Measuring Consumer Willingness to Pay for a Health Risk Reduction of Salmonellosis and Campylobacteriosis

Isabell Goldberg and Jutta Roosen

Department of Food Economics and Consumption Studies, University of Kiel,
Olshausenstr. 40, 24098 Kiel, Germany
Phone +49 (0)431/880-4427, fax +49 (0)431/880-7308
igoldberg@food-econ.uni-kiel.de

Paper prepared for presentation at the 11th congress of the EAAE

(European Association of Agricultural Economists),

'The Future of Rural Europe in the Global Agri-Food System',

Copenhagen, Denmark, August 24-27, 2005

Abstract

This paper presents an application of the contingent valuation method (CVM) and choice experiments (CEs). We examine consumer willingness to pay (WTP) for different health risk reduction levels of Salmonellosis and Campylobacteriosis acquired from the consumption of chicken breast. We test for the embedding effect. The embedding effect was not found in the CVM format. It was however present in the CEs. The WTP values in the CVM format rages from Euro 1.29 to 3.34, whereas the WTP obtained by the CEs ranges from Euro -0.16 to Euro 6.68 depending on the disease and the corresponding risk reduction levels.

Keywords: Chicken, Choice Experiments, Contingent Valuation Method, Food Safety, Willingness to Pay

JEL: C9, D8, D12

1 Introduction

Increase in consumers' concern about food quality and safety is driven by increased affluence, new scientific discoveries, more sophisticated measurement, new information about linkages between diet and health, new food technology and mass communications (Kinsey, 1993). However, many of the scientific and economic variables that are associated to food safety are difficult to measure. One approved method for determining the benefit of an improvement in food safety is the estimation of consumers' willingness to pay (WTP) for risk-reduced food.

In previous studies, choice experiments (CEs) and the contingent valuation method (CVM) have been fruitfully applied to a wide range of foods for measuring consumer WTP for enhanced food safety. Shogren et al. (1999) conducted a survey on irradiated chicken applying the CVM and CEs. Using a choice experiment, Lusk et al. (2003) determined in several European countries consumers' valuation of beef steaks from cattle produced without growth hormones or genetically modified corn. Buzby et al. (1995) used the CVM to determine the benefits of a reduction of pesticide residues in grapefruit.

The quality of the results obtained by CEs and CVM is frequently questioned because of the potential occurrence of the embedding effect (also called part-whole bias or nesting). Embedding is present when respondents do not react sensitively to different amounts of improvements but value the risk reduction in general. This is regarded to bias the survey results. Sælensminde (2003) investigated the embedding effect in a survey on travel time savings, and Horowitz (1993) presented a model that provides an explanation for nesting in an environmental economic survey. In this paper, the embedding effect is investigated for a survey on food safety issues. In particular the robustness of the CEs and the CVM regarding potential embedding is tested for.

In the following, the design of the survey that was conducted in order to estimate consumer willingness to pay for a health risk reduction of Salmonellosis and Campylobacteriosis is outlined. Furthermore, a brief overview of the advantages and drawbacks of CEs and the CVM is given. One of the major foci of this study is to juxtapose the results of the two different methods with regard to the occurrence of the embedding effect. The concept of embedding is described before the empirical results of the contingent valuation questions and the choice experiments are presented. The paper ends with a review on the potential of CVM and CEs to value food safety risk reductions based on the presented estimates.

2 Data and Methods

2.1 CEs, CVM and the Embedding effect

We employed CEs and a dichotomous choice contingent valuation format to reveal consumers' preferences concerning safer chicken. Both methods rely on stated preferences. Economists generally prefer revealed preference methods to stated preference methods. Nevertheless, stated preference methods have some advantages compared to revealed preferences. A salient feature is that preferences for non-existing attributes can be elicited. Also the range of attribute values can be extended. On the other side, the respondents could misinterpret or ignore an attribute if the attribute level lacks reality. Furthermore, the questionnaire could be used as an opinion statement for respondents' own benefit, or they do not consider situational constraints. However, what holds against these objections is that the trade-off relationship among major attributes is assumed to be common to both revealed and stated preferences (Morikawa et al., 2002).

In choice experiments, respondents are asked to make repeated choices between different consumption bundles which include different attributes and the respective levels of these attributes. Typically, one of these attributes is the price. The respondents' utility depends on attribute levels of the choices made from these sets. This procedure enables the researcher to obtain different pieces of information:

- Determining the attributes which influence the choice significantly,
- an implied ranking of these attributes,
- and the marginal willingness to pay for an increase or decrease in the significant attributes (Hanley et al., 1998).

CEs are, like the CVM too, sensitive to information presented to the respondent. In the survey, we balanced that drawback by presenting the same scenario to the respondents in both the choice experiment and the CVM part. Other possible sources for misspecifications are, for instance, ignoring interactions between attributes or excluding attributes which might be important for the choice experiment. In these cases, the experimental design is probably too simple. On the other hand, managers and policy makers may be more interested in the marginal value when changing certain attributes and including all possible attributes might not be of interest. Choice experiments enable the policy researcher to determine and value the individual characteristics of a policy (Hanley et al., 1998). However, it should be kept in mind that only some selected attributes can be taken into account and that the experimental design significantly determines the reliability of the obtained data.

Some aspects of the contingent valuation method should also be highlighted. The CVM is widely used to determine willingness to pay for public and non-market goods. Usually a CV survey contains an introduction section that sets the general context. The respondent receives information about the good being valued, the institutional circumstances in which the good is made available to him/ her, and the payment vehicle. By this means, the hypothetical market is constructed and the respondent becomes familiar with the good. Due to different eliciting formats used in CV studies (e.g. payment cards, bidding games, or dichotomous choice questions) respondents' willingness to pay for the good in question is valued. The additional information that is gained from socio-demographic questions (e.g. age, income, educational background), and questions which elicit respondents' preferences and attitudes about the good helps to estimate a valuation function and is used in regression equations (Carson, 1999; Mitchell and Carson, 1989).

It is often criticized that CV surveys provide just hypothetical answers to hypothetical questions. That might be true if the study is poorly designed. As the results of the CV survey rely mainly on the design of the scenario, it has to be designed carefully. There exist several sources of systematic errors in CV studies. Mitchell and Carson (1989) have identified four principal sources. The scenario is badly constructed if it:

- includes strong incentives to misrepresent the true WTP,
- constains strong incentives for respondents to rely improperly on elements of the scenario to determine their WTP,
- gives an incorrect description from the standpoint of economic theory of the good (→ theoretical misspecification) or describes it correctly but in such a way that respondents misunderstand it (→ methodological misspecification),
- or the sampling design, execution, or benefit aggregation is inadequate.

The biases that can occur because of this misspecifications are strategic behaviour, payment vehicle bias, yea-saying, question ordering bias, and the embedding effect, just to name a few. In this context, the validity of CV survey results is frequently called into question. Because of the methodological drawbacks of CV, it is preferable to use market data including real transactions for economic analysis when it is available (Belzer and Theroux, 1995). The scenario in our survey was designed to avoid or at least to minimize the occurrences of these biases.

In this paper, the occurrence of embedding is investigated. In order to contextualize the survey results, some aspects of embedding are discussed. Embedding occurs when respondents do not sensitively react to different magnitudes of health risk reductions but state an amount more as a general approval in favour of "voting" for a higher risk reduction. It does not imply that these respondents would behave in a similar way in a real market setting and are willing to pay the same if they are really ask to pay the stated amount. For small health risk reductions, theory suggests that WTP should be proportional to the change in health risk (Hammitt and Graham, 1999).

The reasons for embedding are multifariously. Since the WTP values and the quality of the results are contingent upon the scenario, the stimulus representation and the response mode used in the task influence the valuation (Fischhoff et al., 1993). Loomis et al. (1993) for example conclude that embedding is not always persuasive in CV surveys if the context is clearly communicated. But also moral satisfaction is an often cited phenomenon occurring in CV surveys resulting in embedding. Kahneman and Knetsch (1992) argue not to misinterpret individuals' WTP to acquire moral satisfaction for a measure of the economic value of a public good. The degree of embedding that might be traced back to moral satisfaction depends possibly on the good/ program being evaluated.

Embedding might also be the result of a lack of interest and the people do not care about the programme's outcome they are asked to value (Olsen et al. 2004). Also a (food) safety issue might be valued differently from an environmental issue. But there are also overlaps or interdependencies possible. For instance, Hamilton mentioned that when valuing concern about toxic waste, the contamination that affects one's own household becomes then rather a safety than an environmental issue for the respondent (Hamilton, 1985).

When embedding occurs, the question is if the degree of embedding depends on public goods that having use value or those having non-use value. Kahneman and Knetsch (1992) stated that the magnitude of embedding does not depend on use or non-use value of public goods. They suggest that it might be more important to regard if private purchase is conceivable to the public good or not. Broadly speaking, food safety is a public good. It might however become a good that can be purchased privately, when respondents can choose between relatively safer products compared to ordinary ones like it is the case in our study.

In the past, several researchers investigated the occurrence of embedding and the sensitivity to a change of the magnitude of risk reduction, respectively (see for example Fischhoff et al., 1993; Loomis et al., 1993; Hammitt and Graham, 1999). According to Fischhoff et al. (1993), a valid measure should be able to capture relevant changes in applications and should be insensitive to irrelevant ones. But the question is which changes are relevant and which ones are not. Is it more important that the changes are relevant from the theoretical standpoint of the researcher or is the view of the respondent decisive?

However, embedding is not just a problem of non-market valuation. Randall and Hoehn (1996) pointed out, that theory predicts that embedding may be observed with market and non-market valuation and is a routine economic phenomenon. If embedding is identified, it does not invalidate the WTP measures or the CVM in general. However, it is possible that the CVM exacerbates this effect (Randall and Hoehn, 1996). For our study, it has to be shown if the CVM is doing well in determining consumer willingness to pay regarding the occurrence of embedding. Since we obtain different WTP estimates with the CVM approach compared to the CEs, the remaining question is which measures are closer to the reality. A detailed description of the survey design is given in the next section of this paper. The results are described and compared in chapter 3.

2.2 Consumer Survey

The consumer survey was conducted in September and October 2004 in a town of 240,000 inhabitants in Germany. The data was collected in three different local grocery stores in person-to-person interviews using a standardised questionnaire. We draw a random sample of people who do most or at least half of the grocery shopping for their household. Additionally, it was required that they are buyers **and** consumers of chicken. The final sample consists of 240 completed questionnaires.

The questionnaire consists of three parts. The first part includes questions about e.g. consumer concerns about different food safety issues, about meat attributes, which were taken into account when buying meat, and it asks for information sources that the consumer uses concerning food safety issues. The second part of the questionnaire contains the evaluation section of the health risk reduction for Salmonellosis and Campylobacteriosis acquired from chicken breast. In the final part of the questionnaire, the respondents were asked to complete several questions concerning socio-demographic characteristics like age, household size, education, and income.

In the evaluation section of the questionnaire, the consumer was made familiar with the good being valued. Information was provided on Salmonellosis and Campylobacteriosis including symptoms, incidence rates and associated foods. The descriptions on the infections are available from the authors upon request. Two figures illustrated the influence of a health risk reduction on the annual incidence rates. Consumers were then asked to state their WTP for a risk reduction of different degrees.

Real estimates of health risks of becoming ill of Salmonella and Campylobacter are not available for Germany. For that reason, we constructed the health risk using the current incidence rates and two fictive risk reduction levels (40 and 80 percent). The way in which the risk reduction was to be achieved is described as a quality assurance program. The type of the quality assurance program was not specified because valuing the program was not within the scope of this survey. It is only used as a vehicle to reach a health risk reduction and to construct the scenario. In 2003, 76 out of 100.000 people were affected by Salmonellosis and 58 out of 100.000 people by Campylobacteriosis, where these are only the reported cases. The estimated number of unknown cases is assumed to be much higher. Since presenting the health risk in terms of the number of cases seems to be more comprehensible for participants (e.g. 15 cases per 100.000 inhabitants) than giving just risk levels (e.g. 0.00015), we used the present incidence rate to communicate the health risk (Viscusi et al., 1991).

For the evaluation of consumers' willingness to pay, the attributes "Risk Reduction of Salmonellosis", "Risk Reduction of Campylobacteriosis" and "Price" were chosen. The selected attributes and levels are provided in Table 1. The sample includes 24 different choice sets in the choice experiment part and 8 different valuation questions in the contingent valuation part. The sample was divided into 6 sub samples which vary in the levels of risk reduction and price. Each questionnaire includes a choice experiment consisting of 8 choice sets, and three dichotomous choice contingent valuation questions. In total, we gained a sample of 1920 responses to CEs and 720 responses to the CVM questions.

To counteract an ordering bias, half of the questionnaires start with the CV questions and half of them with the CE part. The choice sets are level balanced both within the three subsamples and over all 24 choice sets. The experimental design is nonorthogonal because an orthogonal design measures only the main effects. Since we are interested in the non-linear effects, applying an orthogonal design would not have worked. Moreover, when designing a choice experiment, an orthogonal design is not always available and it is not automatically more efficient than a nonorthogonal design (Kuhfeld et al., 1994). Because of the relatively small number of selected attributes and attribute levels we applied a full factorial design while we excluded some combinations. Not all combinations that were possible made sense because some choice sets dominated others. From that perspective they would have predefined consumers' choice and would have biased the results.

Table 1. Selected Chicken Attributes and Attribute Levels.

Chicken breast attribute	**Attribute Levels**
Price/ kg	€ 9.99 € 10.99 € 11.99
Risk Reduction of Salmonellosis (in percent)	0 40 80
Risk Reduction of Campylobacteriosis (in percent)	0 40 80

The excluded combinations are "80% Risk reduction of Salmonellosis/ 80% Risk reduction of Campylobacteriosis/ € 9.99" (means highest risk reduction but lowest price), and "0% Risk reduction of Salmonellosis/ 0% Risk reduction of Campylobacteriosis/ € 11.99" (means lowest risk reduction but highest price). For reasons of level balance we excluded also "40% Risk reduction of Salmonellosis/ 40% Risk reduction of Campylobacteriosis/ € 10.99". Finally, 24 out of 27 possible choice sets of the 3^3 matrix left. This 24 choice sets were paired with each other whereat 576 possibilities of matching exists. Figure 1 shows a sample choice experiment question.

Attribute	**Option A**	**Option B**	**Option C**
Price/kg.	9.99 €	10.99 €	Neither A nor B
Risk reduction of Salmonellosis	40%	80%	
Risk reduction of Campylobacteriosis	No risk reduction	80%	
I would buy...	☐	☐	☐

Figure 1. Sample Choice Experiment Question.

The most efficient choice sets were selected using the concept of D-efficiency (see Equation 1) that attained a value of 53.2.

$$\text{D}-\text{efficiency} = 100 \times \frac{1}{N_D \left| (X'X)^{-1} \right|^{1/p}} \quad (1)$$

The efficiency of an experimental design can be quantified as a function of the variances and covariances of the parameter estimates while efficiency increases as the variances decrease. The efficiency measure indicates the goodness of the design relative to the orthogonal design and is used to compare different designs for the same valuation problem. Hence, an efficiency that is not close to 100 might be completely satisfactory (Kuhfeld et al., 1994).

In the CVM part, we asked the respondents to answer three dichotomous choice contingent valuation questions. Figure 2 gives an example for one of these questions. We varied the risk reduction levels across the six different versions of the questionnaire while the basic price level is Euro 9.99. That is the price a consumer pays to purchase ordinary chicken breast. Hence, the consumer has to pay at least Euro 9.99 in our survey because that expresses a WTP of zero for the health risk reduction. If the respondent chooses "No", (s)he expresses to prefer the ordinary chicken. There is no "Neither A nor B" option included like in the choice experiments. The whole CVM design and the questionnaires are available from the authors upon request.

Would you buy chicken "A" that was examined for a contamination with Salmonella? The risk of becoming ill of Salmonella is reduced to 80 %. It costs Euro 10.99 per Kilogram.

Yes ☐	No ☐
If yes, would you also pay Euro 11.99? Yes ☐ No ☐	If no, how much are you willing to pay for it? I'm willing to pay Euro_________ [at least Euro 9.99].

Figure 2. Example of a Contingent Valuation Question.

In this section, the designs of the survey, and especially the contingent valuation questions and the choice experiment have been described. It is demonstrated that the CE method is a generalization of CVM because people are asked to choose between different cases described by attributes in choice sets instead of presenting a base case and an alternative (Adamowicz et al., 1998). In this regard, we are interested in investigating how the WTP differs when applying the two different methods. If the WTP estimates differ significantly from each other, then we assume that the method itself must be the reason for obtaining different results.

2.3 Econometric Models

We apply two different models for the analysis of the choice experiments and the contingent valuation part. Due to the structure of the contingent valuation questions, we choose the model for the double-bounded contingent valuation question format proposed by Hanemann and Kanninen (1999). The respondents are asked if they are willing to pay a specific amount for the health risk reduction. According to their answer the follow-up question is asked. The maximum-likelihood function for the double-bounded model is given by

$$\ln L = \sum_{i=1}^{n} \left[I_{yy} \ln P_i^{yy} + I_{yn} \ln P_i^{yn} + I_{ny} \ln P_i^{ny} + I_{nn} \ln P_i^{nn} \right] \quad (2)$$

(Haneman and Kanninen, 1999). The probability of the responses for the underlying WTP distribution is:

$$\begin{aligned}
\Pr\{yes/yes\} &\equiv P^{yy} = 1 - G_C(A_u) \\
\Pr\{yes/no\} &\equiv P^{yn} = G_C(A_u) - G_C(A) \\
\Pr\{no/no\} &\equiv P^{nn} = C_c(A_d) \\
\Pr\{no/yes\} &\equiv P^{ny} = G_C(A) - G_C(A_d)
\end{aligned} \quad (3)$$

$G_c(\cdot)$ = WTP distribution
A = Amount of the first bid
Pr = Probabilities of responses

(following Haneman and Kanninen, 1999). The expression "no/yes" means "no" to 10.99 Euro but "yes" to an amount higher than 9.99 Euro (= positive WTP). The following explanatory variables are included in the logit regression:

$$WTP = \sum_{k,j=0,40,80} \alpha_{kj}\left[S_k C_j\right] + \beta_1 Age + \beta_2 Gender + \beta_3 Income + \beta_4 PvF + \beta_5 SfD + \beta_6 CCH + \varepsilon \quad (4)$$

In Equation 4, S_kC_j represents a set of eight dummy variables that indicates different combinations of risk reductions. That is let S indicate the reduction of risk of Salmonellosis so that S=0, S=40 or S=80. Similarly let C indicate the reduction of risk of Campylobacteriosis so that C=0, C=40 or C=80. Hence we let S_0C_0 =1 if neither risk is reduced, $S_{40}C_0$ =1 if the risk of Salmonellosis is reduced by 40% and that of Campylobacteriosis by 0%, and $S_{40}C_{40}$ =1 if the risk of Salmonellosis is reduced by 40% and that of Campylobacteriosis by 40% etc. We do not include a constant in the estimation, because the way in which we code the dummies precludes us from doing so. We include socio-demographic variables as explanatory variables where:

Age =	Respondent's age
Gender =	Gender (male = 0, female = 1)
Income =	Household Monthly Net Income
PvF =	„Price versus Food Safety“ question
SfD =	Suffered from Food-borne illness
CCH =	Children in Household
Epsilon =	Error term

Apart from the CV question, respondents *i* = 1,2... N had to respond to 8 choice set questions (cf. Figure 1). Each was composed of a choice between two options described by different levels of health risk reduction for Salmonellosis and Campylobacteriosis and prices. A "Neither A nor B" option was included in each choice set. We applied the random utility model for the analysis of the choice experiments. The utility functions of the choice alternatives consist of a deterministic component (V_i) and a stochastic component (ε_i). Consequently, the utility of alternative *i*, is:

$$U_i = V_i + \varepsilon_i \quad (5)$$

(Adamowicz et al., 1998). If $U_i > U_j$ for all $j \neq i$, the respondents chooses alternative *i*. The probability of choosing alternative *i* is:

$$\text{Prob}\ \{i \text{ chosen}\} = \text{Prob}\ \{V_i+\varepsilon_i > V_j+\varepsilon_j\ ;\ \text{for all } j \in C\} \quad (6)$$

C = choice set of all possible alternatives
V_i = deterministic utility of option *i*, depending on the attribute levels of this alternative

We assume a type I extreme-value distribution for the error terms while the choice scenarios and individuals are independent. The probability of choosing alternative *i* is then described by a multinomial logit model as:

$$\text{prob}\ \{i\} = \frac{e^{sVi}}{\sum_{j \in C} e^{sVj}} \quad (7)$$

with *s* being a scale parameter (Adamowicz et al., 1998). We assume that the deterministic part of the utility function depends on the risk attributes of this alternative:

$$V_i = \sum_{k,j=0,40,80} \alpha_{kj} \left[S_k C_j \right]_i \qquad (8)$$

Individual-specific variables cannot be included in this model, because they cannot be identified in the conditional logit model.

3 Results and Discussion

The following results are based on a sample of 240 completed questionnaires. Since we included 8 choice sets and 3 dichotomous choice questions per questionnaire, we obtained 1920 responses to CEs and 720 responses to the CVM questions. Some selected characteristics of the sample are summarized in Table 2.

Table 2. Some Selected Sample Characteristics.

Characteristics	Frequency	Percentage
Female	160	66.7
Male	80	33.3
Children in the Household		
Yes	86	35.8
No	154	64.2
Household Size		
1	59	24.6
2	102	42.5
3	26	10.8
4	40	16.7
5	9	3.8
6	3	1.3
7	1	0.4
Household Net Income		
< 920 Euro	24	10.1
920-1.500 Euro	41	17.2
1.501-2.500 Euro	58	24.4
2.501-3.500 Euro	56	23.5
3.501-4.500 Euro	30	12,6
4.501-6.500 Euro	19	8,0
6.501-8.500 Euro	6	2,5
8.501-10.500 Euro	2	0,8
10.501-12.500 Euro	1	0,4
>12.500 Euro	1	0,4
Age in Years	Mean	Percentile (25/50/75)
	46.2	33/44/60

The sample consists to 2/3 of females and average age is 46. About a third of the respondents has children living in their household. The median household income is between 1501 to 2500 Euro net per month.

The results from the maximum-likelihood estimation of the CVM data are presented in Table 3. The estimated coefficients of the dummy variables related to risk reductions of Campylobacteriosis and Salmonellosis, Gender, Price versus Food Safety, and the Price Term are statistically significant different form zero at the 0.01 significance level. The variable Age is statistically significant at the 0.05 significance level. The p-value of the Income is 0.14. If the respondent has already experienced a food-borne disease, as well as the variable Children in the household were statistically not significant.

Table 3. Results from the Maximum-Likelihood Estimation for the CV Questions.

Variable	**Coefficient**	**t-Statistics**
Risk reduction level Sal 40%	9.025***	11.74
Risk reduction level Sal 80%	10.04***	12.69
Risk reduction level Camp 40%	8.992***	11.54
Risk reduction level Camp 80%	9.768***	12.05
Risk reduction level Sal 40% and Camp 40%	9.760***	12.19
Risk reduction level Sal 80% and Camp 40%	10.44***	12.66
Risk reduction level Sal 40% and Camp 80%	10.07***	11.88
Risk reduction level Sal 80% and Camp 80%	10.16***	12.45
Price term	1.031***	18.28
Gender	-.4412***	-2.627
Age	.0117**	2.197
Household Net Income	.0761	1.476
Price versus Food Safety[1]	.5787***	9.610
Was affected by a food-borne disease	-.1121	-.5806
Children in the household	-.1698	-.9680

[1]The respondents were asked to indicate their preference on a scale from 1 to 7 where 1 meant "low price over all" and 7 "highest food safety over all".
***Significance level = 0.01/ ** Significance level = 0.05

Huang et al. (1999) conducted a CV survey on WTP for vegetables free of pesticide residues. They found out that those respondents who had young children in the household (< 12 years) are more likely to pay a premium. Regarding the influence of children on the households' preferences concerning safer chicken, our findings mirror those of Buzby et al. (1998) who did not find that Children in the household (<18 years) is a statistically significant variable and increases the likelihood of choice. In our survey we tested if then general presence of children in the household, children under the age of 18, or children under the age of 14 influence the probability of respondents' choice significantly. All three variables are found to be statistically insignificant. In the table above the term "Children in the household" refers to the question "Do children live in your household?" where 1 means yes and 0 means no.

According to standard economic theory, the amount an individual is willing to pay to reduce small probabilities of adverse health effects is assumed to increase in the magnitude of risk reduction and in a way that is about proportional to the magnitude (Hammitt and Graham, 1999). We assume that respondents' WTP for the different levels of health risk reduction does not compulsively double because of a nonlinearity of the relationship. It is however interesting to investigate which value respondents place to the different levels of health risk reductions.

Table 4 shows these price premiums estimated from the responses to the CVM questions. The WTP ranges from Euro 1.29 for a risk reduction of 40 percent for Campylobacteriosis to Euro 3.36 for a risk reduction of Salmonellosis of 40 percent and a risk reduction of Campylobacteriosis of 80 percent. The highest risk reduction (80%Sal/ 80%Camp) achieved a lower WTP and is estimated at Euro 2.38. This suggests that the relationship between health risk reduction and WTP is nonlinear as we expected.

Table 4. WTP Estimates of the Contingent Valuation Study.

		Price Premium for Campylobacteriosis reduction (in Euro/ kg chicken)		
		C=0	C=40	C=80
Price Premium for Salmonellosis reduction (in Euro/ kg chicken)	S=0	0 (Initial Situation)	1.288	1.978
	S=40	1.377	1.978	3.335
	S=80	2.230	2.709	2.375

However, to formally test for the embedding effect, we tested the following restrictions. The p-values are those on the χ^2-test statistics of these restrictions:

$2\alpha_{40,0} = \alpha_{80,0}$ p-value: 0.227

$2\alpha_{0,40} = \alpha_{0,80}$ p-value: 0.277

$\alpha_{40,0} + \alpha_{0,40} = \alpha_{40,40}$ p-value: 0.330

$\alpha_{40,0} + \alpha_{0,80} = \alpha_{40,80}$ p-value: 0.882

$\alpha_{80,0} + \alpha_{0,40} = \alpha_{80,40}$ p-value: 0.618

$\alpha_{80,0} + \alpha_{0,80} = \alpha_{80,80}$ p-value: 0.289

It appears from this test that we do not observe a statistically significant embedding effect. This is in favour of the contingent valuation method. It suggests that WTP values in health risk reduction studies are not always biased by the embedding effect. Respondents distinguish between the different risk reduction levels and are able to give different values to them. This could be traced back to the relatively simple design consisting of two food-borne diseases and a price term varying each in three different levels. Fischhoff et al. (1993) conducted a survey on stimulus representation and response mode. It was identified that a simpler design reduced embedding. They recommend that investigators must find a response mode that works for subjects and not using a response mode that is convenient to investigators. It appears as if we applied a response mode that was meaningful to the respondents and thus it avoided the occurrence of the embedding effect.

The results for the maximum-likelihood estimation of the contingent choice experiment differ from the CV results. Table 5 shows the CE estimators. The risk reduction level Campylobacteriosis 40% was statistically insignificant. Salmonellosis 40% is shown to have a significance level of 0.05. All other estimators are highly statistically significant at the 0.01 level.

Table 5. Results from the Maximum-Likelihood Estimation for the Contingent Choice Experiments.

Variable	**Coefficient**	**t-Statistics**
Price	-0.520***	-9.976
Sal40	0.283**	2.059
Sal80	1.353***	11.48
Camp40	-0.081	-0.544
Camp80	0.612***	4.926
Sal40Camp40	1.224***	9.621
Sal40Camp80	2.074***	16.35
Sal80Camp40	2.528***	18.37
Sal80Camp80	3.473***	16.93

***Significance level = 0.01/ ** Significance level = 0.05

Table 6 shows these price premiums estimated from the responses to the CE questions. The WTP ranges from Euro -0.16 for a risk reduction of 40 percent for Campylobacteriosis to Euro 6.68 for a risk reduction of Salmonellosis of 80 percent and a risk reduction of Campylobacteriosis of 80 percent.

Table 6. WTP Estimates of the Contingent Choice Experiment.

		Price Premium for Campylobacteriosis reduction (in Euro/ kg chicken)		
		C=0	C=40	C=80
Price Premium for	S=0	0 (Initial Situation)	-0.156	1.176
Salmonellosis reduction	S=40	0.544	2.353	3.986
(in Euro/ kg chicken)	S=80	2.601	4.859	6.676

To test for the embedding effect, we tested the following restrictions. The p-values are those on the χ^2-test statistics of these restrictions:

$2\alpha_{40,0} = \alpha_{80,0}$ p-value: 0.003

$2\alpha_{0,40} = \alpha_{0,80}$ p-value: 0.010

$\alpha_{40,0} + \alpha_{0,40} = \alpha_{40,40}$ p-value: 0.000

$\alpha_{40,0} + \alpha_{0,80} = \alpha_{40,80}$ p-value: 0.000

$\alpha_{80,0} + \alpha_{0,40} = \alpha_{80,40}$ p-value: 0.000

$\alpha_{80,0} + \alpha_{0,80} = \alpha_{80,80}$ p-value: 0.000

In the case of the contingent choice experiment, we find strong nonlinear effects. However, they are not as expected. WTP is highly convex in risk reduction levels and hence WTP for a risk reduction increases more than proportionally with risk reductions. This is demonstrated in Figure 3, where the elicited WTP amounts are compared. It is illustrated that the WTP obtained by the CVM increases moderately (Euro 1.29 to 3.34), whereas the WTP obtained by the CEs ranges from Euro -0.16 to Euro 6.68. It is questionable, which method elicits values that are closer to reality or are more likely to reflect consumer preferences. The protruded finding is that we obtained different values by different methods although we measured the same issue under equal conditions. Prima facie, it appears as if the contingent valuation method performed better. The absence of embedding is in favour of the CVM as well as the fact that the WTP values are more consistent.

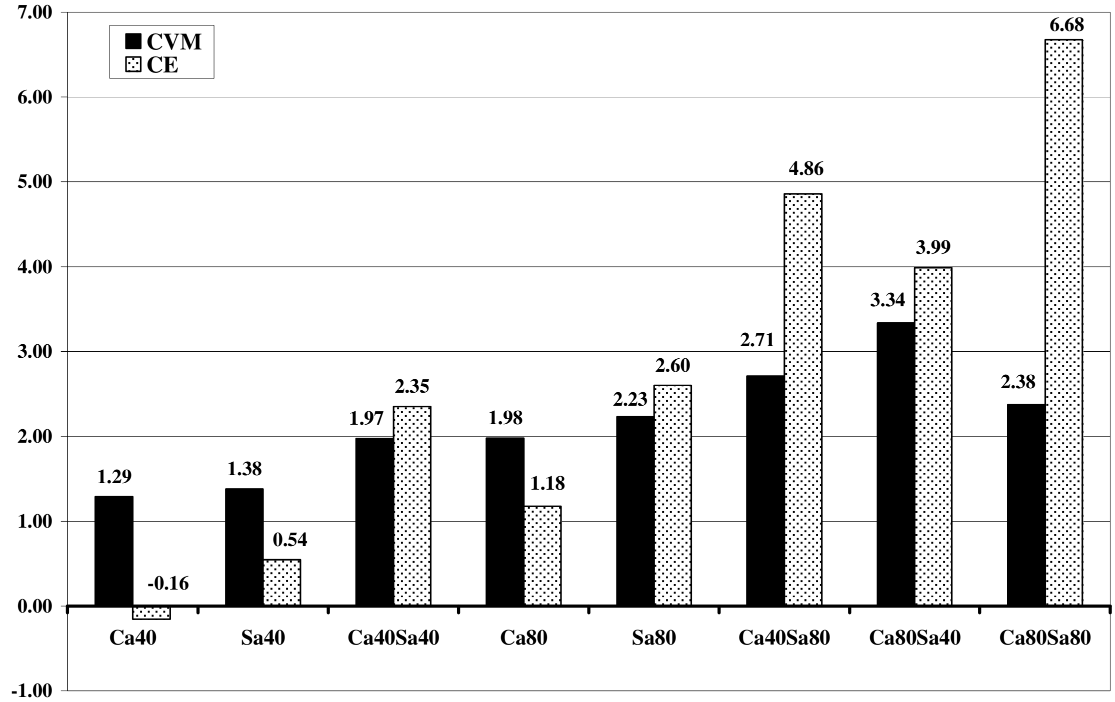

Figure 3: Comparison of WTP Estimates for the different Health Risk Reduction Levels.

When we gathered the data, consumers responded not always in the same way to the different formats. They disclaimed for example an answering possibility in the CVM format but accepted the same option in the CE format although it was just differently presented. It seemed as it was easier to give an answer to a concrete question (rather to buy or not to buy a piece of chicken). It might have been more difficult to choose an option presented in terms of a choice set where different levels are varied and have to be taken into account for the decision-making. The differences of the results are thus not only reduced to the method and the modelling of the data. It suggests that the presentation format and the response mode influence consumers choices and hence the WTP values estimated.

4 Conclusion

This study investigated the WTP for a health risk reduction of Salmonellosis and Campylobacteriosis in chicken breast. The CVM results of the maximum-likelihood estimation indicate that the variables Levels of Risk Reduction of Campylobacteriosis, Levels of Risk Reduction of Salmonellosis, Gender, Price versus Food Safety, and the Price Term are statistically significant different form zero at the 0.01 significance level. The variable Age is statistically significant at the 0.05 significance level. The p-value of the Income is 0.14 and thus not statistically significant. If the respondent has already experienced a food-borne disease, as well as the variable Children in the household were statistically not significant.

In the maximum-likelihood estimation of the choice experiments, no individual-specific variables could be included in the model. The results show that the risk reduction level Campylobacteriosis 40% was statistically insignificant. Salmonellosis 40% is shown to have a significance level of 0.05. All other estimators are highly statistically significant at the 0.01 level. The probability of paying a premium increases with a higher level of risk reduction.

The determined WTP values in the CVM format rages from Euro 1.29 to Euro 3.34. The amounts estimated from the CE data ranges from Euro -0.16 to Euro 6.68 depending on the disease and the corresponding risk reduction levels. The choice experiments elicited a maximum WTP of Euro 6.68 and, hence, an absolute higher WTP value. Also the average WTP of the CEs is with Euro 2.76 sixty Eurocents higher than the average CVM WTP with Euro 2.16.

The embedding effect was not found in the CVM format. It was however present in the CEs. The results of the study cannot answer the question, which values are closer to reality. However, we identified embedding in the choice experiment what suggests that the results of the CEs are biased. Since the scenario is hypothetical and no market for Salmonellosis or Campylobacteriosis risk reduced chicken exists, we revealed just implicit values consumers place on this kind of health risk reduction. It turned out that the contingent valuation method performed well in determining consumers' WTP for food safety. The scenario used in our survey provided helpful information. For ease of illustrating the health risk reduction we provided two graphs. As mentioned above, the same information was provided to the respondents in the choice experiments. Nevertheless, the data analysis identified embedding in the choice experiments and we obtained thus biased results.

Previous studies have shown that choice experiments can be fruitfully applied to measure consumer willingness-to-pay (see for example Lusk et al. 2003). More research is however needed on comparable WTP measures obtained from CVM and CEs to find values in order to approximate to the reality. Calibration function could help to adjust the estimated WTP amounts and to come closer to the "real" WTP (cf. Fox et al. 1998). Future research should investigate the potential of choice experiments and the contingent valuation method to measure health risk reductions to provide meaningful measures for policy decision makers. More research is also needed on the design to improve the applications of both methods. In conclusion, our empirical findings sustain the application of contingent valuation method for valuing food safety risk reductions. On the other side, we concede an enormous potential to the choice experiments even if we found embedding in our study. The question as to which method is appropriate and should be applied remains, however, a case to case decision.

Acknowledgement

We are grateful for the financial support by the foundations "Stiftung Goldener Zuckerhut" and the "H. Wilhelm Schaumann Stiftung" (both Germany) and by the State Government of Schleswig-Holstein, Germany. The views expressed in this paper are those of the authors.

References

Adamowicz, W., Boxall, P., Williams, M., and Louviere, J. (1998). Stated Preferences Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation. American Journal of Agricultural Economics 80 (1): 64-75.

Belzer, R. B. and Theroux, R. T. (1995). Criteria for Evaluating Results Obtained from Contingent Valuation Method. In Caswell, J. A. (ed.). Valuing Food Safety and Nutrition. Westview Press, Colorado, 341-362.

Buzby, J. C., Fox, J. A., Ready, R. C., and Crutchfield, S. R. (1998). Measuring Consumer Benefit of Food Safety Risk Reduction. Journal of Agricultural and Applied Economics 30 (1): 69-82.

Buzby, J. C., Skees, J. R., and Ready, R. C. (1995). Using Contingent Valuation to Value Food Safety: A Case Study of Grapefruit and Pesticide Residues. In Caswell, Julie A. (ed.). Valuing Food Safety and Nutrition. Westview Press, Colorado, 219-256.

Carson, R. T. (1999). Contingent Valuation: A User's Guide. Discussion Paper 99-26, (Dec 1999), University of California, San Diego.

Fischhoff, B., Quadrel, M. J., Kamlet, M., Loewenstein, G., Dawes, R., Fischbeck, P., Klepper, S., Leland, J., and Stroh, P. (1993). Embedding Effect: Stimulus Representation and Response Mode. Journal of Risk and Uncertainty 6 (3): 211-234.

Fox, J. A., Shogren J. F., Hayes, D. J. and Kliebenstein, J. B. (1998). CVM-X: Calibrating Contingent Values with Experimental Auction Markets. American Journal of Agricultural Economics 80 (3): 455-465.

Hamilton, L.C. (1985). Concern about Toxic Waste – Three Demographic Predictors. Sociological Perspectives 28 (4): 463-486.

Hammitt, J. K., and J. D. Graham (1999). Willingness to Pay for Health Protection: Inadequate Sensitivity to Probability? Journal of Risk and Uncertainty 18 (1): 33-62.

Hanemann, W. M., and Kanninen, B. (1999). The Statistical Analysis of Discrete-Response CV Data. In Bateman, I. J., and Willis, K. G. Valuing Environmental Preferences. Theory and Practice of the Contingent Valuation Method in US, EU, and Developing Countries. Oxford University Press, New York, 302-441.

Hanley, N., MacMillan, D., Wright, R. E., Bullock, C., Simpson, I. Parsisson, D. and Crabtree, B. (1998). Contingent Valuation Versus Choice Experiments: Estimating the Benefits of Environmentally Sensitive Areas in Scotland. Journal of Agricultural Economics 49 (1): 1-15.

Horowitz, J. K. (1993). A New Model of Contingent Valuation. American Journal of Agricultural Economics 75: 1237-1279.

Huang, C. L., Kan, K. and T.-T. Fu (1999). Consumer Willingness-to-Pay for Food Safety in Taiwan: A Binary-Ordinal Probit Model of Analysis. The Journal of Consumer Affairs 33 (1): 76-91.

Kahneman, D., and Knetsch, J. L. (1992). Valuing Public Goods: The Purchase of Moral Satisfaction. Journal of Environmental Economics and Management 22 (1): 57-70.

Kinsey, J. (1993). GATT and the Economics of Food Safety. Food Policy, April 1993: 163-176.

Kuhfeld, W. F., Tobias, R. D., and Garratt, M. (1994). Efficient Experimental Design with Marketing Research Applications. Journal of Marketing Research 31: 545-557.

Loomis, J., Lockwood, M., and DeLacy, T. (1993). Some Empirical Evidence on Embedding Effects on Contingent Valuation of Forest Protection. Journal of Environmental Economics and Management 25 (1): 45-55.

Lusk, J. L., Roosen, J. and Fox, J. A. (2003). Demand for Beef from Cattle Administered Growth Hormones or Fed Genetically Modified Corn: A Comparison of Consumers in France, Germany, the United Kingdom, and the United States. American Journal of Agricultural Economics 85 (1): 16-29.

Mitchell, R. C., and Carson, R. T. (1989). Using Surveys to Value Public Goods: The Contingent Valuation Method. Resources for the Future, Washington, D.C.

Morikawa, T., Ben-Akiva, M., and McFadden, D. (2002). Discrete Choice Models Incorporating Revealed Preferences and Psychometric Data. Econometric Models in Marketing 16: 29-55.

Olsen, J. A., Donaldson, C., and Pereira, J. (2004). The insensitivity of "willingness-to-pay" to the size of the good: New evidence for health care. Journal of Economic Psychology 25 (4): 445-460.

Randall, A., and Hoehn, J. (1996). Embedding in Market Demand Systems. Journal of Environmental Economics and Management 30 (3): 369-380.

Sælensminde, K. (2003). Embedding Effects in Valuation Non-Market Goods. Transport Policy 10: 59-72.

Shogren, J. F., Fox, J. A., Hayes, D. J. and Roosen, J. (1999). Observed Choices for Food Safety in Retail, Survey, and Auction Markets. American Journal of Agricultural Economics 81 (5): 1192-1199.

Viscusi, W. K., Magat, W. A., and Huber, J. (1991). Pricing Environmental Health Risks: Survey Assessments of Risk–Risk and Risk–Dollar Trade-Offs for Chronic Bronchitis. Journal of Environmental Economics and Management 21: 32-51.