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Consumer Perspectives on Food Safety Issues: The Case of Pesticide Residues in Fresh Produce[1]

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This paper reviews three approaches to estimating consumer willingness to pay for reductions in food-borne risks. Contingent valuation methods compare favorably to market-based methods. Significant price premia for food safety improvements are found, regardless of the amount of food risk perceived by consumers. This finding suggests that uncertainty rather than risk perceptions may drive willingness to pay. Policy implications of this finding are developed.

Consumer choices about pesticide residues have been examined by several researchers using Lancaster's (1971) theory of the characteristics of goods (Hammitt, 1986; van Ravenswaay, 1988; van Ravenswaay and Hoehn, 1991 b and c). The basic premise of the theory is that a consumer derives value from the characteristics of goods. A consumer is assumed to choose a combination of goods whose characteristics maximize utility subject to income and price constraints. An individual's purchases of a particular type of good are a function of prices, income, and perceived characteristics. Shifts in the demand induced by changes in a good's characteristics reveal consumer willingness to pay for those characteristics.

Observing consumers' choices of pesticide residue and pest damage characteristics is difficult because consumers are offered few choices in actual markets. Special market circumstances created by the Alar scare in 1989 have been used to estimate consumer willingness to pay for reduced pesticide residues (van Ravenswaay and Hoehn, 1991c). A study has been conducted in organic markets (Hammitt, 1986). Contingent valuation approaches are beginning to be used to simulate choices that consumers would make in an actual market setting (Hammitt, 1986; van Ravenswaay and Hoehn, 1991a and 1991b).

This paper reviews the results of these studies to draw conclusions about food safety policy and implications for future research. The review is organized around the three different approaches to examining food safety tradeoffs.

The Impact of Alar on Fresh Apple Demand

Van Ravenswaay and Hoehn (1991c) studied the impact of the Alar scare on fresh apple demand to examine willingness to pay for food safety improvements. The study used existing market data for the New York City/Newark metropolitan area to estimate what consumers would have been willing to pay for Alar-free apples and to reduce risks from pesticide residues.

A statistical model for estimating market demand for fresh apples incorporating prices, incomes, and seasonality was developed. The effect of the Alar incident was incorporated using a measure of media coverage of Alar over time. Willingness to pay for the removal of Alar was calculated estimating the difference in expected apple demand with and without the scare. The study found that consumers would have been willing to pay over 30% (or 21 cents) more for Alar-free fresh apples in 1989. On an annual basis, this finding implies that the average person would have been willing to pay about $2.35 (in 1983 dollars) more that year to avoid the risks from Alar. Cancer risks reported in New York newspapers in 1989 indicated that annual risks were as high as .58 additional cancers per million persons. Dividing annual consumer willingness to avoid Alar by the reported annual cancer risk gives a willingness to pay of $4 (in 1983 dollars) to avoid an annual cancer risk of 1 in a million--assuming that consumers believed the reported risks.

This finding is similar to the findings of studies of peoples'

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responses to occupational risks, seat belt use, and smoke detectors. A critical review of those studies (Fisher et al., 1989) estimates that people are willing to pay between $1.6 and $8.5 in 1986 dollars (i.e., $1.44 to $7.65 in 1983 dollars) for a one in a million reduction in annual mortality risks. This similarity in willingness to pay estimates suggests that consumers reacted to Alar much as they do to other risks.

The study of the impact of Alar gives an indication of what consumers are be willing to pay for reduced pesticide residues. However, it is unknown what people actually thought risks were. Consequently, strong assumptions were required to estimate willingness to pay for reduced risks.

Organic Food Consumers

Hammitt (1986) used both hedonic and contingent valuation methods to estimate consumer willingness to pay for reduced pesticide residues from organic food. His hypothesis was that the organic version of a product will be chosen if the premium paid per marginal benefits received (i.e., risk avoided plus or minus other attributes) is less than or equal to willingness to pay to avoid risk. Assuming that conventional and organic produce differ only in terms of risk--a strong assumption since they may differ in location sold, quality, and size--a consumers' choice between organic and conventional versions of a product was hypothesized to reveal bounds on marginal willingness to pay to avoid risk.

The hedonic study used market data to estimate incremental willingness to pay for organic over conventional produce. The incremental willingness to pay was computed from price premia estimated from weekly organic and conventional produce prices at five stores in the Los Angeles and Santa Monica area in 1985.

The price premia were estimated via linear regression assuming perfectly elastic supply. However, contrary to Hammitt's interpretation, this assumption implies that the price premia represent incremental <u>costs</u> of supplying, not incremental willingness to pay for, organic food. The resulting estimates of the incremental cost of organic produce (in 1985 dollars) were $80 per year or $1400 per lifetime, assuming a 5% discount rate and 50 years of purchasing.

Assuming that consumers perceive risks as scientists do, Hammitt used government data on residues and toxicity to estimate lifetime cancer risks avoided to be 14 in 1 million. Dividing lifetime incremental organic costs by this estimated risk reduction yields an estimate of willingness to pay of $100 for a 1 in a million reduction in lifetime cancer death risks.

Annualizing the data Hammitt used to derive lifetime estimates yields a willingness to pay of $400 (in 1985 dollars) for a 1 in a million reduction in <u>annual</u> mortality risks. This estimate is much higher than the annual estimates of $1.6 to $8.4 (in 1986 dollars) contained in the review of value of life studies by Fisher et al. (1989).

One reason why the hedonic estimates are so high is that the estimated organic price premia actually represent incremental costs of supplying organic produce rather than incremental willingness to pay. If willingness to pay for organic produce is similar to what would be expected on the basis of the studies reviewed by Fisher et al. and the findings of the Alar study (van Ravenswaay and Hoehn, 1991c), then Hammitt's study suggests that the costs of supplying organic produce exceed average willingness to pay for organic produce by a factor of 10.

A second possible reason why the estimates of willingness to pay for risk reduction are comparatively high is that consumers may perceive the risks of pesticide residues avoided to be greater than the estimates based on scientific residue and toxicity data. Higher risk perceptions would lead to a lower per unit willingness to pay for risk reduction.

Since hedonic methods have drawbacks, Hammitt conducted a pilot contingent valuation study using focus groups with organic and conventional food consumers. A brief questionnaire was administered to assess willingness to pay for organic produce and risk perceptions, yielding 45 usable responses.

The questionnaires revealed differences between the two groups in terms of risk perceptions. The median estimate of the conventional food consumers was that the risk of eventually dying from consuming conventional fresh produce was 8×10^{-7}. The median for organic consumers was 8.5×10^{-4}, or three orders of magnitude greater, and they identified a number of different adverse health effects of concern including cancer, sterility, allergies, asthma, and premature senility. Both groups estimated the risks from consuming organic food to be negligible.

Reported willingness to pay for organic food differed between the two groups. The median response of conventional food consumers was that they would be willing to increase their

expenditures on fresh produce by 5% to purchase the safer produce (almost always the organic version). The median response for organic consumers was 50%, which is similar to median organic price premium of 45% estimated using market data.

Implicit values of life were calculated using annual incremental willingness to pay for organic food divided by annual perceived risk avoided. Because organic food consumers' perceived greater risks from consuming conventional food, their implied value of life was lower than it was for conventional food buyers. The median estimate for organic consumers was $.75 per 1 in a million annual risk reduction. The median estimate for conventional consumers was $6.62 (in 1985 dollars). These focus group estimates are much closer than the hedonic estimates to the range expected from the studies reviewed by Fisher et al. (1989) and the Alar study.

Contingent Valuation Survey

Van Ravenswaay and Hoehn (1991a and 1991b) designed a mail survey of consumer perceptions and valuations of pest damage and pesticide residues on fresh apples. Photographs portrayed four red delicious apples, identical except that the percentage of surface area with pest damage was 0%, 2.5%, 6%, and 24%. Three red delicious apples were presented as being labeled as being certified and tested to have "No Pesticide Residues," "No Detectable Pesticide Residues," and "No Pesticide Residues Above Federal Limits." One apple was presented without a label.

Respondents were asked their perceptions of the chance that a member of their household would experience health problems someday because of pesticide residues in foods. Respondents were then asked to assess the percent reduction in risks if all foods were labeled. To compare fresh apples to all foods, respondents were asked about their perceptions of food safety issues and the chance of pesticide residues being in different types of foods.

Respondents were asked how many apples they would buy at different prices during a typical shopping occasion in the fall if the quality of apples were like each of the photos and if all apples were labeled. Prices ranged from $.39 to $1.49 per pound. Respondents were instructed to assume that all apples had the same price, quality, and label, that only apples would be labeled, and that all other fresh fruits were available at normal prices. To extrapolate from the purchase questions, respondents were asked about their normal apple purchases throughout the year and the demographic characteristics of their household.

The surveys were mailed in September of 1990 to a nationwide random sample of 2,200 households with 1,888 of the surveys actually delivered. Completed questionnaires were returned by 48% of the households (906/1,888). The normal range of household sizes, incomes, education levels, and ages were represented.

Respondents reported that they believed pesticide residues are much more likely to be present on fresh fruits and vegetables than other foods. However, only fifty to sixty percent of all fresh fruits and vegetables and fifty to sixty percent of all apples were perceived to have any residues. This figure is very similar to the percentage of fresh fruits and vegetables on which the Food and Drug Administration (1987) detects residues.

Respondents' perceptions of the chance their household may experience health problems someday due to the current level of pesticide residues in food varied considerably. About a quarter of respondents (23.6%) perceived risks from pesticide residues to be one in a million or less. About 45% reported moderate risks (between 1 in 100,000 and 1 in 1,000). About a quarter (25.8%) perceived very serious risks (1 in 100 and above). These results indicate that over half of food consumers perceive risks from pesticide residues to be less than the worst case estimates of the Environmental Protection Agency (1987).

Perceptions of risk included concerns about a wide range of health effects. Cancer and allergies were perceived to be the greatest risk, but most respondents also perceived moderate risks of heart disease, nervous system disorders, and impaired immune system. Lower risks were perceived for impaired child development, birth defects, and mental illness.

The label for "no pesticide residues" was perceived to reduce risks by about a half to two thirds, the label for "no detectable pesticide residues" was perceived to reduce risks by about a half, and the label for "no pesticide residues above federal limits" was perceived to reduce risks by about a third to a half. Note that few respondents felt that risks would be completely reduced by any of the labels.

Willingness to pay for a label was estimated as the price consumers will pay for the no-label apple minus the price they will pay for the labeled apple at a given level of consumption. The prices consumers will pay for the different apples at given levels of

consumption were estimated econometrically using the data from purchase questions (van Ravenswaay and Hoehn, 1991b).

The estimate of the average added price per pound for apples certified and tested to have "no residues above federal limits" was 23.6 cents. Apples certified and tested to have "no detectable pesticide residues" also have an estimated average added price of 23.6 cents per pound. The estimate of the added price per pound for apples certified and tested to have "no pesticide residues" was 37.5 cents per pound.

The measurement of risk perception explained little of the willingness to pay for the labels. There was less than a penny difference in the estimates of willingness to pay for the labels for people seeing no risks and people who perceived large risks. The perceived change in risk must be 1 in 100 or greater to add a penny to the estimate of willingness to pay for the labels.

The estimates of acceptable pest damage for each label, given no difference in price, were measured by the amount of pest damage that offsets the added willingness to pay for a labeled apple. The estimates for the "federal limit" and "no detectable residue" labels were both 7.5% of the apple photo surface. The estimate for the "no pesticide residue" label was 11.9%.

The estimates require careful interpretation. Pest damage was measured as the amount of surface area on an apple in a photograph. The photograph, of course, is only two dimensional, whereas a real apple is a sphere. Thus, in reality, surface area would be measured over the entire apple surface. This means that the estimates of surface area in this study are at least twice as large as what would be acceptable on a real apple.

The estimates of this study are comparable to those found in the Alar study. In the Alar case, it was estimated that people would have been willing to pay 31.3% more for the Alar-free apples--approximately 28.7 cents more per pound in 1990 dollars. This is well within the estimated obtained in the contingent valuation survey. The estimates of price elasticity for fresh apples were also very similar in the two studies. In contingent valuation survey, the price elasticity was estimated to be -1.86. In the Alar study, elasticities ranged from -1.95 to -2.09.

Because most consumers do not purchase organic apples, the estimates of willingness to pay for the no pesticide apple should be less than the price premium actually paid for organic apples in the market. Using data collected in 1985, Hammitt (1986) estimated a market premium for organic apples of 37 cents over an average price for regular apples of 79 cents per pound. In 1990 dollars, that premium would be about 50 cents. As expected, the estimate of willingness to pay for the no pesticide apple from the contingent valuation survey is less than this premium.

The authors also show that their results are consistent with studies of willingness to pay for risk reduction. Their estimates ranged from $.59 to $2.20 in 1990 dollars for a one in a million reduction in annual health risk. The Fisher et al. (1989) annual estimates in 1990 dollars are $1.95 to $10.37. The Hammitt estimate based on the focus group data translated into 1990 dollars is $8.83 for conventional food consumers and $1 for organic consumers. The survey estimates of willingness to pay for risk reductions should be lower since they reflect perceptions of <u>any</u> type of health risk while the estimates from other studies are based on mortality risks.

Conclusions

Contingent valuation methods compare favorably to market based methods. They eliminate the need to make unrealistic assumptions about risk perceptions. They also offer flexibility in examining tradeoffs between pesticide residues and other important food characteristics such as quality.

Future research should aim at refining contingent valuation methods and comparing their results to estimates based on market data. Ways of incorporating the effect of price and quality changes in substitutes and complements need to be developed. Alternative methods for measuring risk perceptions also need to be developed.

The empirical results indicate that consumers are willing to pay significant price premia for food safety improvement. The finding that consumers are willing to pay for foods certified and tested to meet federal limits suggests that consumers believe federal standards give them significant risk reductions, but they are uncertain that federal standards are being met. The implication is that consumers would obtain significant value from learning that virtually all foods do meet federal standards.

While consumers may see value in learning that residue standards are being met, information about the percentage of foods with detectable levels of residues would be unlikely to improve the confidence of consumers. The average consumer perceives the

percentage of foods with any residues to be similar to what is actually detected by the FDA's monitoring program.

Consumers are willing to pay even higher price premia for apples certified and tested to have no pesticide residues, but not for apples with "no detectable" residues. This finding suggests that consumers believe that federal standards do not eliminate all the risks from pesticide residues.

However, the additional willingness to pay for a "no pesticide residue" apple may not be high enough to cover the costs--both in terms of higher food prices and pest damage--of eliminating all pesticides. This is an important point because consumers appear unwilling to accept more than a minor amount of pest damage. Even if apples were certified and tested to have no pesticide residues and were no higher in price, the amount of pest damage that would be accepted would be very small.

People's perceptions of the likelihood of someone in their household becoming ill from pesticide residues vary tremendously. About half of consumers view the chance of illness as fairly low, but a quarter see very high risks. Moreover, many types of illnesses are associated with pesticide residues in food--not just cancer. This finding has important policy implications because federal policy and risk communication has tended to focus exclusively on cancer.

Despite the variation across people, perceptions of the likelihood of illness from pesticide residues explain little of the estimated willingness to pay for the different residue levels presented in this study. It is possible that it is people's uncertainty about what the risks could be that may better explain why people were willing to pay significant premia for guarantees that residues meet federal standards. If so, risk communication aimed at reducing people's perception of the average risks from pesticides may have little impact on consumer concerns. What may be needed instead is information about the safeguards in place that reduce the chance of mistakes--mistakes which result in contamination problems or the need to revise tolerances for pesticide residues in food. This type of information would increase trust and reduce uncertainty about risks.

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