# Consumers' Willingness to Pay a Price for Organic Beef Meat

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**Paper prepared for presentation at the X^th EAAE Congress**
**'Exploring Diversity in the European Agri-Food System',**
**Zaragoza (Spain), 28-31 August 2002**

X[th] EAAE Congress Zaragoza, August 28-31, 2002

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Abstract

The goal of this paper is to estimate the maximum price consumers are willing to pay (MPWTP) for organic beef meat. To this purpose, a theoretical and econometric approach is presented, based on the RUM model and on a Contingent Valuation technique.
The results show that consumers' MPWTP is quite high, thus suggesting that organic beef meat might gain an appreciable market share. This is also an encouraging signal for prospective producers of organic meat, who might compensate the likely increase in production costs with a substantial premium for the new good.

Key-words:
Organic meat, willingness-to-pay, double-bounded probit

## Introduction

The European food market has suffered from several food scares, the most recent being the BSE scandal. Consumers are therefore more and more concerned about food safety and quality. Organic products provide a response to their concern, and in the same time their production is more environment-friendly. Being a credence good, public regulation is appropriate to guarantee consumers that what they buy is really an organic product; at the European level Council Regulation (EEC) 2092/91 prescribed the characteristics that organic products should comply to have the right to the label "organic". This regulation left out animal products until Council Regulation (EC) 1804/1999 was issued. Since a national regulation was further needed, in Italy it

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** The financial support of Piedmont Region is gratefully acknowledged; the research was implemented in collaboration with Agri-Bio Piemonte.

was not before 2000 that organic animal products could be legally marketed. But until now production is still sporadic, due to the uncertainty about production costs on one side, and on the price that consumers are ready to pay on the other side. Knowledge on the price consumers would pay if organic meat were available is therefore important for prospective producers to make their decisions on whether to start organic production.

Several papers have dealt with the attitudes of consumers towards organic products and safe food in a broader sense (Thompson (1998) provides a more detailed review of U.S. studies on consumer demand for organic produce). Huang (1996) and Thompson and Kidwell (1998) analyse consumers' preferences for organic produce in connection with their willingness to accept sensory defects, but do not quantify consumers' willingness-to-pay; the latter paper models the choice between organic and regular products as mutually exclusive, using a theoretical framework based on the difference in utilities of organic and regular products. Van Ravenswaay and Blend (1999) present purchase probability and demand functions for regular, ecolabeled, and unlabeled apples, including, among the explanatory variables of the latter two functions, the prices for both the relevant and the regular apples. Some studies assess consumers' willingness to pay a premium (in terms of a percentage increase in price) for organic or safe products (Weaver et al. 1992; Ott, 1990; Govindasamy and Italia, 1999; Underhill and Figueroa, 1996), but do not compute willingness-to-pay measures. Using a similar approach, Loureiro and Hine (2001) estimate by ML methods the mean willingness-to-pay price for organic, GMO-free, and locally-grown potatoes. Boland et al. (1999) estimate consumers' willingness-to-pay for pork produced under integrated meat safety systems. Gil et al. (1999) investigate the main factors influencing consumers' decision to pay a premium for organic food products and use an open-ended format to assess their willingness-to-pay. An open-ended question is also used by Mora Zanetti (1998) for assessing the willingness-to-pay for safer meat.

The goal of this paper is to estimate the maximum price consumers are willing to pay (MPWTP) for organic beef meat. Like much of the above literature, we use stated preferences techniques, namely Contingent Valuation, to estimate MPWTP, since organic meat is not yet currently available and actual consumers' behaviour cannot therefore be observed. Nevertheless, in our study the actual behaviour with reference to regular meat is also investigated and, for those who buy regular meat, the price they pay is asked; this adds realism to the analysis. Second, we try to put in a different theoretical perspective the estimation of MPWTP: our approach includes the possibility for consumers to adjust quantities purchased of other goods (regular meat included) when the organic product becomes available; this departs from the approach followed by most of the above papers, that implicitly assume a mutually exclusive choice between regular and organic products and/or no quantity adjustments following this choice.

## Theoretical and econometric model

Organic meat represents a differently perceived meat quality, which was not available until now; in this sense, availability of organic meat is equivalent to the enlargement of the choice set the consumer is facing.

Assume the only available meat is the regular one (quality $q^0$) and the consumer has solved his/her maximisation problem and chosen the optimal quantity $x^0$ of regular meat at a price $p^0$. His/her level of utility can be indicated through the indirect utility function as:

$$v^0 = v(P, p^0, M, s) \quad (1)$$

where P is the vector of other prices, s are preference shifters as attributes of the individual, and M is income.

The minimum expenditure necessary to achieve level of utility $v^0$ is indicated by the expenditure function:

$$e(P, p^0, v^0) = e(P, p^0, v(P, p^0, M, s)) = e(P, p^0, s, M) \quad (2)$$

Now assume that quality $q^1$ is made available in perfectly elastic supply to the consumer at a higher price $p^1$; to attain the same utility level $v^0$ the minimum expenditure will be:

$$e(P, p^0, p^1, v^0) = e(P, p^0, p^1, v(P, p^0, p^1, M, s)) = e(P, p^0, p^1, s, M) \quad (3)$$

The consumer will buy a positive quantity of organic meat if:

$$e(P, p^0, p^1, s, M) < e(P, p^0, s, M) \quad (4)$$

For an empirical analysis of the problem, following the random utility model (RUM), it is assumed that, while consumers know their preferences with certainty, there are some components unknown to the researcher that are treated as random. Calling $e_0$ and $e_1$ the random components of the expenditure functions, the above condition is therefore:

$$e(P, p^0, p^1, s, M) + e_1 < e(P, p^0, s, M) + e_0 \quad (5)$$

or:

$$e(P, p^0, s, M) - e(P, p^0, p^1, s, M) > e_1 - e_0 \quad (6)$$

$$f(P, p^0, p^1, s, M) > m \quad (7)$$

where $f(\cdot) = e(P, p^0, s, M) - e(P, p^0, p^1, s, M)$ and $m = e_1 - e_0$.
Assuming a probability distribution for m, it is possible to express the probability of a positive consumption of organic meat for a particular $p^1$ offered ($p^{bid}$) in terms of the cumulative density function of m, $G_m$; the probability that a consumer will respond "yes" to an offered $p^{bid}$ is the probability that $f(\cdot)$ is greater than m:

$$P(\text{consumption}) = P[m < f(P, p^0, p^{bid}, s, M)] = G_m[f(P, p^0, p^{bid}, s, M)] \quad (8)$$

and:

$$P(\text{no consumption}) = 1 - G_m[\cdot] \quad (9)$$

Maximum likelihood techniques can be employed to estimate the parameters in $f(\cdot)$, the difference-in expenditure (DE) equation. If $f(\cdot)$ is linear, assuming m to have a normal or logistic distribution respectively yields the usual probit or logit models.
Since the maximum level of $p^1$ for which the consumer is willing to buy organic meat is the one for which the expenditure with and without organic meat are equal, i.e. the level of $p^1$ for which $f(\cdot)$ is equal to zero, the maximum price the consumer is willing to pay a for organic meat can be recovered from the estimated equation by setting $f(\cdot)$ to zero and solving for $p^1$, thus finding a maximum-price-consumers-are-willing-to-pay equation (MPWTP). Using the MPWTP equation, it is then possible to calculate the maximum price each consumer is willing to pay for organic meat[1], and to compute its mean value and other descriptive statistics for the sample[2].
For our empirical exercise, the density function of m is assumed to be normal, with mean 0 and variance $\sigma$. In other words, the parameters in the DE equation are only identifiable up to a scale parameter, as usual in probit and logit analysis. Nevertheless, the parameters of the MPWTP equation are perfectly identified, since they are found by dividing the parameters of the difference-in expenditure equation other than the $p^{bid}$ by the parameter of the $p^{bid}$.
To increase the efficiency of the estimates of the difference-in-expenditure equation, a double bounded approach was followed (Carson et al., 1986; Hanemann et al., 1991): consumers were

[1] This can be considered a sort of choke price for organic quality of beef: for higher prices, the consumer will consume no organic beef; for lower prices, consumption will be positive.
[2] Careful readers will notice a similarity of our approach with Cameron's treatment of referendum contingent valuation questions (Cameron, 1991). Nevertheless, in Cameron's approach the difference in expenditure measures the willingness to pay for a *given* change in the quantity/quality of the relevant good; put in the same terms, in our approach it measures the willingness to pay for an *unknown* (to the researcher) quantity of the new good at a given price, *allowing for a change in the quantity of the regular one*. It is therefore not possible to compute from this equation a welfare change measure; the DE equation is only functional for estimating the MPWTP equation.

asked if they were willing to buy organic meat at a given price (first bid, B); if they were, they were asked if they were equally willing to buy at a higher price (higher bid, HB); if, by contrast, they answered no to the first bid, the question was asked again with a lower price (lower bid, LB). There are four possible responses for the two questions: "yes-yes", "no-no", "no-yes", "yes-no". Each of them defines a portion of the cumulative density function. Precisely, defining for brevity G(·) the value of $G_m[f(P, p^0, p^{bid}, s, M)]$ for $p^{bid}$=B, HB, LB, and recalling that by the symmetry of the normal distribution $1- G_m[\cdot] = G_m[-(\cdot)]$, we have:

$$P(\text{yes-yes}) = G(HB) \quad (10)$$

$$P(\text{yes-no}) = G(B) - G(HB) \quad (11)$$

$$P(\text{no-no}) = G(-LB) \quad (12)$$

$$P(\text{no-yes}) = G(LB) - G(B) \quad (13)$$

The likelihood function for estimating the model is reported in the appendix.

Since some consumers had stopped to consume meat, due to the BSE, and others did not know the price they paid for regular meat, $p^0$ does not enter in their DE equation; therefore, the equation was estimated separately for them and for consumers who usually bought regular meat and knew its price.

It should also be noted that, since f(·) is a difference between two expenditure functions, it is quite possible that income and personal characteristics effects vanish if their parameters are equal in both. Nevertheless, we preferred to keep them, in order to take into account possible interaction effects with quality. Different specifications were tested for the equation; our preferred version was a very simple linear specification, including among the explanatory variables prices, income classes, and personal characteristics.

One important issue is the accuracy of the mean MPWTP estimates. Since the parameters in the MPWTP function are non-linear functions of the parameters of the DE equation, the variation in mean MPWTP also depends on the variability of the DE equation parameters. For this reason, confidence intervals for the mean MPWTP have been calculated using Krinsky and Robb's (1986) Monte Carlo simulation approach. Multiple random drawings from a multivariate normal distribution with mean β (the vector of the estimates of the DE equation) and variance-covariance matrix V (the estimated variance-covariance matrix) have been made, resulting in random β vectors; from each of them, a new vector of the MPWTP equation parameters has been calculated, and the mean MPWTP for the sample has been computed. The final result is an empirical distribution of mean MPWTP. A (1-α) confidence interval has been obtained by sorting the distribution and dropping α/2 values from both tails of the sorted distribution.

**Data and procedure**

Data were collected through a random telephone survey. The questionnaire was designed with three specific goals: a) to analyse consumers' behaviour changes after BSE events and consumers' knowledge and purchase habits of organic products; b) to evaluate consumers' willingness to pay for organic beef; c) to determine consumers' preferences about organic beef selling outlets, packaging and label. More details can be found in Corsi and Novelli (2002).

In the central part of the interview, a closed-ended[3] contingent valuation (CV) question was asked: respondents were asked whether they would pay a specific price (bid price) to buy organic beef. As mentioned above, to increase the elicitation process efficiency, the take-it-or-leave-it format was set with a follow-up question: if the answer to the first question was 'yes' another WTP question was asked using an higher price; if the answer was 'no' the interviewer proposed a lower price.

To evaluate meat cuts characterised by different prices and cooking processes, respondents were asked about their WTP for roast and minute steak, two cuts of beef largely popular among Italian consumers.

Respondents were previously informed about the prospective availability, the characteristics, and the certification process of organic beef meat. The wording of the elicitation question for those persons presently consuming regular meat was as follows: "Assume you can find on the market certified organic beef meat; if roast cost X L./kg, would you buy it?". Three answers were provided: "Yes, I would buy it in the same quantity I'm currently consuming"; "Yes, but I would reduce roast consumption"; "No". According to the above theoretical approach, both the two first answers were considered as "yes". These respondents were also asked about the price they presently paid for regular meat.

Respondents who had answered to a previous question that they had given up eating beef after the 'mad cow' events were asked about the possibility to go back and consume it; the wording of the elicitation question in this case was: "Assume you can find on the market certified organic beef meat; if roast cost X L./kg, would you buy it again?". In this case, the answer could only be yes or no. For these respondents the question about prices currently paid was obviously omitted.

The same questions were asked for minute steak.

[3] The closed-ended format simulates the real-life situation, in which consumers have to decide whether or not to buy goods at given prices; it therefore simplifies respondents' valuation process.

To avoid a question order bias, six different versions of the questionnaire were randomly submitted to the respondents, each different for the ordering of the questions and/or of the provided answers. The bid vector of the X prices was set based on a preliminary inspection of regular beef prices. Organic beef is supposed to be, at present, more expensive than regular meat, due to higher production costs and to specialised distribution. Bid prices were therefore set higher than, or equal to, first-rate quality meat currently on sale Bids were randomly submitted to the respondents. When the respondent stated to be willing to pay the first bid price, he/she was asked a second bid price, 5,000 L./kg (2.58 €/kg) higher. If the respondent was unwilling to pay the first price, then he/she was asked a second one, reduced by the same amount.

The questionnaire was pre-tested with a small pilot sample in order to assess the adequacy of the bid design and the clearness of the questionnaire.

The target population was those residents in Piedmont Region who were usually in charge of buying food for themselves and their family. A sample of families living in Piedmont region were randomly drawn from the electronic telephone directory[4]. A total of 879 families living in the region were contacted in June and July 2001[5]; interviewers explicitly asked to speak to the household member who was usually responsible for food shopping. The response rate was 51.4%, which is reasonably fair for a telephone survey. Part of the interviews (4,9%) were stopped by the interviewer when respondents were found to be permanently out of the beef market (vegetarians, people consuming only white meat for health reasons, farmers self-consuming their products). Finally, 0.8% of the questionnaires were not usable because incomplete (respondents were unable to state their WTP). In conclusion, a final sample of 402 questionnaires was successfully completed. Part of the respondents who completed the questionnaire did not consume specifically roast or minute steak; so, the usable number of questionnaires employed to estimate MPWTP for organic meat was 376 for roast and 397 for minute steak.

Table 1 reports the descriptive statistics of the explanatory variables. They include respondents' socio-demographic characteristics[6] (sex, age, education, household size, household income classes), their residence (divided in small –less than 50,000 inhabitants- and big towns), and a dummy variable indicating their answer to the question whether they knew organic products, which supposedly could influence their preference for organic meat. A comparison of the sample with the population is difficult because the reference population are the persons in charge of purchasing

[4] Bias due to unlisted telephone numbers has been assumed to be marginal, since the share of households not having a telephone is very low.

[5] "Contacted families" do not include those who were not found at home.

[6] Since 15.2% of the interviewed people refused to reveal their family income, missing income values were imputed, regressing socio-economic variables on income for the complete questionnaires, using the estimated parameters to predict missing values, and attributing the observations to the relevant income classes.

food, not the entire population. Nevertheless, the sample characteristics, whenever possible, were compared to Census data: in our sample, the share of women is obviously much higher, as expected, because they more frequently take care of buying food (82 vs. 52%); the younger age group (20-39) is slightly underrepresented (31 vs. 36%); the same applies to people with lower education (no respondent without any school diploma is included in the sample, while they are 6.4% in the Region; the relevant shares for elementary school are 19 vs. 38%). Inference of the results to the general population should be therefore done with some caution, because of a possible bias.

**Results**

Tables 2 and 3 present the results of the difference-in-expenditure equations for roast and minute steak. As already mentioned, they are estimated separately for those consumers who know the price of regular meat (Group A) and those who either do not consume regular meat or consume it, but do not know its price (Group B). The last columns for each group present the parameters of the equation for the maximum price the consumers are willing to pay for organic meat, as illustrated above.

Starting with *roast*, in the DE equation the parameters of the bid price and of the regular meat price are negative (as expected) and positive, respectively, and are highly significant. The price parameter in the first MPWTP equation suggests that a thousand ITL/kg increase in the price the consumer pays for regular meat implies an increase of 966 ITL/kg (€ 0.50) in the maximum price he/she would pay for organic meat. The parameters of consumers' characteristics are in general not significantly different from zero, thus indicating that the effect of these variables are equal for the expenditure functions for regular and for organic meat, and that there are few interaction effects with quality. Only the parameter of city size is weakly significant among group A, indicating that the MPWTP for organic meat, in the case of regular meat consumers, is higher for consumers in larger towns: consumers in larger towns are willing to pay 3,567 ITL/kg (€ 1.84) more than consumers in smaller towns. By contrast, among these consumers, the knowledge of organic products is not significant at the usual levels. The opposite is nevertheless true for the other group of consumers, possibly because some of them are those who stopped buying regular meat after the BSE crisis, and therefore are more concerned by food safety; so, they are probably more interested in organic meat when they already know other organic products. Those consumers who already knew organic products are willing to pay 8,765 ITL/kg (€ 4.53) more than the others. As to income, it has a significant, positive and increasing effect among Group A, at least among the first classes. By contrast, it is not significant among Group B, which seems consistent with the fact that persons who do not remember the price they paid are included in it, along with people concerned with BSE, which may make them much interested in organic meat regardless of their income.

Also in the case of *minute steak* the parameters of the bid price and of the regular meat price are highly significant and have the same negative and positive signs. For this cut, however, the effect of the price of regular meat on the MPWTP for organic meat is weaker: an increase of one thousand ITL/kg in the former increases the latter by 440 ITL/kg (€ 0.23). Among the other variables, the knowledge of organic products is significant, and has a positive effect on the MPWTP which is very similar for group A and for group B: 5,558 ITL/kg (€ 2.87) for the former, 5,765 (€ 2.98) for the latter. Again, income classes parameters are to a large extent significant and exhibit the predicted signs and values among Group A, unlike Group B.

Using the MPWTP equations, the individual MPWTP for the surveyed consumers have been estimated, and their mean and descriptive statistics have been computed for the sample. They are presented in Table 4.

The group of consumers presently buying regular meat and remembering its price have an average MPWTP for organic *roast* of 40,566 ITL/kg (€ 20.95). The median MPWTP is 41,953 ITL/kg (€ 21.67), thus indicating a slightly left–skewed distribution. Among the second group of consumers, the average MPWTP for roast is 44,980 ITL/kg (€ 23.23). The overall mean MPWTP is 44,439 ITL/kg (€ 22.95). All MPWTP values show a strong variation, which is consistent with the strong variation in prices actually paid for regular meat.

The results for *minute steak* are also shown in Table 4; the average MPWTP is 44,980 ITL/kg (€ 23.23) for Group A; it is slightly lower (44,784 lire, € 23.13) for Group B. The overall mean MPWTP is 44,896 ITL/kg (€ 23.19). In the case of minute steak, the variation in MPWTP is lower than for roast.

Among consumers of Group A, the MPWTP is higher for minute steak than for roast, as expected; in fact, the difference between average MPWTP for organic minute steak and roast (4,414 lire, € 2.28) is only slightly larger than the difference between the prices of the two cuts for regular meat (3,921 lire/kg, € 2.03). By contrast, among respondents of Group B the estimated mean MPWTP is higher for roast than for minute steak. As a result, the overall mean MPWTP is almost the same for the two cuts.

The MPWTP for roast for Group A is 14,941 ITL/kg (€ 7.72) higher than the price currently paid for regular meat (25,626 lire, € 13.23), implying a 58% increase relative to present prices. It should be stressed that this "premium" means the difference between the price presently paid for regular meat and the maximum price for which the consumer would buy a minimum amount of organic meat, not the difference between present price for regular meat and the price of organic meat for which the consumer would buy the same quantity. Both MPWTP and "premium" have a large variation; consistently with the result that MPWTP is positively related to the price of regular meat, the variation in “premium” is lower than the variation in MPWTP. The MPWTP for roast among consumers of Group B is higher, and implies a 75% “premium” relative to the average price consumers of Group A were paying for regular meat. In this group are included those who had stopped buying meat because of the mad cow scare, and who are probably inclined to value food safety high; and those consumers who actually buy regular meat but who do not remember its price, which probably implies a lower importance of price in their decisions.

The “premium” for minute steak among consumers of Group A is 15,434 ITL/kg (€ 7.97), equal to a 52.2% increase. Comparing the MPWTP of Group B to the average price for regular minute steak paid by consumers of Group A results in a slightly lower “premium” (15,238 lire, corresponding to € 7.87, a 51.6% increase).

Finally, as indicated above, the accuracy of the mean MPWTP has been assessed using a Monte Carlo simulation. The results of the simulation exercise (10,000 draws were made) are reported in Table 5. The results show that the distribution of the mean WPWTP is asymmetrical and right-skewed; simulation medians are closer to the original mean MPWTP for the sample than simulation means; confidence intervals are tighter for Group A, both for roast and for minute steak, as expected. The estimated confidence intervals suggest that the estimated MPWTP is quite accurate, at least for Group A.

## Summary and conclusions

In this paper, a theoretical and econometric approach for evaluating the maximum price consumers are willing to pay for a new quality has been presented, and implemented for estimating the maximum price Italian consumers are willing to pay for organic beef meat.

The results show that consumers’ MPWTP is quite high, thus suggesting that organic beef meat might gain an appreciable market share. This is also an encouraging signal for prospective producers of organic meat, who might compensate the likely increase in production costs with a substantial premium for the new good.

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**Appendix**

The log-likelihood function for the model is as follows.

Call:

a = first bid
ah = higher bid
al = lower bid

and create dichotomous variables for the four possible outcomes:

yy = 1 if the answer to both question is yes; else yy = 0;
ny = 1 if the answer to the first question is no, and to the second is yes; else ny = 0;
yn = 1 if the answer to the first question is yes, and to the second is no; else yn = 0;
nn = 1 if the answer to both question is no; else nn = 0

The log-likelihood function for Group A (consumers who remember the price they pay for regular meat is:

$$\begin{aligned}
LL = \Sigma_i \,[&\text{yy} * \log(\Phi(b_0 + b_1 * \text{ah} + b_2 * \text{p} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} + b_6 * \text{bigtown} \\
&+ b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{inc2} + b_9 * \text{inc3} + b_9 * \text{inc4} + b_9 * \text{inc5})) + \\
&+ \text{yn} * \log[\Phi(b_0 + b_1 * \text{a} + b_2 * \text{p} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} + b_6 * \text{bigtown} \\
&+ b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{logincome}) - \Phi(b_0 + b_1 * \text{ah} + b_2 * \text{p} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} \\
&+ b_6 * \text{bigtown} + b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{inc2} + b_9 * \text{inc3} + b_9 * \text{inc4} + b_9 * \text{inc5})\,] + \\
&+ \text{ny} * \log[\Phi(b_0 + b_1 * \text{al} + b_2 * \text{p} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} + b_6 * \text{bigtown} \\
&+ b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{logincome}) - \Phi(b_0 + b_1 * \text{a} + b_2 * \text{p} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} \\
&+ b_6 * \text{bigtown} + b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{inc2} + b_9 * \text{inc3} + b_9 * \text{inc4} + b_9 * \text{inc5})\,] + \\
&+ \text{nn} * \log(1 - \Phi(b_0 + b_1 * \text{al} + b_2 * \text{p} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} + b_6 * \text{bigtown} \\
&+ b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{inc2} + b_9 * \text{inc3} + b_9 * \text{inc4} + b_9 * \text{inc5}))]
\end{aligned}$$

Where $\Phi$ is the normal cumulative density function, and the explanatory variables are illustrated in the text.
The log-likelihood function for Group B (persons who do not usually buy regular meat or who buy it, but do not remember the price they pay for regular meat) is identical to the above, except that the price for regular meat is not included:

$$\begin{aligned}
LL = \Sigma_i [&\text{yy} * \log\{\Phi(b_0 + b_1 * \text{ah} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} + b_6 * \text{bigtown} \\
&+ b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{inc2} + b_9 * \text{inc3} + b_9 * \text{inc4} + b_9 * \text{inc5})\} + \\
&+ \text{yn} * \log\{\Phi(b_0 + b_1 * \text{a} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} + b_6 * \text{bigtown} \\
&+ b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{logincome}) - \Phi(b_0 + b_1 * \text{ah} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} \\
&+ b_6 * \text{bigtown} + b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{inc2} + b_9 * \text{inc3} + b_9 * \text{inc4} + b_9 * \text{inc5})\,\} + \\
&+ \text{ny} * \log\{\Phi(b_0 + b_1 * \text{al} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} + b_6 * \text{bigtown} \\
&+ b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{logincome}) - \Phi(b_0 + b_1 * \text{a} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} \\
&+ b_6 * \text{bigtown} + b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{inc2} + b_9 * \text{inc3} + b_9 * \text{inc4} + b_9 * \text{inc5})\,\} + \\
&+ \text{nn} * \log\{1 - \Phi(b_0 + b_1 * \text{al} + b_3 * \text{age} + b_4 * \text{educ} + b_5 * \text{housesize} + b_6 * \text{bigtown} \\
&+ b_7 * \text{knowsorg} + b_8 * \text{sex} + b_9 * \text{inc2} + b_9 * \text{inc3} + b_9 * \text{inc4} + b_9 * \text{inc5})\,\}]
\end{aligned}$$

## Table 1: Descriptive statistics of the explanatory variables

| | Mean | Standard deviation |
|---|---|---|
| Big town (*=1 if living in towns with more than 50,000 inhabitants*) | 0.311 | 0.463 |
| Sex (*female = 1*) | 0.818 | 0.386 |
| Age (*years*) | 50.108 | 15.612 |
| Education (*years of study*) | 10.313 | 3.852 |
| Household size (*number of family members*) | 3.189 | 1.052 |
| Family income classes (*) | | |
| *0-15 million ITL/year (0-7,747 €)* | 0.080 | 0.271 |
| *15-30 million ITL/year (7,747-15,494 €)* | 0.308 | 0.462 |
| *30-45 million ITL/year (15,494-23,241 €)* | 0.338 | 0.474 |
| *45-60 million ITL/year (23,241-30,987 €)* | 0.194 | 0.396 |
| *Over 60 million ITL/year (over 30,987 €)* | 0.080 | 0.271 |
| Knows organic (*=1 if knowing organic products*) | 0.639 | 0.481 |
| N. observations = 402 | | |

(*) Values missing because of respondents' refusal to declare their income were replaced by fitted values (see footnote 5)

## Table 2: Difference-in-expenditure and MPWTP equations for roast

| | Group A | | | | Group B | | | |
|---|---|---|---|---|---|---|---|---|
| | Difference-in-expenditure equation | | | MPWTP equation | Difference-in-expenditure equation | | | MPWTP equation |
| | Coeff. | t-ratio | P-value | Coeff. | Coeff. | t-ratio | P-value | Coeff. |
| Constant | -0.387 | -0.295 | 0.768 | -2.433 | 1.142 | 0.931 | 0.352 | 19.005 |
| pbid | -0.159 | -4.851 | 0.000 | | -0.060 | -4.427 | 0.000 | |
| p | 0.154 | 4.471 | 0.000 | 0.966 | | | | |
| Age | 0.016 | 1.436 | 0.151 | 0.101 | 0.015 | 1.266 | 0.206 | 0.245 |
| Education (years) | 0.027 | 0.513 | 0.608 | 0.167 | 0.048 | 0.918 | 0.358 | 0.803 |
| Household size | -0.032 | -0.229 | 0.819 | -0.203 | -0.149 | -1.136 | 0.256 | -2.483 |
| Big town (1 = > 50000 inh.) | 0.568 | 1.675 | 0.094 | 3.567 | -0.079 | -0.276 | 0.783 | -1.322 |
| Knows organic (1 = yes) | 0.432 | 1.510 | 0.131 | 2.710 | 0.527 | 2.181 | 0.029 | 8.765 |
| Sex (Female = 1) | 0.484 | 1.332 | 0.183 | 3.040 | 0.270 | 0.952 | 0.341 | 4.490 |
| Income class 2 | 1.192 | 2.654 | 0.008 | 7.489 | 0.575 | 1.133 | 0.257 | 9.565 |
| Income class 3 | 1.384 | 2.666 | 0.008 | 8.690 | 0.773 | 1.228 | 0.220 | 12.869 |
| Income class 4 | 0.844 | 1.576 | 0.115 | 5.303 | 0.110 | 0.185 | 0.854 | 1.826 |
| Income class 5 | 0.738 | 0.984 | 0.325 | 4.633 | 0.858 | 1.101 | 0.271 | 14.283 |
| N | 199 | | | | 177 | | | |
| Log-likelihood | -85.590 | | | | -113.297 | | | |

## Table 3: Difference-in-expenditure and MPWTP equations for minute steak

| | Group A | | | | Group B | | | |
|---|---|---|---|---|---|---|---|---|
| | Difference-in-expenditure equation | | | MPWTP equation | Difference-in-expenditure equation | | | MPWTP equation |
| | Coeff. | t-ratio | P-value | Coeff. | Coeff. | t-ratio | P-value | Coeff. |
| Constant | 2.139 | 1.962 | 0.050 | 16.289 | 2.215 | 2.213 | 0.027 | 26.111 |
| pbid | -0.131 | -6.891 | 0.000 | | -0.085 | -6.008 | 0.000 | |
| p | 0.058 | 2.659 | 0.008 | 0.440 | | | | |
| Age | 0.013 | 1.591 | 0.112 | 0.100 | 0.007 | 0.767 | 0.443 | 0.078 |
| Education (years) | -0.011 | -0.284 | 0.776 | -0.082 | 0.075 | 1.631 | 0.103 | 0.880 |
| Household size | -0.014 | -0.145 | 0.884 | -0.105 | -0.125 | -1.031 | 0.302 | -1.470 |
| Big town (1 = > 50000 inh.) | 0.173 | 0.662 | 0.508 | 1.316 | -0.354 | -1.447 | 0.148 | -4.176 |
| Knows organic (1 = yes) | 0.730 | 3.068 | 0.002 | 5.558 | 0.489 | 2.234 | 0.025 | 5.765 |
| Sex (Female = 1) | 0.305 | 1.030 | 0.303 | 2.326 | 0.270 | 0.942 | 0.346 | 3.181 |
| Income class 2 | 0.656 | 1.745 | 0.081 | 4.996 | 0.610 | 1.588 | 0.112 | 7.189 |
| Income class 3 | 0.897 | 2.114 | 0.035 | 6.830 | 0.648 | 1.465 | 0.143 | 7.643 |
| Income class 4 | 0.838 | 1.843 | 0.065 | 6.381 | -0.005 | -0.011 | 0.991 | -0.061 |
| Income class 5 | 0.692 | 1.248 | 0.212 | 5.268 | 1.167 | 1.653 | 0.098 | 13.755 |
| N | 226 | | | | 171 | | | |
| Log-likelihood | -136.070 | | | | -133.545 | | | |

## Table 4: Maximum price consumers in the sample are willing to pay for organic beef

| | Mean MPWTP | SD | Median MPWTP | Mean Premium | SD | Median Premium |
|---|---|---|---|---|---|---|
| | **Thousand ITL** | | | | | |
| | **Roast** | | | | | |
| Group A | 40.566 | 6.482 | 41.953 | 14.941 | 3.629 | 15.495 |
| Group B | 48.792 | 6.959 | 49.943 | | | |
| *Total* | *44.439* | *7.863* | *44.564* | | | |
| | **Minute steak** | | | | | |
| Group A | 44.980 | 4.440 | 45.580 | 15.434 | 4.155 | 15.371 |
| Group B | 44.784 | 5.783 | 45.012 | | | |
| *Total* | *44.896* | *5.056* | *45.191* | | | |
| | **Euro** | | | | | |
| | **Roast** | | | | | |
| Group A | 20.95 | 3.35 | 21.67 | 7.72 | 1.87 | 8.00 |
| Group B | 25.20 | 3.59 | 25.79 | | | |
| *Total* | *22.95* | *4.06* | *23.02* | | | |
| | **Minute steak** | | | | | |
| Group A | 23.23 | 2.29 | 23.54 | 7.97 | 2.15 | 7.94 |
| Group B | 23.13 | 2.99 | 23.25 | | | |
| *Total* | *23.19* | *2.61* | *23.34* | | | |

**Table 5: Results of the simulation on the mean maximum price consumers are willing to pay for organic beef**

| | Mean | Median | 95% confidence interval | |
|---|---|---|---|---|
| | | | Lower bound | Upper bound |
| | | **Thousand ITL** | | |
| | **Roast** | | | |
| Group A | 40.881 | 40.582 | 38.240 | 45.309 |
| Group B | 49.694 | 48.750 | 43.137 | 60.968 |
| *Total* | *45.288* | *44.044* | *38.566* | *58.366* |
| | **Minute steak** | | | |
| Group A | 45.131 | 44.970 | 42.872 | 48.362 |
| Group B | 45.015 | 44.777 | 41.835 | 49.442 |
| *Total* | *45.073* | *44.888* | *42.237* | *48.896* |
| | | **Euro** | | |
| | **Roast** | | | |
| Group A | 21.11 | 20.96 | 19.75 | 23.40 |
| Group B | 25.66 | 25.18 | 22.28 | 31.49 |
| *Total* | *23.39* | *22.75* | *19.92* | *30.14* |
| | **Minute steak** | | | |
| Group A | 23.31 | 23.22 | 22.14 | 24.98 |
| Group B | 23.25 | 23.13 | 21.61 | 25.53 |
| *Total* | *23.28* | *23.18* | *21.81* | *25.25* |