subsidies in Local Telephone Rates: Do Business Customers Subsidize Residential Customers?" by Karen L. Palmer. (QE90-24) $2.25

- "The Cost-Effectiveness and Energy Security Benefits of Methanol Vehicles," by Alan J. Krupnick, Margaret A. Walls, and Michael A. Toman. (QE90-25) $2.25

Center for Risk Management

- "An Analysis of EPA Regulation of Food-Use Pesticides," by Maureen L. Cropper, Bill Evans, Steve Berardi, Maria Soares, and Paul R. Portney. (CRM 90-04) Free

New appointments

Two new members recently joined the staff of the Center for Risk Management. Maureen L. Cropper, a former university fellow at Resources for the Future, was appointed a senior fellow of the center on October 1. Cropper is associate professor of economics at the University of Maryland. She will work on several center projects, including an examination of the cost-effectiveness of environmental regulations as public health measures.

Also effective October 1, Katherine N. Probst became a consultant-in-residence, collaborating on a project aimed at assessing alternative funding mechanisms for the cleanup of hazardous waste sites. Probst has worked in the Environmental Protection Agency's Office of Policy, Planning, and Evaluation, at the Environmental and Energy Study Institute, and, most recently, at Clean Sites, Inc.

Jeffrey B. Hyman was appointed a fellow of the Quality of the Environment Division on September 17. He is currently working with other division researchers on development of methodological tools and data that can be used to determine the cost-effectiveness of strategies to mitigate damage to fish and wildlife resources from hydroelectric dams in the Columbia River Basin in the Pacific Northwest. ■

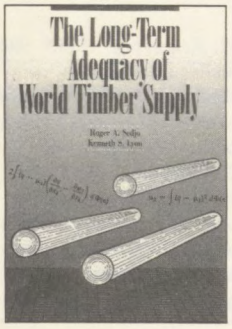
Resources: Five-score and one

With this edition, *Resources* marks its 101st issue and the beginning of its 32nd year of continuous publication. In its first incarnation, *Resources* carried the rather modest subtitle, "Some findings and conjectures from recent research into resource development and use." Today this description would have to be extended to include environmental quality, with a further subtitle pertaining to the consideration of a vast number of social concerns intertwined with the management of environmental and natural resources. Now with a worldwide readership of more than 16,000, *Resources* continues to report the results of RFF research in the humble acknowledgement that each new discovery only enlarges our knowledge of what is still unknown. ■

Recent corporate contributions, grants

Resources for the Future has recently received corporate contributions from the following corporations and corporate foundations: Agway Foundation; ARCO Chemical Company; Baltimore Gas & Electric Company; The Brooklyn Union Gas Company; Champion International Corporation; Chevron Corporation; Cummins Engine Foundation; The Duke Power Company Foundation; EG&G, Inc.; Exxon Corporation; General Electric Foundation; General Public Utilities Corporation; Georgia-Pacific Corporation; The New York Times Company Foundation, Inc.; Public Service Electric and Gas Company; Shell Oil Company Foundation; TECO Energy, Inc.; and Texaco Foundation.

In addition, The German Marshall Fund of the United States awarded a grant to the International Policy Council on Agriculture and Trade at Resources for the Future to support a conference in Budapest on Restructuring Food and Agricultural Systems in Central Europe and the U.S.S.R.: Strategies for Policy, Investment, and Assistance. ■

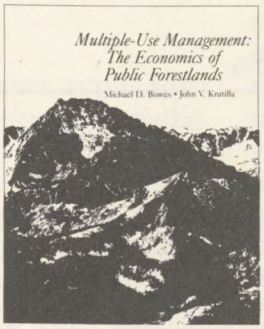


The Long-Term Adequacy of World Timber Supply

Roger A. Sedjo and Kenneth S. Lyon

This study utilizes an improved timber supply model developed by the authors. It presents forecasts of regional and world harvest levels, world market price, and investments in forest regeneration by region, and it examines the effects of technological change upon long-term timber supply.

1990 256 pages $30.00 cloth ISBN 0-915707-46-2



Multiple-Use Management: The Economics of Public Forestlands

Michael D. Bowes and John V. Krutilla

The authors develop a theoretical framework that accounts for joint production and the growth of recreation as a predominant forest use, and that shows how forest age structure and dynamics can be included in the economic model. They discuss the theory's relevance to contemporary policy issues such as below-cost timber sales, and examine its implications for forest resource allocation decisions made during the congressional budget and appropriations processes.

1989 380 pages $40.00 cloth ISBN 0-915707-41-1

RESOURCES FOR THE FUTURE 1616 P Street, N.W., Washington, D.C. 20036

ADDRESS CORRECTION REQUESTED

Published by Resources for the Future
1616 P Street, N.W., Washington, D.C. 20036

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Resources for the Future, founded in 1952, is an independent organization that conducts research on the development, conservation, and use of natural resources and on the quality of the environment.