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Indirect Effects of Pesticide Regulation and the Food Quality Protection Act

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The Issue

A driving factor behind pesticide regulation in Canada and the United States is the desire to protect consumers from harmful residues on food. The Food Quality Protection Act (FQPA) was unanimously passed by the U.S. Congress in 1996 and hailed as a landmark piece of pesticide legislation. It amended the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA), and focused on new ways to determine and mitigate the adverse health effects of pesticides. The FQPA is different from past legislation; it is based on the understanding that pesticides can have cumulative effects on people and that policy should be designed to protect the most vulnerable segments of the population. Recent research has investigated some of the impacts the FQPA's provisions – many of which have yet to be fully implemented – may have on growers and consumers.

Implications and Conclusions

Under the FQPA, the U.S. Environmental Protection Agency is required to review classes of agricultural pesticides to assess the risks posed by aggregate use of these chemicals. Such cumulative risk assessments may result in reduced exposure to harmful substances but may also impose substantial costs on growers and consumers by removing common pesticides from use. The case of organophosphate use in California provides a vehicle for examination of these aspects of regulation.

When a pesticide ban has economic consequences that raise the market price of fruits and vegetables, consumers will respond by consuming less of the affected goods. Since increased consumption of fruits and vegetables is related to a decreased incidence of several common diseases, there may be dietary health effects that detract from the public health benefits of such bans. The magnitude of these countervailing risks is sufficiently large that more lives may be lost than saved by some regulatory actions.

The FQPA's Main Provisions

The publication of the National Research Council (United States) report *Pesticides in the Diets of Infants and Children* (1993) showed that pesticide residues have disproportionate effects on children. Children eat and drink more as a percentage of their body weight than do adults; they also consume fewer types of food. These dietary differences account for a large part of the exposure differences between adults and children. The committee also found that pesticides have qualitatively different impacts on children because children are growing at such a rapid pace. This concern for the differential impact pesticides have on children is reflected in regulatory changes required by the FQPA. For instance, the "10X" provision of the FQPA requires an extra tenfold safety margin for pesticides that are shown to have harmful effects on children and women during pregnancy.

The FQPA has also resolved the "Delaney Paradox" created by the Delaney Clause of the FFDCA. Prior to the FQPA, the Delaney clause prohibited the use of any carcinogenic pesticide that became more concentrated in processed foods than the tolerance for the fresh form. This was supposed to protect consumer health, yet it had the paradoxical effect of promoting other non-carcinogenic pesticides that created other (possibly more serious) health risks for consumers. The FQPA standardizes the tolerances for pesticide residues in all types of food and looks at all types of health risks.

The federal Environmental Protection Agency (EPA) must now ensure that all tolerances are "safe", defined as "a reasonable certainty that no harm will result from aggregate exposure to the pesticide" (United States Environmental Protection Agency, 1999). Historically, pesticide exposure was regulated through single pathways, either through food or water or dermal exposure. Now the EPA must consider all pathways of pesticide exposure, including cumulative exposure to multiple pesticides through a common mechanism of toxicity. Even though two pesticides may be sufficiently differentiated that they are used on different crops to control different pests, they can have similar health effects on people. The result of the new requirement is that, in some instances, pesticide tolerances for seemingly different insecticides must be regulated together based on their cumulative effects.

The Costs of Banning Organophospates

When the FQPA was first signed into law, 49 Organophosphate (OP) pesticides were registered for use in pest control throughout the United States and accounted for approximately one third of all pesticide sales (Casida and Quistad, 1998). OP insecticides are highly effective insect control agents because of their ability to depress the levels of cholinesterase enzymes in the blood and nervous systems of insects. It has been suggested that while dietary exposure to a particular OP may be low, the cumulative effects of simultaneous exposure to multiple OP insecticides could cause some segments of the U.S. population to exceed acceptable daily allowances (Byrd, 1997). The need to reduce the risk from these aggregate effects is specifically addressed in the FQPA and is one of the reasons the EPA has chosen OP pesticides for the first cumulative risk assessment.

Due to their popularity and widespread use, many in the agricultural community are worried about FQPA implementation resulting in increased restrictions on OP pesticides. By the time the EPA released the Revised OP Cumulative Risk Assessment in 2002, 14 pesticides had already been canceled or proposed for cancellation; 28 others have had considerable risk mitigation measures taken (United States Environmental Protection Agency, 2002). Risk mitigation may include the following:

- limiting the amount, frequency, or timing of pesticide applications;
- changes in personal protective equipment requirements (for applicators);
- ground-/surface-water safeguards;
- specific use cancellations;
- voluntary cancellations by the registrant.

Economic theory suggests that these increased restrictions and cancellations from the eventual implementation of the FQPA will result in a reduced supply of the commodities that currently rely on OP pesticides for pest control. This reduced supply will result, in turn, in higher prices for consumers and a lower quantity sold. In order to estimate the possible welfare effects on the state of California, University of California researchers conducted a study on the effects of a total OP pesticide ban on 15 crops. The estimated price and quantity changes are presented in table 1.

Table 1 Price and Production Changes from Organophosphate Ban

Crop	Change in price (Percentage)	Change in production*	
		California	Rest of U.S.
Alfalfa	0.93	-184,845	48,743
Almonds	0.48	-1,356	n/a
Broccoli	16.00	-111,285	2,083
Carrots	>0.01	-5	-3
Cotton	1.69	-1,148	-19,214
Grapes	0.05	-999	-265
Lettuce, head	0.36	-12,778	3,864
Lettuce, leaf	0.46	-1,510	-148
Oranges	0.32	-40,517	-28,137
Peaches & nectarines	0.32	-1,561	-2,016
Strawberries	0.26	-508	-743
Tomatoes, fresh	0.03	-388	-223
Tomatoes, processed	0.16	-10,849	114
Walnuts	0.58	-1,091	n/a

* Change in tons
Source: Metcalfe et al. (2002).

Results of the economic analysis suggest that the total loss to producers and consumers in California from banning all OP use will be approximately $200 million. There is significant uncertainty as to the final level of OP restrictions that might be imposed, so this is only an order-of-magnitude estimate of the effects. However, these effects represent only about 2 percent of the total revenue generated by the 15 crops studied in California. While the overall effects seem small, they may be more intense in some segments than others. The researchers found that the degree of impact rests on the effectiveness of alternative pest control strategies producers have to choose from when faced with an OP ban. In some cases, OP pesticides have no close substitute, and cancellation will have larger effects. For instance, the losses in broccoli, one of the crops most sensitive to an OP ban, are driven by the lack of an alternative insecticide to treat cabbage maggot.

Prices and Nutrition

As illustrated above, it is generally true that removing a pesticide from the production process will result in an increase in the price of the treated commodity. If consumers respond to the increased prices by reducing consumption of the affected fruits and vegetables (and perhaps shifting consumption to less nutritious foods), they may suffer a loss of health benefits associated with the change in consumption. Scientific evidence is accumulating for a protective effect for fruits and vegetables in prevention of cancer, coronary heart disease, ischemic stroke, hypertension, diabetes mellitus, diverticulosis, and other common diseases. The level of protection suggested by these studies is often quite dramatic. A recent review of several studies found that “the quarter of the population with the lowest dietary intake of fruits and vegetables compared to the quarter with the highest intake has roughly twice the cancer rate for most types of cancer” (Ames, Gold and Willett, 1995).

Negative health outcomes from a change in dietary behavior may offset the direct health benefits of a pesticide ban, such as reduced exposure to carcinogenic residues on produce. A recent study by Cash (2003) investigates the possible magnitude of such offsetting health effects. Using data on what over 18,000 people eat, and previous findings on how people respond to changes in the price of fruits and vegetables, the author simulated some of the health effects of a small increase in produce prices. Specifically, Cash examined the effects of an increase of 1 percent in the price of broad categories of fruits and vegetables on coronary heart disease and ischemic stroke, two of the most common causes of death in the United States. The results are reported in table 2.

For a 1 percent increase in the average price of all fruits and vegetables, the simulations indicate an increase of 6,903 cases of coronary heart disease and 3,022 ischemic strokes. In order to offset these 9,925 cases in a population of 253.9 million people, a pesticide action would have to prevent 1 in 25,580 cancers. This is almost four

Table 2 Cases of Coronary Heart Disease and Ischemic Stroke Induced in the U.S. Population by a 1 Percent Increase in the Price of All Fruits, All Vegetables, or All Fruits and Vegetables

Disease	All fruits	All vegetables	All fruits and vegetables
Coronary heart disease	1,442	2,951	6,903
Ischemic stroke	744	1,482	3,022
Total	2,186	4,433	9,925

Source: Cash (2003).
Results reported are the simulation means from a series of Monte Carlo trials (n=100,000).

times as protective as the mean risk of pesticide uses that were banned between 1975 and 1989 (Van Houtven and Cropper, 1996). Although these results can not be applied directly to most individual pesticide bans – which typically affect the price of only a few crops – the study shows that pesticide regulations that reduce relatively small risks at high cost may actually have a negative impact on overall consumer health. Furthermore, the research also suggests that low-income consumers may be the hardest hit by the negative health impacts of price-induced dietary changes, whereas high-income consumers tend to reap the greatest direct benefits from reduced residue exposures.

Discussion

Economic theory tells us that regulatory intervention is justified in the presence of market failures. In the case of pesticide residues on food, the two most salient sources of failure are externality and incomplete information. The externality arises because the costs associated with dietary exposure to pesticide residues are not in the main borne by the producers who make the application decisions. The incomplete information problem arises because a consumer cannot easily determine the level of pesticide residue on produce. Even if the level were readily apparent, the nature of the risks posed by these residues is not well understood.

The problem illustrated in the previous section is that regulatory decisions that are based on narrow criteria may give rise to other undesirable outcomes. When the target risk is small and the costs of reducing it are relatively large, there is a strong possibility that the net effect of a regulatory effort may be negative. Although consideration of such tradeoffs may be repulsive when the metric is in "body counts", the reality is that it is impossible for government to eliminate all risks to our health and well-being. A standard of discretion must be applied, whether it be benefit-cost analysis, established levels of acceptable risk, or some other measure.

The Food Quality Protection Act is a wide-reaching law that will have a large impact on U.S. agriculture in the coming years. While an increased awareness of the effects of agricultural chemicals on vulnerable groups – especially infants – is a welcome addition to the nation's pesticide laws, regulators need to take into account the potentially high costs of additional pesticide bans on both producers and consumers. These costs can be measured not just in dollars, but also in dietary changes that may have negative health consequences. In implementing the regulations required by the FQPA, The EPA should keep in mind that this most recent overhaul of the pesticide laws specifically grants the agency discretion in setting standards when use of the pesticides prevents other risks to consumers or avoids "significant disruption in domestic production of an adequate, wholesome, and economical food supply" (United States House of Representatives, 1996).

The authors are among those who, everything being equal, would prefer to consume fewer pesticide residues in their own diets. Yet too narrow of a regulatory focus that ignores economic responses and countervailing health risks is misguided, as the net effect on public health could be negative. This point is especially pertinent when one considers that certain pesticide uses have been canceled by the EPA on the basis of consumer risks that were less than one in a million over a lifetime of exposure. In many cases, other less costly interventions such as labeling requirements and food preparation education campaigns may prove to be more effective means of achieving consumer safety with regard to agricultural chemical use.

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