Consumer risk perceptions of zoonotic, chemical and gm risks: the case of poultry purchase intentions in Finland

JAAKKO HEIKKILÄ[a] , EIJA POUTA[a], SARI-FORSMAN-HUGG[a] AND JOHANNA MÄKELÄ[b]

a) MTT Economic Research, Latokartanonkaari 9, FI-00790 Helsinki, Finland, firstname.surname@mtt.fi
b) National Consumer Research Centre, P.O. Box 5 (Kaikukatu 3), FI-00531 Helsinki, Finland, firstname.surname@ncrc.fi

Paper prepared for presentation at the EAAE 2011 Congress
Change and Uncertainty
Challenges for Agriculture,
Food and Natural Resources

August 30 to September 2, 2011
ETH Zurich, Zurich, Switzerland

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1. Introduction

Demand for poultry meat in Finland has increased significantly in recent years. Until recently most of this demand has been covered by domestic supply, but in the past few years the import of poultry meat has increased. Increasing globalisation of the food markets means that, in addition to products themselves being transported in large quantities, also the safety risks can pass rapidly from one country to another. At the same time, consumers have become increasingly interested in the way meat is produced and how safe it is.

Consumers value the safety of the product as an attribute. For instance, in the US the consumers have been shown to value certification of USDA food safety inspection more than any other attribute related to beef (including the country of origin, traceability and tenderness) (Loureiro and Umberger 2007). As food safety is not easily observable it rests on trust. In many disease epidemics loss of consumer confidence in the products is often one of the most significant cost components. If safety is compromised, short or long term reductions in demand are to be expected, as demonstrated in Europe by for instance BSE (Burton and Young 1996; Adda 2007) and avian influenza H5N1 (Agra Europe 2006a,b).

The consumer values related to food safety are, however, multifaceted. Beyond health itself consumers – and the society – value their leisure time and their input as employees. If a food product can be guaranteed to be safe for consumers, it attracts a higher price, presuming that the information reaches the consumers' attention in the purchasing situation (Becker 2000). Since the safety features have no observable variation or direct price in the store, measures such as purchase intentions expressed in surveys need to be used to estimate their demand.

The Codex Alimentarius (FAO/WHO 2010) divides food safety hazards into biological, chemical and physical agents. Biological hazards include for instance foodborne microbes and diseases present in cooked or uncooked foods. Chemical hazards include different types of acute and accumulating chemical substances, and physical hazards include for instance foreign objects present in food. Yeung and Morris (2001) divide the risks slightly differently into microbiological, chemical and technological hazards, where the last type deals with issues such as irradiation and genetic modification. Consumers can receive objective information on some of these risks but some are subjectively perceived by the consumers, as objective information is not available. Information processing is also a cost for the consumer and often, even if objective information was available, subjective perceptions direct the purchasing decisions. These subjective beliefs and attitudes can relate particularly strongly to some sources of risk.

Previous studies have focused on specific safety risks and there is less information regarding whether consumers distinguish between different sources of risk, or whether they have certain attitude towards risk, irrespective of its source. It is not known how these various sources of risk affect different consumer segments and their buying behaviour. This is relevant for at least three purposes. First, the World Trade Organisation SPS-agreement requires a consistent approach towards risk in different circumstances, and the welfare implications of this may differ depending on consumer risk perceptions. Second, if the consumer perceptions differ, certain kind of policies (e.g. precautionary policies), benefit one group of consumers whereas others may suffer from the policy. Third, identifying the perceptions towards specific risks by specific groups helps in targeting information and product development.

In this study we look at the Finnish consumers' views on the safety of broiler products, and the underlying factors behind these views. The dataset follows the division of Yeung and Morris (2001) and includes a biological hazard (increased risk of salmonella in broiler), a chemical hazard (chemical treatment of broiler meat) and a technological hazard (use of genetically modified feed). These three products are here collectively called "risk products", but it is worth noting that the last two items are objectively only potentially riskier than standard products – a risk product here thus refers to risk as

perceived by the consumer. The emphasis is on how the perceived risks affect the purchase intentions when consumers are facing different kinds of risks.

2. Background and previous literature

Safety is an important food product attribute. Consumer response to food safety and risks has been studied in previous literature in relation to consumer choices as well as general attitudes. The sources of risk have varied from production related risks such as hormone treatment (Alfnes 2004, Lusk et al. 2003), chemical control substances (Travisi and Nijkamp 2008) and genetic modification (Lusk and Coble 2005) to animal disease risks such as campylobacter (Christensen et al. 2006), salmonella (Goldberg and Roosen 2005) and BSE (Latouche et al. 1998, Mazzocchi et al. 2004, Kalogeras et al. 2008). As much of the consumer experience is dependent on different types of choice cues, also issues such as safety labelling (Enneking 2004, Loureiro and Umberger 2007) and provision of general safety information (Piggott and Marsh 2004) have been targets of research.

The choices made by the consumers are dependent on the beliefs and perceptions of risk. These form the attitudes of the consumers and affect their purchase intentions – this is the essence of the theory of planned behaviour (Ajzen 1991; Ajzen and Madden 1986). Attitudes and beliefs or perceptions have been used to predict food purchasing behaviour also in relation to risky food (e.g. Cook et al. 2002).

It has been shown that the risk perceptions of for instance managers, experts and the public are different from one another. For instance Mertz et al. (1998) found that the chemical risk perceptions of senior managers of a chemical company were low compared to those of the toxicologists, and the perceptions of the toxicologists were low compared to those of the general public. The authors note that the result is consistent with earlier studies indicating that highly educated older males in an industrial setting have a lower risk perception. The public perceives the risks larger than the experts also in the case of biotechnology (e.g. GM-technology) (Savadori et al. 2004). It has also been suggested that whereas experts judge microbiological hazards to be the main health risk in case of food, the public is more concerned about pesticides and food additives (TNS Opinion and Social 2010; Lechowich 1992). Furthermore, food-related applications are perceived as more risky than for instance medical applications (Savadori et al. 2004).

There is a well-documented discrepancy also between expert and laypeople's perceptions of risk (see, e.g. Hansen et al. 2003). It is fairly widely agreed that this divergence is not simply due to ignorance or irrationality (Hansen et al. 2003; Slovic 2001). Instead, it has been suggested to depend on sensitivity to technical, social and psychological qualities of hazards that are not well modelled in technical risk assessments, as well as to trust or distrust. Further, risk as perceived by the public is a more multifaceted concept than the mere probability times impact (Slovic 2001).

Therefore, instead of the traditional dimensions of risk, probability and magnitude, other dimensions that better describe consumer perception of risk have been developed. For instance, Fischhoff et al. (1978) suggested voluntariness, immediacy, known to exposed, known to science, controllability, newness, chronic, common, and severity of consequences as appropriate criteria. German Advisory Council on Global Change (1998) came up with eight criteria: extent of damage; probability of occurrence; incertitude (indicator for uncertainty); ubiquity (geographical dispersion and hence intragenerational equity); persistency (and hence intergenerational equity); reversibility; delay effects; and potential for mobilisation. The last was divided into: i) inequity and injustice in risks and benefits over time, space and social status; ii) psychological stress and discomfort; iii) potential for social conflict and mobilisation; and iv) spill-over effects. Hence, consumer reactions depend on several factors, including the extent to which they can affect the risk themselves, how familiar they are with the risk, to what extent the exposure is voluntary, how severe the consequences are (irrespective of their probability), and so forth (see also e.g. Yeung and Morris 2001).

There is also geographical (country-specific) and demographic variation in response to risk (e.g. Mazzocchi et al. 2008). The EU consumers have been particularly sceptical regarding genetically modified products (e.g. Grunert 2002) as well hormone treated beef. In 2006 the news regarding avian influenza H5N1 temporarily reduced the demand for poultry by up to 70% in some South European

countries (Agra Europe 2006b) and on average by 10-15% in the EU (Agra Europe 2006a). In a study relating to salmonella in chicken Mazzocchi et al. (2008) found that the reduction in purchase intention was particularly strong in Italy (reduction of 41%) and Germany (30%), whereas the UK (23%), the Netherlands (12%) and France (6%) had much more moderate responses. The response in Finland has typically been at the lower end of the scale, with consumers reacting relatively moderately to food safety scares such as the H5N1 avian influenza or BSE (see, e.g., TNS Opinion and Social 2010).

Among the Finnish consumers safety is nonetheless seen as a very important attribute of food and production of food. Safety is also considered to be the most important factor influencing the choice of broiler, followed by taste and healthiness, according to a study by Isoniemi et al. (2008). In their study, the consumers considered the most important factors related to poultry production to be low risk of salmonella, healthy birds, reliability of surveillance and that the entire food chain works for safety and quality.

In addition to risk attitude and country-specific factors also various socio-demographic factors have been found to correlate with the risk response. The risk response has been found in different cases to depend on, for instance, age, gender, whether the respondent has children and whether the respondent lives in urban or rural surroundings (see, e.g. Hammitt and Haninger 2007; Adda 2007; Lusk and Coble 2005; Goldberg and Roosen 2005). In other studies links between socio-demographic factors and consumer trust have not been found (e.g. Mazzocchi et al. 2008), and the argument in these cases is that the response depends on the source of information rather than on the recipient.

3. Methods and Data

3.1 The survey data

The consumer survey data of poultry meat consumption was conducted as an online internet questionnaire in November 2007, and provided information on the consumers' reaction to risk sources. The consumer data set (N = 1312) with a response rate of 51% was a sample of Finnish internet users between the ages of 18 to 79 years. The sample was representative of the general population regarding gender, age, income and geographic location (Table 1), but in the sample the education level was somewhat higher and the share of individuals with children in the family somewhat lower than in the general population. In the data 95% of the consumers had broiler in their monthly diet and almost half of them perceived that the share of broiler was increasing.

Table 1. Descriptive statistics of the 18-79 year-olds in the data and in the population.

	In data	In population*
Share of females, %	51	51
Mean age, years	49	47
Share of higher education level, %	38	26
Share of people living in households with gross-income under 40 000 euros, %	42	42
Share of people with children (<18 yr) in family, %	29	42
Share of people living in South Finland, %	43	41
Consumers having broiler in monthly diet, %	95	N/A
Consumers having increased the share of broiler in their diet, %	49	N/A

* Source: www.stat.fi, 2009. N/A denotes data not available.

The survey included questions relating to consumer patterns of using poultry meat, several attitude and belief questions relating to broiler production, and socioeconomic background variables. The attitude variables included health-orientation, domestic preference, safety orientation, and GM-negativity. The health orientation was measured with eight questions that formed the final sum variable. Attitude towards Finnish production was formed from six questions dealing with domestic and foreign production. The safety-orientation was constructed as a sum variable from eight questions. The respondent's attitude toward the use of GM-feed in chicken production was formed from four questions measuring GM-related beliefs. The socio-demographic variables tested in the models were gender, age, education, income, families with children and the residential region. In addition, the relative proportion of broiler in the diet of the respondent was used in order to take into

account the effect of their dietary behaviour. The survey measured respondents' conditional purchase intentions under changes in 1) biological risk; 2) chemical risk; and 3) technological risk.

In the case of biological risk, the zoonotic risk related to salmonella was the topic of the question. The levels of morbidity and mortality from Finnish National Salmonella Control Programme were provided for the respondents. The respondent was told that annually 3300 persons get mildly and 400 seriously (requiring attending a doctor or hospital) ill after eating broiler. They were asked to consider a situation where 19800 persons get moderately ill, 2400 seriously ill and additionally four persons die annually due to eating broiler. Half of the respondents were asked how the risk would affect their consumption decisions if the broiler were half of the current price and half of them were asked about their reactions if the price remained unchanged.

In the question concerning the chemical safety the respondents were presented a scenario where the chemical treatment is an alternative approach to maintain the product safety: "The safety of broiler meat in Finland is ensured with good production hygiene throughout the production chain. An alternative approach is to treat the meat products before they reach the consumer with chemicals to eliminate potential pathogens. International trade negotiations may lead to the market entry of chemically treated meat in the EU". After this information a four-level scale was presented to the respondents to indicate their willingness to choose the product a) if it was cheaper than the conventional product, b) if it had the same price as the conventional product, c) even if it was more expensive than the conventional product, or d) would not choose the product at all.

The technological risk scenario explained the respondents that genetically modified soya is currently not used in the broiler production in Finland but is a future alternative. The purchase intention was asked if GM-feed was used in production. The same scale was implemented as in the chemical treatment scenario.

In all three cases the respondents who would still buy the product (although possibly at a lower price) were coded in the yes-category, and the respondents who would stop buying altogether were coded in the no-category.

3.2 The statistical models

For each of the risk products a model of purchase intention was constructed. The method used for modelling each purchase intention separately was the logistic regression analysis. The dependent variable in the models was whether the respondent would continue buying poultry meat under a change in the safety of poultry or stop buying it. The independent variables were selected based on the assumption of attitudes and perception explaining behavioural intentions. In this manner the intended purchase was explained by the previously described attitude variables but also by socio-demographic variables. In addition, the relative amount of poultry in diet was included in the model.

The potential heterogeneity of the respondents regarding the purchase intentions of risk products was analysed by latent class logistic regression that included all three risk products. The idea of the latent class regression model is that behind the observed variables, an unobserved nominal variable x, may exist that indicates separate subpopulations, each having their own distribution of the observed variables, y. In our application, there might be subpopulations of consumers with their own distributions in relation to purchasing decisions under risk. To take this heterogeneity into account and to improve the explanatory power of the logit models, latent consumer classes were investigated with a latent class model for binary choices.

For latent class analysis, the data was constructed in a panel form with T replications, i.e. three purchasing decisions per each individual i (T=3). The Q predictors z_{itq}^{pred} whose values change across replications are assumed to affect the dependent variable. In our case the predictors were the dummy variables of risk source (biological or chemical), while the GM-feed risk was the reference level (Q=2). In addition to these predictors that vary between replications, the model includes R covariates z_{ir}^{cov} that influence the latent variable and vary between individuals, such as attitude variable or socio-demographics. The probability structure in the general case is

$$f(y_i \mid z_i^{\text{cov}}, z_i^{pred}) = \sum_{x=1}^{K} P(x \mid z_{ir}^{\text{cov}}) \prod_{t=1}^{T_i} f(y_{it} \mid x, z_{it}^{pred}).$$

In the case of binary dependent variable the probability of *y=1* gets a logistic form

$$P(y_i = 1 \mid x, z) = \frac{\exp(\alpha_x + \sum_{q=1}^{Q} \beta_{qx} z_{itq}^{pred})}{1 + \exp(\alpha_x + \sum_{q=1}^{Q} \beta_{qx} z_{itq}^{pred})},$$

where α and β are model estimates. The latent class model for binary choices in Latent Gold software was used to estimate the model. Bayesian (BIC) and Akaike (AIC) information criteria were used to define the number of classes.

4. Results

The measures of purchase intentions revealed respondents' reactions to the three sources of risk in broiler production. In the case of biological (zoonotic) risk about half of the respondents expressed to decrease the use of broiler if the risk of morbidity and mortality increased six-fold. In the case of no price impact, only 13% of the respondents would continue the use on the current level and 57% at a lower level. If the increased disease risk would cause a price reduction of 50%, 20% of the respondents would continue to use broiler at the current level. 5% of the respondents were risk takers who would consider increasing the use of broiler if the product price decreased by half. However, the share of respondents not willing to buy were the same, 30%, regardless of the price effect.

Nearly 90% of the respondents were of the opinion that they would not choose chemically treated poultry meat. Seven percent of the respondents, however, were willing to select the chemically treated product if it was cheaper than conventional meat.

63% of the respondents would not select broiler meat fed with GM-feed. Approximately 25% would select the GM-product, if it was cheaper than the conventional product. Over 90% expressed the opinion that GM-feed should be marked with a label.

Table 2 presents the logistic regression models and the variables that affect the buying intention of each risk product. This provides an opportunity to compare the association of perceived risks to various background variables. For biological risks the purchase intention probability was significantly affected by the amount of broiler in the respondent's diet. This probably indicates that when the share of broiler increases the consumers perceive the probability of infection to increase. The effect of health orientation of the respondent was slightly higher and had a lower p-value in the case of biological risk than in the models for other products. Safety orientation was consistently affecting the choice in all models, but the effect was slightly lower for biological risk than for the other risks. Women were more sensitive to reduce their purchase intention as biological risk increased, but the effect of gender was even higher for the other products. Young and highly educated reacted to the biological risk more moderately than older consumers with lower education, although these were significant only at 85% significance level. Domestic preference played no role in biological risks.

In the model for purchasing chemically treated broiler the explanatory factors differed somewhat from those in the biological model. Willingness to buy chemically treated broiler was, in particular, reduced by domestic preferences, indicating that it may not be only risk attitude that is expressed in the hypothetical choice situation. Income of the respondent also played a role, with high income respondents indicating a particularly negative intention to buy chemically treated broiler. Also the effect of age was particularly clear in the case of chemical treatment, the older people being more reluctant towards buying chemically treated products.

The unwillingness to buy GM-fed broiler was related to the high "GM-negativity", i.e. strong negative beliefs regarding the impacts of GM-feed. Also safety orientation had a higher coefficient

than in the models for the other products. As in chemical model, domestic preference also played a role, with those having preferences for domestic products being less likely to choose a GM-product.

Table 2. Logistic regressions for buying intentions of risk products (buy=1).

	Biological risk	Chemical risk	Technological risk
Constant	5.729***	6.751***	10.662***
Amount of broiler in diet	-1.304***	-0.386	-0.298
Health-orientation	-0.246**	-0.211º	-0.208*
Domestic preference	-0.024	-0.879***	-0.585***
Safety orientation	-1.099***	-1.261**	-1.293***
GM-negativity	-0.244***	-0.563***	-1.497***
Gender, female	-0.370***	-0.560**	-0.385**
Age		º	*
25 – 34 years	0.365	-0.450	0.036
35 – 54 years	-0.530º	-0.847**	-0.380
over 54 years	-0.570º	-0.729*	0.060
Higher education	0.219º	0.100	0.046
Income			
20 000e – 40 000e	0.206	0.206	-0.148
40 000e – 60 000e	0.051	0.187	-0.301
60 000e – 80 000e	-0.201	-0.141	-0.381
over 80 000e	0.192	-0.952*	-0.428
N	1226	1226	1226
Share of buyers (data), %	70.5	11.5	37.4
Share of buyers (model), %	93.6	2.9	32.1
Nagelkerke R^2	0.104	0.258	0.485

*** 99% significance, ** 95% significance, * 90% significance and º 85% significance. The reference level for age is <25 years and for income <20 000 euros.

The possible heterogeneity of respondents regarding the purchase intentions of risk food was analysed further with the latent class logistic regression model. The model allowed also the analysis of the relative importance of risk sources. Based on BIC and AIC information criteria a two-class model was selected (Table 4). About 60% of the respondents belonged to the group of *risk avoiders* in which the purchase intention of risk food was significantly lower than in the second group of *risk neutrals*. Among the risk avoiders there was a positive intention to buy a risky product in 22% of the cases and among the risk neutrals the buying probability was 66% considering all risk products together. This lower tendency to buy risky products among the risk avoiders is visible in the negative constant in the model for risk sources. In the model for risk sources the GM-risk was used as the reference level to which the other risks were compared. In the group of risk avoiders, chemical treatment reduced the willingness to purchase a product slightly compared to GM-risk. Compared to GM-risk in this group the increased risk of zoonoses raised the probability of buying. In other words, biological risk had less impact on purchase intention than chemical risk or GM-feed among the risk avoiders. The risk neutral group experienced chemical treatment as the source of risk that reduces the purchasing intentions most. They, however, felt the risk of zoonoses as more important negative cue than GM-feed.

The model classes were used to illustrate the effect of risk source in buying intentions based on the data (Figure 1). The figure clearly shows the milder reaction to biological risk in both classes. The GM-feed divided the sample: the buying intentions for a GM-product were zero percent among the risk avoiders but 92% among the risk neutrals. The figure shows also that the chemical treatment received a strongly negative reaction in both classes. However, among the risk neutrals 27% were still willing to buy the chemically treated products.

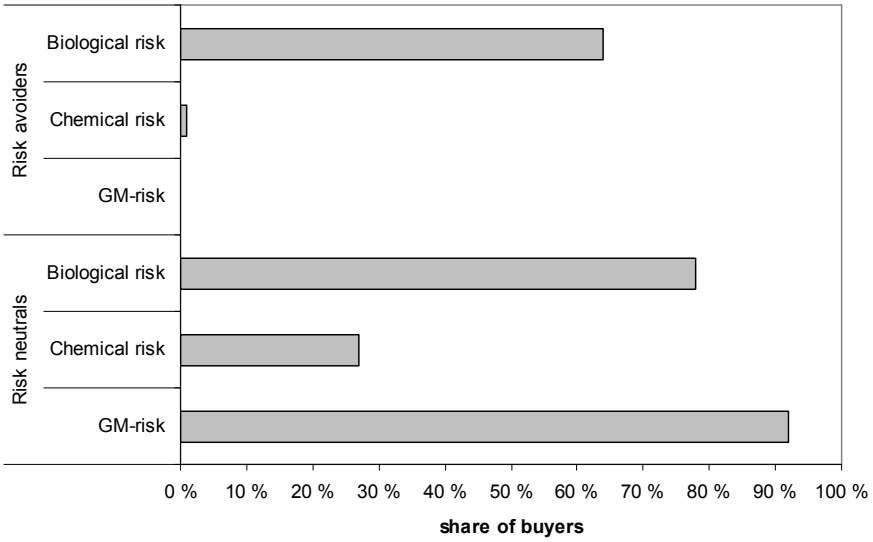

Figure 1. The buying intension of risk products in classes based on latent class logistic regression.

Table 3. Latent class logistic regression.

	Class 1: risk avoiders	**Class 2: risk neutrals**	***Wald***	***Wald(=)***
Class share, %	59	41		
Model for risk source				
▪ GM-feed as reference				
Constant	-4.1701	1.9643	68.94***	29.65***
Biological risk	4.7377	-0.6505	22.38***	21.98***
Chemical risk	-0.3874	-3.0361	147.83***	4.20**
Covariate function				
Constant	0	10.7879	41.42***	
GM-negativity	0	-2.0995	85.84***	
Domestic preference	0	-0.8508	23.68***	
Importance of price	0			
1 = not at all important	0	0	18.45***	
2	0	0.8863		
3	0	1.1932		
4	0	1.63		
5 = very important	0	2.2885		
Age			9.66**	
25 – 34 years	0	-0.2712		
35 – 54 years	0	-0.9814		
over 55 years	0	-0.5314		
Gender, female	0	-0.6375	9.84***	
Northern Finland	0	-1.1782	3.97**	
Overall R^2			0.56	
R^2	0.50	0.33		
Share of positive buying intentions, %	22	66		

*** 99% significance, ** 95% significance, * 90% significance and º 85% significance. The reference level for age is <25 years.

Covariate function for latent classes (Table 3) confirmed the picture given in the logistic models for each risk regarding the background variables. Table 3 describes the profile of classes using class 1 (risk avoiders) as the reference group. The attitude-level variables explained the buying intentions. In particular, the attitude towards GM-food was highly important and significant in the risk avoiding group. They also appreciated domestic production more than the risk neutral group. The status of price consciousness was quite natural: for the risk neutral group price was a more important choice criterion than for the risk avoiding group.

The membership in latent classes could be explained by several background factors that also confirmed the results of the individual models to describe purchase intentions under increasing risk. Especially women and middle-aged and older respondents belonged to the group that avoided risky food. From geographical regions only Lapland proved to be significant with bigger share of risk avoidance.

5. Discussion

The latent class model provided information on two different groups of consumers and their buying behaviour under the various risk sources. While the attitude towards individual risk factors was strongly negative, the amount of those who are less sensitive to risky foods can be seen as surprisingly high, about 40% of the consumers. Also for instance Adda (2007) found that some households increased their consumption of beef during the BSE epidemic. The results also suggest that those who avoid risk foods are more likely to be women, older people, and people who have a large share of broiler in their diet. The larger response for women than for men is also reported in Hammitt and Haninger (2007). Older people have shown stronger reactions also in Adda (2007) who studied BSE. Families with children variable has received mixed results in different studies. We found it to be statistically not significant, as did Goldberg and Roosen (2005). In earlier studies the willingness to pay to reduce foodborne illness has been found to be larger for risks transmitted on chicken than on ground beef or packaged meat (Hammitt and Haninger 2007). We found additionally that those who had a large proportion of broiler in their diet were also more safety oriented.

Overall, the results showed that safety is an important factor influencing the purchase decision. The reactions to various sources of risk, biological, chemical and technological, varied among the consumers. Measured by the purchase intention, the reaction to chemical risks is stronger than the reaction to biological risks. Biological risks, which may be, to some extent, controlled by the consumer by paying attention to the food preparation, seem to affect the intended purchase less than the chemical production risks, or the use of GM-feed. This is consistent with the findings of Mazzocchi et al. (2008) and TNS Opinion and Social (2010), but nonetheless interesting, because objectively it is the only unambiguous risk of the three risks considered. The results are in contrast to those of Grande et al. (1999) who found that bacteria infected food is seen as a higher risk than chemical additives in food in Scotland as well as in Norway.

The chemical treatment and the use of GM-feed presented in this study are matters that rely strongly on the consumers' own perception and beliefs. The European Food Safety Authority (EFSA) has established that chlorine treatment of poultry meat is not a risk to human health nor does it promote development of resistance to antimicrobials. The avoidance of chemical risk may have more to do with domestic preference than risk per se. Similarly, no self-evident health impacts have been observed in relation to GM-feed. Siegrist et al. (2006) suggest that products that are perceived to have direct tangible benefits for the consumers (such as artificial sweeteners or convenience foods) are seen as less risky than those with no obvious consumer benefits (such as GM-food).

Nonetheless, our results are consistent with the finding of Lusk and Coble (2005) that the risk perceptions and risk preferences were significant determinants of acceptance of GM-food. This raises the question of how to separate risk from the other negative beliefs of consumers. It may be possible to affect these experiences through provision of objective information regarding the levels of risk, as was done for the biological risk. However, it has also been suggested that in the case of GM the perceived risks affect the purchase decisions more than the perceived benefits, and the consumers' own knowledge about GM only affects the perceived risks (Grunert 2002). Hence information provision does not necessarily help.

The results confirm the point presented by Yeung and Morris (2001) that there may be a divergence between objective technical risk assessment and subjective psychological risk assessment by the consumer. Microbiological risk of salmonella can be seen as a voluntary hazard that is relatively familiar to the consumer. In contrast, chemical control and use of (unlabelled) GM-feed are involuntary, uncontrollable and have possibly delayed effects, and hence are rated as more risky by

the consumer (Yeung and Morris 2001). However, they also argue that salmonella is rated high on the dread factor because of its severe consequences, which is in some conflict with the current results.

The purchase intentions were statistically related to several attitude-based variables. Particularly in the case of the GM-product the variation in buying probabilities was affected by the attitude. This gives support for the theory of planned behaviour in the case of purchase intentions of risk food. Also the role of the product price was highlighted: it can be seen as a behavioural control as suggested in the theory of planned behaviour. In existing literature Goldberg and Roosen (2005) found the variable that measures the importance of price versus food safety statistically significant, suggesting that the relative importance placed on safety also materialises in the purchase intentions.

There are some caveats in the current study. First, the information on salmonella risk was provided through estimated numbers of morbidity and mortality, whereas for the other two risk product types the potential outcomes were not described. We acknowledge that the form of presenting the risk to people can have a substantial impact on results – but there is necessarily no 'right' way to present the information (Slovic 2001; Sparks and Shepherd 1994; Kahneman and Tversky 1984). Second, in an ideal study design, the magnitude of the risk (including impact and probability) and the measurement of the buying intention were identical for all risk sources. This survey-based study relying on hypothetical buying intentions needs to be complemented with the actual choice studies if products with various risk sources enter the markets. However, the current comparison helps us to get an idea of the types of differences that there are likely to exist on real markets.

6. Conclusions

The public often overestimate the probability of rare events and underestimate the probability of common events (Sparks and Shepherd 1994). One could argue that the probability of GM-originating risks may be overestimated, whereas the biological risk of salmonella may be underestimated by the consumers. Klinke and Renn (2002) suggest that for standard health risks traditional risk-based management with emphasis on scientific assessment and reduction of exposure/probabilities is sufficient. However, risks such as biotechnology, they argue, require resilience-based management with emphasis on transdisciplinary research and investigations, containment of application (in time and space), constant monitoring, redundancy and variety in safety design, strict liability, and no tolerance policy for risk control. Finally, for risks such as genetic modification they suggest discourse-based management with emphasis on reaching political consensus or agreement, importance of procedure and transparency, establishment of trust-generating institutions, investment in risk communication, involvement of stakeholders including industry and governmental organisations, and public participation.

This matters for the current discussion, as food safety is a multifaceted issue, and as has been discussed in this paper, different risks are perceived differently by different consumer groups. Reliance on solely, for instance, traditional risk-based management does not address those consumers who perceive chemical or GM-risks to be large and affect their utility negatively. Provision of technical information regarding the potential risks alone does not suffice in such cases.

This study has also showed that a policy directed towards particular risks benefits certain segments of consumers. For example, a policy towards avoidance of GM-food divides the consumers and benefits particularly the risk avoiding consumers that base their opinion on attitudes. In contrast, a policy increasing the awareness and acceptance of GM-products would benefit those consumers who are less sensitive to risks and more interested in the price of the goods. A policy aiming at control of biological risks would benefit all consumers, but the effect of the policy would be low if measured in terms of purchasing intentions. The restrictive policy regarding chemicals treatment of poultry appears to have a fairly support among all consumer segments providing support for the current EU policy.

Overall, the study showed that risk matters to consumers, not all risk is equal, and consumer types react somewhat differently to various sources of risks. Taking such diversity into account in risk assessment, risk management and risk communication is a challenge for the authorities as well as for the food manufacturers.

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