Paper prepared for Presentation at the Annual Meeting of the

American Agricultural Economics Association

August 8-11, 1999

Nashville, Tennessee

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Izmir, 1999

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Consumer Willingness to Pay for Reduced Pesticide Residues in Tomatoes: The Turkish Case

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Abstract: The paper investigates the Turkish consumers' willingness to pay for a label that guarantees that pesticide residues in foods do not cause health problems. Contingent valuation survey was conducted to 1005 randomly selected households to elicit tomato purchasing behavior under alternative prices and residue scenarios. A tobit model was used to estimate a demand model. To determine the probability of purchase, a probit model was estimated.

Keywords: pesticide residues, food safety, consumer demand.

Pesticide use in Turkey was encouraged by pesticide credits and subsidies over the years yet little investment was made to promote sustainable pesticide use. New policies are needed to encourage farmers for reduced pesticide use and to assure safe food supply to the consumers (Akgüngör, 1995; Aksoy and Alt• ndi• li, 1996; Akgüngör, Miran and Abay, 1997). One policy option is to ensure the consumers with food labels that would guarantee that the present levels of pesticide residues in food supply do not cause health risks. The costs of such a policy should be compensated by the value of consumer benefits from reduced pesticide residues in food. One consumer benefit from reduced pesticide residues is through reduced probability of health impairment associated with pesticide residues in foods. Such benefit can be estimated by eliciting consumers' willingness to pay for reduced health risks from pesticide residues.

The aim of the paper is to estimate the value of the Turkish consumers' health benefits from reduced pesticide residues in foods. The paper investigates the Turkish consumers' willingness to pay for labels that warrant that the current levels of

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The authors thank the Agricultural Economic Research Institute (AERI) (Ankara, Turkey) for providing financial support for the project.

pesticide residues in foods do not cause health-related problems. To elicit the consumers' willingness to pay for products that are free of pesticide health risks, fresh tomato demand was chosen since tomatoes are widely purchased by the Turkish consumers.

Theoretical Background

The theoretical basis of the research is van Ravenswaay and Hoehn approach as an extension of Lancaster's attribute model (Lancaster, 1971). The Lancaster attribute model assumes that the consumer's utility is a function of attributes from the goods consumed. To maximise utility, the consumer chooses to consume from a bundle of goods that contain such attributes, under a budget constraint.

In their model, van Ravenswaay and Hoehn (1991) uses the hypothesis that the consumer maximises utility on a bundle of products offering certain amounts of attributes such as food calories, nutrients, cosmetic quality and pesticide residues (van Ravenswaay and Hoehn, 1991; van Ravenswaay and Wohl, 1995). The maximisation problem leads to a demand function of a single product x_1^0 offered at a price of p_1^0 that has a vector of characteristics $\mathbf{a_1} = (a_{11},...,a_{1j})$. If $\mathbf{p}$, $\mathbf{a_1}$ and $\mathbf{m}$ are respectively vectors of prices of all other products, attributes and income, the demand function for product x_1^0 is:

$$x_1^0 = x_1(p_1^0, a_{11}^0, \boldsymbol{p}, \boldsymbol{a_1}, \boldsymbol{m}) \qquad \textbf{(1)}$$

van Ravenswaay and Hoehn show that if the demand function is linear or semi-logarithmic, willingness to pay for a change in the amount of one of the attributes from a_{11}^0 to a_{11}^1 is,

$$\text{WTP} = (p_1^1 - p_1^0)\,x_1^0 \qquad \textbf{(2)}$$

where p_1^1 is the price of good x_1^0 when attribute a_1^1 is present and p_1^0 is the price of good when attribute a_1^0 is present. Holding quantity constant, estimating the shifts in the demand curve yields an estimate of willingness to pay for an attribute change.

Field Work

The data is collected through a contingent valuation survey from a random sample of 1005 consumers in Istanbul, Ankara and Izmir (three largest metropolitan areas in Turkey).[2] Personal interviews were performed in May 1998 via a structured questionnaire with the household member who performs most of the food shopping.

The contingent valuation questionnaire was constructed through extensive pre-testing of each particular question via personal interviews with the consumers. The interviewed individuals were asked to state their interpretations of a series of suggested questions.

The completed questionnaire was pre-tested once again through personal interviews with a randomly selected 100 individuals in Izmir. The six interviewers who conducted the pre-test gave feedback to the researchers about how each particular question worked. Following the discussion with the interviewers, the contingent valuation question was finalised.

The fieldwork was conducted with cooperation of a professional marketing research firm. To ensure close collaboration with the researchers and the research firm, the research team played an active role throughout the fieldwork. The research team, along with the field directors and field supervisors of the professional research firm held training sessions with the field workers regarding the survey questions and

[2] The number of individuals in the population is 7,984,540. The size of the population is taken from the "list of voters" that is compiled by the State Statistics Institute of Turkey for the 1995 Turkish general elections. This list is regarded as the best available and most current data regarding adult population (age 18 and above) at the time of the fieldwork.

sampling scheme.[3] Following training, the fieldwork was conducted in Istanbul, Ankara and Izmir during May 1998. After the fieldwork is finished, phone calls were made to 500 randomly selected respondents to inquire whether the field workers had actually conducted the interviews. The supervisors asked the respondents about the length and quality of the interview and basic demographic questions. Following validation, the completed questionnaires were validated for the quality of data.

Design of the Contingent Valuation Survey

Questions to Elicit Perceptions related to pesticide residues:

The contingent valuation questionnaire asked the consumers their attitudes regarding their perceptions related to pesticide residues in foods; and fresh fruits and vegetables in particular. They were given a list of names of foods, including fresh fruits and vegetables. The choices for each food item were, "no pesticide residues", "pesticide residues are present but they are at levels not harmful to human health", "pesticide residues are present and they are harmful to human health".

Questions to Elicit Health-risk perceptions:

The survey also asked consumers about their perceptions related to probability of a health problem someday because of pesticide residues in fresh fruits and vegetables. The first risk question asked the consumers about the probability of health problem someday because of pesticide residues in fresh fruit and vegetables. They were then asked to state the probability in quantitative terms (probability of health impairment). To ease understanding, the consumers were told the following: "Suppose that there are 1 million people your age who live under the same standards and food consumption habits. Out of these 1 million people, how many of them do you think would someday in their entire lifetime would experience health problems

[3] Details regarding the random sampling scheme can be obtained from the authors.

due to pesticide residues in fruits and vegetables?" The options were "none of them", "1 person", "10 Persons", "100 persons", "1,000 persons", "10,000 persons", "100,000 persons", "all of them". The consumers were then asked to suppose that all fresh fruits and vegetables were tested and certified that they do not contain any pesticide residues at levels harmful to human health. Under such scenario, respondents were asked once again to estimate the number of people out of the same 1 million who are likely to experience health problems someday in their entire lifetime because of pesticide residues in fresh fruits and vegetables. The choices were identical with the previous question.

Pricing Questions:

The survey was designed to simulate consumers' tomato purchasing behavior for their respective households under alternative prices and scenarios about pesticide residues. Under scenario 1, the consumers were not given any information about pesticide residues in tomatoes (present case). Under scenario 2, the consumers were provided with a label that guarantees that the tomatoes were tested and certified that they do not contain pesticide residues harmful to human health. The price under scenario 2 was above the price under scenario 1. Prices of all other fruits and vegetables were at their prevailing levels and none of them were under sale. The sample was divided into 6 subsamples which received different sets of prices. The two sets of prices for 6 subsamples and the number of individuals in each subsample are given in Table 1.

Under scenario 1, the survey asks the individuals the amount of tomatoes that they would buy at given prices. The individuals were read and shown a statement indicating that "Assume that over stack of the tomatoes that you usually buy, there is a label that says: ‘These tomatoes are tested and certified that there are no pesticide residues that are harmful for human well-being’ and these tomatoes are sold at (price under scenario 2) TL/kg”. The individuals were asked whether they would buy tomatoes under the at the prevailing price and scenario. If so, the individuals were then asked to state the amount of tomatoes that they would buy.

Aside from the above group of questions, the contingent valuation included questions about demographics such as monthly household income, age of the respondent and education.

Econometric Model

Two econometric models were estimated. The first model aims to estimate the consumer’s willingness to pay for reduced health risks due to pesticides in tomatoes (willingness to pay for tomatoes under scenario 2). The second model aims to estimate the probability of purchasing under scenario 2.

The dependent variable in the tomato demand model is the consumer’s tomato purchases under two alternative scenarios and prices given. Since the dependent variable contained zero values, tobit model was used to estimate the consumer’s willingness to pay for reduced pesticide residues in tomatoes. The independent variables in the demand model is presented in Table 2.

To estimate the probability of purchase under scenario 2, a probit model is used. The dependent variable in the model is a binary variable whose value is 1 if the consumer agrees to buy tomatoes, otherwise 0 given scenario 2’s higher price. The independent variables in the probit model is presented in Table 3.

Econometric Results

Three linear tobit models are estimated. The common variables in all three models are, tomato price, income, age, education, household and gender. Model 1 is estimated using these variables alone. Model 2 incorporates the variable that measures the presence or absence of the residue label ('label' variable). To test the impact of health risk perceptions on tomato purchases, a variable that measures the difference in perceived risk is incorporated to the tomato demand model ('risk difference' variable).

As seen in Table 4, income, tomato price, household, gender variables are statistically different than zero on all three models. Price has a negative coefficient as expected. A change in 100,000 T.L (1 $ = 256,000 T.L in May 1998) reduces weekly tomato purchases by 0.7 kg per household. On average, the tobit equation yields a price elasticity of 0.72.[4] As expected, income has a positive coefficient. However, the effect of income on tomato purchases is weak. The number of persons living in the house has a positive effect of monthly household tomato purchases. An additional one person to the household increases monthly quantity purchases by 0.33 kg. The coefficients for income and age are both statistically equal to zero, indicating that these two variables do not effect household fresh tomato purchases.

To see the effect of a label indicating that the tomatoes are 'tested and certified that there are no pesticide residues that are harmful for human well-being', a dummy variable was incorporated to the demand equation (Model 2). The 'label' variable is found to be insignificant. The insignificance of the 'label' variable indicates that the label alone without any additional information would not have any effect on apple

[4] The average household tomato non-zero purchases is 3.17 kg/household. The average tomato price for non-zero consumption is 326454 TL/kg, yielding to an average price elasticity estimate of 0.000007x(326454/3.17)=0.72.

purchasing behavior. To find out whether variations in apple purchases were explained by the respondent's risk perception, 'risk difference' variable was incorporated to the demand model (Model 3). As expected, this variable is positive and significant. Model 2 and Model 3 indicate that the presence of the label alone does not explain variations in tomato purchases. However, variations in the consumer's perceived change in the probability of health problem due to pesticide residues associated with the label has statistically significant impact on variations in tomato purchases. Reduction in the perceived lifetime probability of health problem by 1 in 100,000 increase quantity demanded by 0.051 kg. On average, the consumers' perception in the reduction in the lifetime probability of health problem with label is 0.091. Reducing perceived lifetime probability of health problem by 0.091 (average perceived reduction in the perceived probability of health impairment) results with an average willingness to pay of 6440 Turkish Liras (approximately 0.03$ [5]) per 1 kilogram of tomatoes (approximately 2% price premium)[6].

To explain the tomato-purchasing behavior under scenario 2, a probit model was used (Table 5). The probit model reveals that the probability of tomato purchase under scenario 2 is negatively affected by the number of persons living in the household and tomato price in scenario 2. The probability of purchase is positively affected by change in perceived probability of health problem between the two sceneries, current tomato consumption, income and education.

Conclusion

The results indicate that on average, the Turkish consumers are willing to pay up to 2% price premium for tomatoes that are certified to have no pesticide residues at

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[5] 1$=256,000 TL in May 1998.

[6] The average tomato price given under scenario 1 was 275,000 TL/kg. The 6,440 TL/kg therefore reflects a price premium of 2%.

levels harmful to human well-being. In Turkey, a market for such products does not exist. However, due to rapid expansion of department stores where urban consumers shop for groceries rather than traditional marketing outlets such as open bazaars and grocery stands, there exists a suitable distribution channel to the potential end user of certified groceries.

It is likely that a market for tomatoes that are tested and certified for pesticide residues in Turkey will exist if the added willingness to pay covers the cost of certification and distribution process. The target consumer segment is educated and high-income households whose perceived health risks due to pesticide residues are high.

The results indicate that the willingness to pay and the probability to purchase tested and certified tomatoes is dependent on the degree of consumers' perceived risk level due to pesticide residues. However, the certification label alone does not explain willingness to pay. Rather, it is the perceived risk reduction due to a label, which explains willingness to pay the price premium. Such finding has a meaningful implication for marketers of certified groceries. While introducing and promoting the tested and certified groceries, the marketers should provide educational and informative material related to health-risk reductions due to consumption of certified groceries for pesticide residues.

Table 1: Unit Price of Tomatoes Under Alternative Scenarios (TL/kg)

	Scenario 1	Scenario 2	Number of Persons in the Subsample
Group 1	150.000	225.000	167
Group 2	200.000	300.000	164
Group 3	250.000	375.000	166
Group 4	300.000	450.000	165
Group 5	350.000	500.000	169
Group 6	400.000	550.000	165

Table 2: Variables in Tomato Demand Model (Tobit Model) (Dependent Variable: Tomato Consumption = Weekly household purchase of tomatoes (kg/household/week)

Variable	**Explanation**
Income	Household total disposable income (TL/month)
Tomato Price	TL/kg
Age	Age of the respondent
Education	Respondent's latest degree (None=0, Primary school=1, Middle school=2, High school =3, Üniversity=4, Graduate=5)
Household	Number of people in the household
Risk 1	Probability of health impairment (Scenario 1)
Risk 2	Probability of health impairment (Scenario 1 or Scenario 2 depending on the particular scenario)
Risk difference	$Risk_1 – Risk_2$
Gender	Female=0, Male=1
Label	Dummy variable that explains the presence or absence of the residue label. It takes the value of 0 under scenario 1 and the value of 1 under scenario 2

Table 3: Variables Used in The Probit Model (Dependent Variable: A binary variable that measures the purchasing behavior under scenario 2; The variable takes the value of 0 if the respondent declines to purchase under scenario 2; takes the value of 1 otherwise.)

Variable	**Explanation**
Knowledge	A dummy variable that measures the presence or absence of knowledge of the respondent has ever heard the concept organic production (0=heva not heard; 1=have heard)
Household	Number of people in the household
Gender	Female=0, Male=1
Education	Respondent's latest degree (None=0, Primary school=1, Middle school=2, High school =3, Üniversity=4, Graduate=5)
Education	Respondent's latest degree (None=0, Primary school=1, Middle school=2, High school =3, Üniversity=4, Graduate=5)
Confidence	Respondent's perceived confidence regarding safety of fresh fruit and vegetables over time (unsafe compared with previous times=0; no change in safety over time=1)
Age	Age of the respondent
Risk 1	Probability of health impairment (Scenario 1)
Risk 2a	Probability of health impairment (Scenario 2)
Risk Difference2	Risk 1-Risk 2a
Tomato Price2	Tomato price under scenario 2 (TL/kg)
Residue	A dummy variable that measures respondent's perceptions related to pesticide residues in fresh tomatoes (0 if the respondent's answer is "no pesticide residues", "pesticide residues are present but they at levels not harmful to human health"; 1 if the respondent's answer is "pesticide residues are present and they are harmful to human health".
Consumption	Household's current level of tomato purchases (kg/week/household)

Table 4: Tomato Demand Models

Dependent Variable: Household weekly tomato purchase			
Independent Variables	**Model 1**	**Model 2**	**Model 3**
Constant	2.9590* (0.4254)	2.9223* (0.4267)	3.0046* (0.4259*)
Tomato Price	-0.69189E-05* (0.5341E-06)	-0.66730E-05* (0.6293E-06)	-0.71720E-05* (0.5540E-6*)
Income	0.28375E-08* (0.4125E-09)	0.28499E-08* (0.4124E-09)	0.28410E-08* (0.4121E-09)
Age	-0.15277E-02 (0.5110E-02)	-0.11262E-02 (0.5109E-02)	-0.20108E-02 (0.5113E-02)
Education	0.69103E-01 (0.5339E-01)	0.67937E-01 (0.5338E-01)	0.70007E-01 (0.5334E-01)
Household	0.33248* (0.4017E-01)	0.33267* (0.4017E-01)	0.33367* (0.4014E-01)
Gender	0.42306* (0.1531)	0.40875* (0.1531)	0.43454* (0.1531)
Label		-0.12081 (0.1471)	
Risk Difference			0.50555E-06*** (0.2949E-06)
σ	2.5675* (0.4733E-01)	2.5668* (0.4731E-01)	2.5652* (0.4728E-01)
N	1745	1745	1745
Log-likelihood	-3836.865	-3835.989	-3835.397

Table 5: Probit Model

Dependent Variable: A binary variable that measures the respondent's tomato purchasing behavior under scenario 2 . (Purchases=1, Does not purchase=0)	
Independent Variables	Probit (1)
Constant	0.940853** (0.39068)
Knowledge	-0.09639 (0.20563)
Household	-0.05965*** (0.03552)
Gender	-0.20054 (0.12999)
Residue	-0.05079 (0.113)
Consumption	0.12347* (0.02897)
Education	0.088046*** (0.0489)
Income	2.36E-09* (8.04E-10)
Confidence	-0.29423** (0.15709)
Tomato Price2	-2.00E-06* (5.09E-07)
Age	0.003689 (0.00429)
Risk Difference2	4.13E-07** (1.98E-07)
N	864
Log Likelihood	-367.5655

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