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Higher Environmental Standards Can Enhance Competition and Welfare

by Y. Hossein Farzin

ENVIRONMENTAL quality has become a prime public concern worldwide. Not surprisingly, the improvement of environmental standards is high on public representatives' agenda. However, the public desire for higher environmental standards has usually met with severe resistance by domestic industrial groups and their lobbies. Underlying this resistance has been industry's claim that by raising abatement costs, higher standards raise the polluting firms' overall production costs, thus rendering them uncompetitive and forcing them out of business. On this basis, they also argue that the consequent reductions in the industry's output, employment, and competition will be against the public interest.

Recently, President Clinton supported new EPA recommendations to toughen health standards for ozone and fine soot, despite the opposition of industry. According to the Associated Press, industry groups are waging a multimillion-dollar campaign in Congress, within the administration, and in state capitals around the country, to rally opponents to the rule. "It's clearly up to Congress to prevent EPA from inflicting this harmful proposal on the American economy," said Jerry Jasinowski, president of the National Association of Manufacturers. The Associated Press also cited Charles DiBona, president of the American Petroleum Institute, who said the new pollution controls will threaten "thousands of inner city jobs" by forcing businesses out of smog plagued areas without significantly improving health protection. "The punishing new standards. . .are a noose around the neck of American business," complained Thomas Kuhn, president of the Edison Electric Institute, which represents more than 200 utilities, many of whom will be key targets of new emission requirements.

Opposition by industry to increased environmental standards has been historic. A vivid example of this position is the opposition to the 1970 Clean Air Act by Lee Iacocca, then vice president of Ford Motor Company, who warned that "compliance with the new regulations would require huge price increases for automobiles, force U.S. automobile production to a halt after January 1, 1975, and do irreparable damage to the U.S. economy." Ironically, governments also often use the same argument when negotiating the adoption of higher international or global environmental standards.

An economic analysis was conducted on the effects of environmental standards on the profitability of industry both in the short-run and in the long-run. Since industry's claim may act as a significant force to dissuade policy makers from adopting higher national or international/global environmental standards, its validity was subjected to close economic scrutiny. The analysis shows that this claim is

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not generally valid because it relies only on the cost effect of a higher environmental standard and fails to take into consideration its demand increasing effect.

The study analyzes a simple economic model of a competitive industry, in which the production of a good by identical firms inflicts a negative environmental externality. Beside incorporating the positive demand effect of a higher environmental standard, which is crucial to the results obtained, a novel and desirable feature of the model studied is that it allows for the free entry and exit of firms. The study examines how an increase in the environmental standard affects each firm's output level, profitability, the number of firms in the industry, the industry's total output and total pollution emission. Although it should be recognized that what matters for policy is social welfare and not industry output *per se*, the issue is important.

A higher environmental standard implies that at any given output level, firms should abate a greater portion of pollution they emit. This, as industries commonly claim, increases the abatement cost of the representative firm and therefore its overall production cost. This "cost" effect of a higher environmental standard is basic to almost all economic analyses of environmental standards.

What is often ignored in the claim is the "demand" effect of a higher environmental standard. The demand effect is present either when (1) cleaner environment directly or indirectly complements the produced good (therefore having a positive feedback effect on its demand) so that a higher environmental standard practiced by the firms leads to an expansion of the industry demand, or (2) consumers' preferences for the environment are altruistic. Specifically, the consumer acts out of benevolence to promote the provision of a *public* good or service in the form of higher environmental quality or greater preservation of natural and environmental resources. The first demand effect is clear in the following examples:

- Agricultural runoffs in a river serving as source of fishing, drinking water, and irrigation in downland communities, reduce demand for upland farm outputs. The runoff inflicts costs on fishermen and downland farmers in the forms of reduced harvest rates and loss of both labor and land productivity, damages to farmers' health, or use of polluted water for irrigation. In turn, these negative externalities cause losses of income and hence a reduction in the affected population's demand for the uplands' agricultural outputs.
- Higher quality standards of urban air, water, and land (*e.g.*, beaches and recreational sites) can attract a larger tourist population and hence boost the demand for tourist services. Although all firms in the industry will benefit from higher environmental standards, in the absence of regulations they will free-ride on each other's standards.

Thus, whether indirectly (as in the first example) or directly (as in the second), environmental quality is complementary to the produced good. In both cases, lowering pollution has a *positive* feedback effect on the demand for the good. However, low pollution is a *public* good and hence is external to an individual producer.

The second justification for the demand behavior postulated above is an *altruistic* attitude of the representative consumer toward the environment. Altruistic actions (choices) may be manifested by a willingness to pay a higher price for a commodity if its production, distribution, or consumption involves less harm to the environment, thereby increasing the demand for the good. Or, it may be displayed by choosing to completely forego (boycott) the consumption of an environmentally harmful commodity, thereby reducing (or even cutting off) its demand. In either case, the consumer incurs a cost, but need not necessarily share in the benefits of his/her action. These benefits may well occur in far distant places (the boycott of hamburgers produced from cattle ranches in the Amazon Rain forests), or in the far distant future (switching to low emission or emission-free vehicles to mitigate the global warming effect of burning fossil fuels). The following are further examples:

- Consumer's preference for organic over conventionally produced agricultural products, where preference is derived not only from concern for the quality of the products, or food safety and health risks, but rather from the beneficial environmental effects associated with organic farming.
- Consumers' preference for cruelty-free cosmetics over the animal tested ones, for "eco-friendly" detergents, for CFC-free aerosols, for recycled paper, or by their aversion to electricity produced using nuclear generating technology.

Softkey

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Evaluation of California Commodity Marketing Programs

by Hoy F. Carman

GOVERNMENT mandated commodity marketing programs continue to be both popular and controversial. These programs, which are requested, approved, and funded by California producers, have the stated objectives of contributing to orderly marketing and/or improving producers' returns. Their popularity is reflected by their long-standing use and the number of California commodity groups which have approved these programs.

Currently, California has 13 federal marketing orders and 48 state marketing programs, including state marketing orders, commodity commissions, and councils. California commodity producers have recently assessed themselves upwards to $150 million annually to operate these marketing programs, with about 75% of budgeted expenditures devoted to generic advertising and promotion. These programs cover commodities that account for over 50 percent of California's agricultural output, based on value.[1]

The use of these marketing programs is in a continuous state of flux. A total of 24 new state programs were added since 1980 and 15 were terminated. Of the 17 federal marketing orders operating in 1993, four were eliminated by January 1996, with none added. The federal programs that were terminated included the marketing order for desert grapes and the long-standing marketing orders for California-Arizona navel oranges, Valencia oranges, and lemons. Five of the currently effective California programs have been in continuous operation for over 50 years.

Although supported by an overwhelming majority of covered producers, government mandated commodity marketing programs have encountered organized and powerful opposition. The opponents, who have largely failed in the political arena, have concentrated on filing legal actions against various provisions of individual programs. These legal challenges were largely ineffective until 1995, when the U.S. Ninth Circuit Court declared that federally required funding of commodity promotion programs for peaches and nectarines violated the First Amendment rights of the producers funding them. This decision, which had a potentially adverse impact on all state and federal mandatory commodity promotion programs, was appealed by the government to the United States Supreme Court and the case, *Daniel R. Glickman, Secretary of Agriculture* v. *Wileman Bros. & Elliott, Inc., et al.* was heard December 2, 1996. In a 5-4 decision handed down on June 25, 1997, the Supreme Court upheld the constitutionality of federally required funding of commodity promotion programs. This action, which reversed the Ninth Circuit's 1995 decision, will severely restrict First Amendment challenges to marketing programs, but likely it will not end the legal challenges to these programs. A number of pending court cases involving constitutional challenges to the marketing programs for kiwifruit, plums, apples, grape rootstocks, cut flowers, almonds, milk, and cling peaches are expected to be dismissed as a result of the Supreme Court decision.

Economic Evaluation of Marketing Programs

Legal actions have focused producer, legislative, and administrative attention on the effects of mandated marketing programs. Provisions in the 1996 Farm Bill require all Federal Research and Promotion Boards to do an economic evaluation of their programs at least every five years. While evaluations are not required for state programs, some of the largest and most visible programs have begun to investigate the impacts and effectiveness of their program expenditures. There is increasing interest in verifying and documenting the costs and returns associated with expenditures on (1) advertising and promotion, (2) minimum maturity, size, and quality standards, (3) quantity controls in the form of reserves, prorate, and set-aside, and (4) research programs.

Faculty in the Department of Agricultural and Resource Economics at UC Davis have a long tradition of conducting research on important California commodity problems and issues. Recent industry sponsored research include projects on California almonds, walnuts, table grapes, avocados, prunes, and dairy products. The almond research focused on the specification and estimation of a detailed econometric model of both domestic and export market almond supply and demand that can be used to assess the impacts of industry programs. The walnut research was designed to determine the impact of market development efforts in Japan. The research projects for table grapes, avocados, and prunes had an objective of computing benefit/cost ratios for industry funded domestic advertising and promotion programs. Reports for each of the projects have been submitted to the commodity groups, and publications from the almond, walnut, and table grapes projects are available. For the other projects, manuscripts prepared for publication are in

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various stages of the review process. Research procedures, data sources, and results will be of interest to California commodity groups who are considering the evaluation of their own programs' economic impacts. Following are some brief comments on each of the research efforts.

California Almonds

Details on the econometric model of the almond industry are contained in a Giannini Foundation Monograph.[2] This model, which can be used for industry simulations and the evaluation of alternative marketing programs, shows that industry actions which increase short-run returns can be expected to lead to increased almond plantings in California and in competing areas, such as Spain.[3] The model has been updated and frequent projections of acreage adjustments with pricing projections are available to California almond producers to help guide investment decisions.

California Walnuts

Weiss, Green, and Havenner examined the impact of the USDA's Market Promotion Program (MPP) for walnuts in Japan. They concluded that the program had been very effective in the Japanese market, with a cumulative increase in shelled walnut shipments totaling 4.5 tons for every $1,000 of promotion expenditures. In total revenue terms, each promotional dollar spent in Japan increased revenues by approximately $5.85.[4]

Table Grapes

Work completed and underway documents significant increases in product demand as a result of commodity advertising and promotion programs, with net monetary benefits to producers being much greater than costs. For example, Alston, *et al.* (1997) estimated that the elasticity of demand with respect to promotion for California table grapes was 0.16.[5] Using this promotion coefficient, they estimated that the promotional activities of the Table Grape Commission had increased per capita consumption by about 1.5 pounds over that which would have existed in the absence of a promotional program. This increase was about one-third of recent total per capita consumption. The benefits to producers were very high in both the short and long-run. The short-run marginal benefit-cost ratio was estimated at over 80:1 which indicates that, for every $1 spent on the program, the industry gained net benefits of $80. When producer supply response was factored into the analysis, the benefit-cost ratios decreased. Using a supply elasticity of 5, the average benefit-cost ratio was about 10:1 and the marginal benefit-cost ratio for a 10 percent increase in promotional expenditures was about 5:1.

Avocados

Carman and Craft found that industry advertising and promotion programs have significantly increased the demand and price for California avocados.[6] Based on estimated price flexibilities of demand, a 10 percent increase in advertising and promotion expenditures was associated with a 1.3 percent increase in the price of California avocados. Estimated discounted short-run (month-to-month and year-to-year) returns ranged from $5.33 to $6.35 for every dollar spent on advertising and promotion over the period of analysis. After allowing for increased production due to improved returns, discounted real long-run returns from advertising and promotion expenditures still averaged $1.71 to $1.78 for every dollar of advertising and promotion expenditures over the 34-year period of analysis. While the estimated benefit-cost ratios for avocado advertising and promotion were below those for table grapes, estimated returns were still quite attractive in both the short and long-run.

Prunes

Our most recent research results indicate that expenditures on promotion by the California Prune Board and by Sunsweet Growers have significantly increased the demand for prunes.[7] For the various models estimated using ordinary least squares (OLS), the elasticity of sales with respect to promotion generally ranged from 0.17 to 0.22, meaning that a 10 percent increase in expenditures on promotion would have induced about a 2 percent increase in sales, holding price and other explanatory variables constant. The marginal benefit-cost ratio for promotion of California prunes hinges importantly on the value of the price elasticity of supply and on whether growers bear the entire burden of funding the expenditures or some of the burden is shifted to consumers.

For values of the price elasticity of supply of prunes in the range of 0.0 to 0.5, the means of the simulated marginal producer benefit-cost ratios range from 9.0:1 to 20.7:1 for 1992-1996 if only the producers' share of the assessment burden is considered (*i.e.*, some of the burden is shifted to consumers), and from 1.1:1 to 2.4:1 if producers are assumed to bear the entire burden of the assessment. Only when the supply elasticity is increased to 1.0 and producers are (implausibly) assumed to bear the entire cost of the promotion, is it possible to derive average benefit-cost ratios less than 1:1. Over the four-year period analyzed, investments by prune growers in promotion yielded them marginal returns of at least $2.65 for every dollar spent. Moreover, marginal benefit-cost ratios in the range of 2.7:1, and

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rBST Use in the California Dairy Industry

by L.J. (Bees) Butler

BOVINE somatotropin is a naturally occurring (peptide) hormone produced in the pituitary gland of cows. It was discovered in the 1920s, and originally called bovine growth hormone or BGH. Experiments in the 1930s revealed that BGH, when extracted from the pituitary gland of a cow and injected into another cow, could increase milk production in the recipient cow. In the late 1970s, Dr. Dale Bauman, an animal scientist at Cornell University, successfully transferred the gene responsible for BGH production in cows to a bacterium. The resulting product was called recombinant bovine growth hormone, or rBGH. Simple multiplication of the bacterium meant that it could easily be produced in commercial quantities at a very reasonable cost. Several pharmaceutical and nonpharmaceutical companies became very interested in the product in the early 1980s. Despite the fact that rBGH is a peptide hormone and not a (much-maligned) steroidal hormone, to avoid the stigma associated with hormones, the industry agreed to change its name to bovine somatotropin (BST). Thus, its synthetic analog would be called recombinant bovine somatotropin, or rBST. Today, both names (rBGH and rBST) are still used.

Four companies involved in rBST research applied for patents for their particular brands of rBST in the early 1980s, which resulted in many misstatements, exaggerations and misunderstandings. Congressional hearings were held in June 1986. From these hearings emerged the alleged last word on rBST. The basic findings were:

- rBST, when injected into a cow, could cause a 10-25 percent increase in milk production.
- There was also a 10-15 percent increase in feed efficiency. This means that there was an effective decrease in feed costs per unit of milk produced, and therefore a lower average cost of production.
- rBST appeared to be safe both for human milk consumption and for cows.

It took until November of 1993 to gain FDA approval, and rBST was not released commercially until February of 1994. However, the controversy surrounding rBST that has existed since 1983 continued. Specifically, questions were raised about adverse health effects on animals treated with rBST, the appropriateness of the technology for an industry plagued with surpluses, the effects of increased milk production on milk prices, and the plight of the family farm in the U.S. Media coverage about the impacts of rBST has been intermittent since 1983, but increased substantially from 1988-1993.

In 1987 a survey of California dairy producers was carried out to determine their attitudes and concerns about rBST. A sample of 152 producers (about 7 percent of the total) was drawn randomly from a complete list of all Grade A dairy producers in California.[1] Grants from the Giannini Foundation and the University of California Biotechnology Research and Education Program allowed the author to continue to survey the same producers every year (except 1995) to the present. In 1990, the original survey sample was increased to 262 producers to represent approximately 10 percent of the total California dairy producer population.

The overall objective of this long-term research was to survey a continuous sample of California dairy producers prior to, during, and after the commercial availability of rBST to determine a timetable of adoption and diffusion patterns. A review of the results collected to date provides an interesting perspective on the prospective adoption of the new technology prior to and during its release. For example, the results indicate that as more information regarding a new technology becomes available, opinions and attitudes toward the new technology change, thus significantly modifying the responses to the survey.

Impress

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Survey Results Before rBST Availability (1987-1993)

Prospective Adoption Rates

Survey participants were asked whether they would use rBST immediately after it became available, wait to use it, or would not use it at all. Over the 7 years of the survey prior to the commercial availability of rBST, responses to this question varied considerably. As more information became available and as the controversy surrounding rBST increased, survey respondents dramatically reduced their desire to use it immediately after it became available.

The proportion of respondents who said they would *not* use rBST at all increased 33 percentage points between 1987 and 1993. Similarly, the number of those who said they would use rBST dropped from a high of 55 percent in 1988 to 30 percent in 1993.

Concerns about rBST

Those who said they would not use rBST expressed a variety of reasons for not using it, but these opinions changed over the years. For the seven years prior to the commercial availability of rBST, the major reason for not using it was concern about negative consumer reaction and its effect on milk sales. The proportion of respondents expressing this concern increased dramatically from 1987 to 1990. A consistent secondary concern of respondents was concern over cow health as a result of using rBST.

Three other frequently expressed reasons for not using rBST were concerns about milk quality and safety, concerns over whether primary handlers would accept milk from cows treated with rBST, and a desire to avoid injecting cows on a daily basis. Finally, a more recent concern has been the cost of rBST. While the companies who manufacture rBST did not indicate a price at which they would sell the product once it was approved for commercial use, the uncertainty surrounding the issue was clearly a concern. Recent research indicates that for every $0.01 increase in the cost of rBST per day, there is $2 per cwt. of milk decrease in net revenues.[2]

Apart from the concerns expressed by those producers who said they would *not* use rBST, over 70 percent of respondents who said they *would* use rBST consistently expressed some concerns about using it, or about its impacts. Three major concerns consistently emerged over the seven years of the survey prior to commercial availability. Most prospective users worried over public opinion and potentially negative consumer reactions to the use of rBST. This concern increased dramatically over the years of the survey and was considered by many to be the major reason why the California dairy industry was skeptical about the use of rBST. Many producers expressed concern over rBST's potential to increase milk production resulting in increased surpluses of milk and a consequent decline in milk prices. Producers also expressed an increasing concern about cow "burn out" reflecting the continuing uncertainty about this issue. Others questioned the cost effectiveness of rBST and the administration method.

1994 and 1996 Preliminary Survey Results

Adoption and Use of rBST

With the FDA approval of rBST in November, 1993 and its commercial availability in February 1994, the survey was modified to solicit responses about current use of rBST, its use in the past, or consideration of its future use. Table 1 is a tabulation of the adoption and use of rBST in 1994 and 1996.

Overall we could conclude that about 20 percent of California dairy producers were currently using rBST. Another 8 percent had used it in the past for a total

Table 1: Adoption and Use of rBST in 1994 and 1996

	% of Respondents		% of Total Avg. Cows Represented		% of Cows Treated		% of Total Cows Treated	
	1994	1996	1994	1996	1994	1996	1994	1996
Current Users	18	18	30	30	25	20	8	6
Past Users	5	8	9	12	23	23	2	3
Prospective Users	18	30	19	28	22	23	4	6
Non Users	59	44	43	30	0	0	0	0

adoption rate of about 28 percent. Another 20-30 percent of producers reported that they would consider using rBST in the future, defined as prospective users. If these figures are an indication of total rBST use in California, and taking into account those who may stop using it, then we might expect a total adoption rate of about 45-50 percent.

If, however, we are to gauge the impact of rBST on total milk production, we must examine the proportion of the total cows that have been treated with rBST. As Table 1 indicates, while about 20 percent of producers have adopted rBST, respondents reported treating an average of about 20-25 percent of cows. Thus, only 5-8 percent of the cows were being treated with rBST at that time. If we include producers who have used it in the past but have stopped, the total proportion of cows treated with rBST in our sample in 1994 and 1996 was about 10 percent.

Assuming cows were treated only during mid and late lactation when 64% of the milk is produced, and an 11% average increase in milk production, then:

10% of the cows
x 11% milk increase
x 64% = 0.00704 which is <1%.

Therefore, we could conclude that rBST use in California in 1994 and 1996 probably resulted in an increase in milk production of less than 1 percent per year.

Of the few producers who reported using rBST in the past but had stopped using it, half said they stopped using it because of the cost of rBST. Presumably these producers have figured that it was not feasible to use rBST either because of the cost of the rBST itself, or because the added cost of producing the extra milk did not noticeably increase profits. The rest reported having reproductive problems with rBST, and one producer was just experimenting.

Most of the current users of rBST reported using their monthly milk testing records or daily milk tank measurements to monitor the increase in milk production from using rBST. Similarly, almost 95 percent of the current users were monitoring changes in feed intake by weight or by total mixed ration programs.

Concerns About rBST

Among those who were currently using rBST, have used it in the past, or were considering using it in the future, over 68 percent still had concerns about it. Table 2 tabulates these concerns.

In 1993 just prior to the commercial availability of rBST, 60 percent of those who said they would use rBST indicated that they had concerns about public opinion. In 1994, this concern had dropped to just 12 percent of those who were current and prospective users of rBST, and increased slightly in 1996. Concerns about administration methods and handler refusal of milk also decreased substantially in 1994 and 1996.

Table 2: Concerns of Past, Current and Prospective Users of rBST in 1994 and 1996 Compared to 1993

(numbers do not sum to 100 due to multiple responses)

	1993	1994	1996
Public opinion	60	12	17
Adverse prices	20	26	19
Cow "burn out"	23	52	56
Cost effectiveness	31	21	25
Application method	17	7	0
Milk quality / safety	6	5	6
Reproductive problems	17	31	16
Handler refusal of milk	20	2	12
Not enough research	11	7	0
Other	17	21	44

More recently, users were clearly more concerned about the potential impacts of rBST on the health of their herds. For example, whereas only 23 percent of those who said they would use rBST in 1993 were concerned about cow "burn out", 52 percent of current and prospective users were concerned about it in 1994. This increased slightly in 1996. Similarly, only 17 percent of those who said they would use rBST in 1993 were concerned about reproductive problems; 31 percent were concerned about it in 1994, but this decreased to 16 percent in 1996.

In 1994 and 1996 there was clearly still some uncertainty about rBST among its current and prospective users. Apart from concerns about the health of their herds, concern about adverse prices due to increased milk production also increased slightly in 1994 but decreased in 1996. And although concerns about the cost effectiveness of rBST decreased from 31 percent in 1993 to 21 percent in 1994 and 25 percent in 1996, this concern still ranked fourth among the concerns of current and prospective users.

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There were some interesting differences between those who were currently using rBST, or who used it in the past, and those who said they would consider using rBST in the future. Current and past users clearly had fewer if any concerns about public opinion or adverse prices and were mostly concerned about herd health and cost effectiveness. Prospective users of rBST, on the other hand, still had concerns about public opinion and adverse prices as well as herd health.

We asked each respondent who said they would consider using rBST in the future what single factor would play a major role in their decision to use rBST. A major proportion of them (45 percent) felt that they would only use it if economic forces compelled them to adopt it. That is, many producers felt that there were better ways of increasing herd productivity than using rBST, but they were not prepared to neglect the technology in their decision making; they would use it if they needed to in order to remain competitive. Another 26 percent of respondents said they would use rBST in the future if they could obtain a release from the affidavit they signed with their cooperative or creamery agreeing not to use it. The rest of the respondents gave a variety of reasons for considering using rBST in the future, including consumer acceptance, recommendation from the veterinarian, easier administration methods, and waiting until the issues had played themselves out.

Conclusions

A panel survey of about 260 California dairy producers between 1987 and 1993 indicated a declining interest in using rBST immediately after it became available. Preliminary results of the survey (of the continuous sample) in 1994 and 1996 indicated that about 10 percent of the total California herd was currently being treated with rBST. Average milk yield response appeared to be about 11 percent. Therefore, rBST use in California in 1994 and 1996 probably resulted in an increase in milk production of less than 1 percent per year.

There was clearly still some uncertainty about rBST use among its current and future users. Concerns about public opinion and the effect on milk sales have diminished dramatically. However, current and prospective users still had concerns about the effect of rBST on the health of their herds, adverse prices as a result of increased milk production, and the cost effectiveness of the new technology.

Future use of rBST will depend largely on how producers adapt the new technology to their current management styles and the effect that it will have on their profit margins in the next 2-3 years. A 1997-98 study is in progress, in which a greater number of dairy producers are included in the survey.

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A higher environmental standard in the short-run can increase firms' profitability and scale. In the long-run it can encourage more firms to enter the industry than would be the case with a lower standard, and, despite the possibility of lowering each firm's output level, expand the industry's aggregate supply. Importantly, these positive effects can be obtained in addition to improvements in environmental quality and increased social welfare.

The analysis shows that each firm must achieve a *minimum* amount of pollution abatement to stay in the market. That amount is higher in *less* efficient industries.

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higher, indicate that the industry could have profitably invested even more in promotion during this period.

Dairy Products

A research team, working with the Dairy Council of California, examined the costs and returns of nutrition education programs sponsored by the council in California schools.[8] The focus of the study was on one of their programs, the "Exercising Your Options" (EYO) program for sixth, seventh, and eighth grade students. The EYO program consists of materials provided by the Dairy Council to help teachers explain the USDA's Food Pyramid and other nutrition related topics. While nutrition education has potential benefits to several groups, in addition to the individual students, the main focus was on the private benefits to the California milk producers and processors who fund the programs. Research questions included the effect of the nutrition education program on consumption of dairy products and other food groups, the persistence of changes in consumption (the "wear-out" effect), and the effect of any demand changes on total revenues received by California milk producers.

Three sets of detailed food records completed by all of the students in a representative sample of over 100 California classrooms were collected and analyzed. The "Exercising Your Options" program did affect the eating habits of the children who participated in the program, at least in the time frame sampled. Under a number of reasonable assumptions, the benefits to milk producers from increased fluid milk consumption outweighed the costs of the program, and the private benefit-cost ratio was greater than one. The overall benefit-cost ratio would have certainly been even greater when the positive externalities and the full, long-run benefits generated by the program were included.

The Future

Commodity marketing administrative committees will continue to face questions concerning the economic effectiveness of their individual marketing program expenditures. Given standards of evidence and information presently available, many California commodity groups are in the position that they would be hard-pressed to defend their marketing programs in a court of law should the need arise. The studies described above provide important information for selected commodities, but empirical evidence concerning the impact of marketing order programs on producers, marketing intermediaries, and consumers has a large number of gaps. Review of these studies will provide interested readers with details on data requirements and some of the gaps and deficiencies encountered, as well as an appreciation for the analytical techniques employed. California commodity groups who have a serious interest in an economic evaluation of their programs, however, may want to consult with UC Davis Department of Agricultural and Resource Economics researchers to determine the adequacy of data resources and analytical requirements.

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For information on how to obtain reprints of the above, call the ARE Department, (530) 752-1515, or visit our Web site at http://www.agecon.ucdavis.edu/outreach/outreach.htm

Hoy F. Carman is a professor in the Department of Agricultural and Resource Economics. His fields of interest include agricultural marketing, managerial economics, and economic aspects of taxation. Dr. Carman can be contacted at (530) 752-1525, or visit his Web site at http://www.agecon.ucdavis.edu/Faculty/Hoy.C/Carman.html

ARE Faculty Profile

PROFESSOR Richard Howitt, a native of England, came to Davis in 1970 to earn both his M.S. and Ph.D. degrees in Agricultural Economics. Before that he worked as a farm management consultant in western Australia. He has been on the ARE faculty since 1975, maintaining an active research and teaching program.

Dr. Howitt's fields of interest include resource economics, environmental economics, and quantitative methods. The focus of his current research interests includes:

- **Disaggregated economic modeling methods.** Dr. Howitt is developing reconstruction and calibration methods based on maximum entropy estimators to model the economic structure of farming and other economic uses of land and resources from disaggregated data on land area, yield, and crop selection. In short, instead of using economic survey data to infer the use of resources, Dr. Howitt is using physical data to infer the underlying economic functions facing the manager. The reasons for this approach are (1) environmental analysis must be done on a disaggregated level to be meaningful, and (2) remote sensing methods can supply physical data at a fraction of the cost of economic surveys.
- **Market mechanisms to allocate resources and achieve environmental goals.** His research focuses on water use and associated water and air pollutants from agriculture. This is implemented with the design of electronic water markets, and testing of institutions for theoretical properties, using an experimental economics laboratory.
- **Empirical dynamic stochastic methods.** These approaches can be used to analyze the switch in investments and changes in institutions subject to dynamic stochastic inputs and irreversible costs or decisions.

In addition to Dr. Howitt's research and teaching responsibilities, he serves on a number of boards and commissions on the state and federal level. Currently he is serving on committees that are drafting water transfer legislation, reviewing Bay-Delta economic models, and establishing electronic water markets in the San Joaquin valley. These research projects are part of a larger change in California's water system.

Water is California's most limiting resource and it impinges on life in the state in many ways. Agricultural production, which uses the majority of the developed water supplies in the state, is affected through the timing and availability of irrigation water supplies and drainage problems. Industrial and urban development in the state is heavily restricted by water availability and reliability since most of the development is occurring in water-short parts of the state. The impact of water on environmental conditions and the quality of life in residential areas is a new and rapidly growing demand. These competing pressures for different uses of water are in the process of forcing a change in the way in which this resource is developed and managed. Essentially, the water system in the state is moving from one which satisfied new demands by new supply development, to one which can manage and reallocate the existing developed water supply in a way that accounts for California's variable and capricious climate that swings from drought to flood conditions in rapid cycles. These new conditions require a water industry that more resembles the energy sectors where price signals enable production to be shifted and reallocated as industries, technologies, and demands change.

Richard E. Howitt

In his spare time Dr. Howitt is a regular lunchtime runner from the UC Davis gym, has a small hobby farm with sheep and horses, and has an interest in the restoration of classic cars. He is also an associate editor of *California Agriculture*.

Professor Howitt has an extensive list of publications and several economic models posted on his Web page, which can be accessed at http://www.agecon.ucdavis.edu/Faculty/Dick.H/Howitt.html

Sample of Available Cost of Production Studies

UC Davis Department of Agricultural and Resource Economics

Commodity	County/Region	Year	Production Conditions
Alfalfa	Yolo	94	Hay, flood irrigated
Almond	Sacramento Valley	95	Sprinkler irrigated
Apple	Central Coast	94	Organic, fresh market
Apple	Sonoma	94	Golden Delicious, Rome, sprinkler irrigated
Artichoke	Imperial	95	Imperial Star, Emerald
Asparagus	Imperial	95	Nonspecific varieties
Barley	San Luis Obispo	95/96	Dryland, conventional tillage
Bean, green	Fresno	93	Nonspecific varieties
Bean, garbanzo	San Luis Obispo	95/96	Dryland, conventional tillage
Beef	Fresno/Madera	93	Cow-calf, rangeland
Broccoli	Imperial	95	Nonspecific varieties
Cabbage	Imperial	95	Nonspecific varieties
Cantaloupe	Imperial	95	Fall crop, nonspecific varieties
Carrot	Imperial	95	Nonspecific varieties, cello packs
Cauliflower	Imperial	95	Nonspecific varieties
Citrus	Ventura	93	Lemon, Valencia orange
Corn, sweet	Imperial	95	Yellow, white
Corn, field	Yolo	94	Woodland area
Cotton	Riverside	97	Palo Verde Valley
Cotton	San Joaquin Valley	95	40 inch rows
Cotton	San Joaquin Valley North	95	Organic
Cucumber	San Joaquin Valley	93	Greenhouse, bag culture
Cucurbit Seed	Sacramento Valley	95	Nonspecific varieties
Eggplant	Fresno	93	Japanese, fresh market
Fig	San Joaquin Valley	94	Black Mission
Grape, wine	Santa Barbara	96	Chardonnay, drip irrigation
Grape, wine	San Joaquin Valley	94	Cabernet Sauvignon
Grape, raisin	San Joaquin Valley	97	Thompson Seedless, drip irrigation
Grape, raisin	San Joaquin Valley South	97	Organic
Lettuce	Riverside	96	Loose leaf, Coachella Valley
Melon	Imperial	95	Mixed muskmelons
Okra	Riverside	95/96	Furrow irrigated, Coachella Valley
Olive	San Joaquin Valley South	97	Manzanillo
Onion	Imperial	95	Processing, White Creole
Orange	San Joaquin Valley	95	Navels, Valencias, low volume irrigation
Pasture	Stanislaus/San Joaquin	93	Irrigated
Pear	Lake	94	Bartlett, sprinkler irrigated
Pecan	Tulare	94	Flood irrigated
Pepper, chili	Riverside	95/96	Drip irrigated, Coachella Valley
Pepper, bell	San Benito, Santa Clara	97	Drip irrigated
Pistachio	San Joaquin Valley	96	Low volume irrigation, Kerman area
Potato	Kern	95	Nonspecific varieties
Prune	Sacramento Valley	95	French, low volume irrigation
Safflower	Yolo	96	Irrigated
Sheep	Fresno, Madera	93	Range fed
Squash, zucchini	Fresno	93	Plastic mulch, tunnels, drip irrigation
Strawberry	Fresno	93	Freezer type
Strawberry	Santa Cruz, Monterey	96	Winter planted
Sugarbeet	Yolo	94	Spring planted
Tomato	Imperial	95	Processing, nonspecific varieties
Tomato	Sacramento Valley	94	Organic, processing
Tomato	Yolo	97	Processing
Walnut	Sacramento Valley	94	Organic, sprinkler irrigated
Walnut	Sacramento Valley	95	English, sprinkler irrigated
Watermelon	Imperial	95	Seedless
Wheat	San Luis Obispo	95/96	Dryland, conventional tillage
Vegetables, mixed	**Central Coast**	**94**	**Organic**

The price of each Cost of Production Study is **$1.00** (other than the Organic Mixed Vegetable Study, which is **$10.00**). For a complete list of over 125 available Cost of Production Studies on crops grown in different regions under varying production conditions, call the ARE department at **(530) 752-1515** or view our Web site at **http://www.agecon.ucdavis.edu/outreach/outreach.htm**

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