CONSUMER INTENTIONS OF BUYING POULTRY MEAT UNDER PERCEIVED BIOLOGICAL, CHEMICAL OR TECHNOLOGICAL RISK IN FINLAND

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Abstract

The study focuses on various types of food safety risks: biological (zoonoses), chemical (chemical treatment of the meat) and technological (use of genetically modified feed). The emphasis was on how the perceived risks affect the purchase intentions in the case of broiler meat. In the case of each risk products the attitude-level variables had importance in explaining the buying intentions. The heterogeneity of the respondents regarding the purchase intentions of risk products was analysed by latent class logistic regression that included all three risk products. 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 in which 64% of the respondents had the intention to use the broiler despite the possible increase in risk levels. Especially chemical treatment reduced the willingness to purchase. Among the risk avoiders the impact of zoonoses was smaller than the impact of GM-feed. Risk neutrals felt the risk of zoonoses as more significant than GM feed.

Keywords: broiler, consumer behaviour, risk, food safety, consumer heterogeneity
JEL codes: C25, D12, Q18

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 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, similarly to organic production or animal welfare promoting production. 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 disease epidemics loss of consumer confidence in the products is often one of the most significant cost components. For instance in the case of BSE, Burton and Young (1996) find a strong short-term reduction and a 4.5% long-term reduction for the beef market share (in relation to other types of meat) in the UK. Similarly, in the later BSE outbreak in Europe Adda (2007) found that 8% of the consumers in the sample stopped consuming beef altogether, compared to 3.5% in pre-BSE period.

The consumer values related to food safety are multifaceted. Beyond the health itself consumers also 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 the 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, although

objective information was available, subjective perceptions direct 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 little 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. In this study we use an existing dataset to 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“. It is worth noting that the last two items are objectively only potentially riskier than standard products – a risk product here refers to risk as perceived by the consumer. The emphasis is thus on how the perceived risks affect the purchase intentions.

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. 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). These studies are typically based on the theory of planned behaviour (Ajzen 1991; Ajzen and Madden 1986). The basic idea is that attitudes affect behaviour, such as purchasing decisions. Attitudes as general evaluations are based on beliefs of the effects of the behaviour such as perceptions of risks related to the food. Risk attitude reflects

the agent's general predisposition to the risk content in a consistent way, and risk perception reflects consumers' interpretations of their chance of being exposed to the content of the risk (Kaloregas et al. 2008).

The consumer reactions have been suggested to depend also on the extent to which they can affect the risk themselves, how familiar they are with the risk, to what extent the exposure is voluntary, and how severe the consequences are (irrespective of their probability) (see, e.g. Yeung and Morris 2001). There have also been suggestions that the willingness to pay to reduce foodborne illness is larger for risks transmitted on chicken than on ground beef or packaged meat (Hammitt and Haninger 2007).

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 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.

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 conducted as an online internet questionnaire in November 2007 provided information on the consumers' reaction to risk sources. The consumer data set (N = 1312) with a response rate of 51% was a representative 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.

Table 1. Descriptive statistics of the 18-79 year-olds in the data and in the population (www.stat.fi, 2009).

	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

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-fear. The health orientation was measured with eight items that formed the final sum variable. Attitude toward Finnish production was formed from six measures dealing with domestic and foreign production. The safety-orientation was constructed as a sum variable from eight measures. The respondent's attitude toward the use of GM-feed in chicken production ("gm-fear") was formed from four statements measuring GM beliefs. The socio-demographic variables included 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) chemical safety; 2) biological safety; and 3) technological safety. 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 chicken 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 respondent to indicate her 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 GM-feed scenario explained the respondents that GM-feed 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. The variables of the willingness to purchase in both cases were constructed from the scale such that classes from a to c were combined to category of "yes" responses, in which the purchase was possible, and the d-class indicated that the respondent would not buy the product in question.

In the scenario of zoonotic risk the objective levels of morbidity and mortality from Finnish National Salmonella Control Programme were provided for the respondents. The respondent was asked their purchase reactions if the risk of morbidity would increase six-fold and mortality would increase from zero to four persons annually. Half of the respondents were asked how the risk would affect their purchasing decisions if the broiler were half of the current price and half of them were asked about their reactions if the price remained unchanged. The respondents who would still buy the product were coded in the yes-category, and the respondents who would stop buying altogether were coded in the no-category.

3.2 The econometric 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 such as gender, age, education, family phase and region. 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 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, chemical treatment or zoonotic risk, 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

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

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

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

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 information criteria (AIC) were used to define the number of classes.

4. Results

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 2). Among the Finnish consumers safety was seen as a very important attribute when the respondents evaluated food and production of food in general. Safety was also considered to be the most important factor influencing the choice of broiler (on a scale of 1-5, mean 4.57). It was followed by taste (4.51) and healthiness (4.43). From the factors related to poultry production, the most important ones were low risk of salmonella (4.68), healthy birds (4.63), reliability of surveillance (4.49) and that the entire food chain works for safety and quality (4.45).

The measures of purchase intentions revealed respondents' reactions to the three sources of risk in broiler production. In the case of 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 percent 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%, fifth of the respondents would continue to use broiler at the current level. Five per cent 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 (Table 2).

Nearly 90 percent of the respondents estimated that they would not choose the 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. Of the respondents 63% would not select GM-feed fed broiler meat. Approximately one fourth would select 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. Willingness to buy broiler at present and under increased risk.

	Share of consumers %	
Consumers having broiler in monthly diet	94.6	
Consumers having increased the share of broiler in their diet	49.3	
	willing to buy	**not willing to buy**
Increased zoonotic risk	70.0	30.0
▪ no price effect	70.0	30.0
▪ 50% price decrease	70.0	30.0
Chemically treated	11.1	88.9
GM-feed	36.8	63.2

In the logistic regression model (Table 3) for zoonotic risks the purchase intention probability was significantly affected by the health and safety orientation of the respondent. Women and highly educated were more sensitive to reduce their purchase intention as zoonotic risk increased. Young people reacted to the risk more moderately than older consumers. Corresponding to the observations from the data the model shows clearly that decline in the price in growing zoonotic risk did not affect the share of potential buyers.

In the model for purchasing chemically treated broiler the explanatory factors differed somewhat from those in the zoonosis model. Willingness to buy chemically treated broiler was, in particular, reduced by domestic preferences. Income of the respondent also played a role,

while low and middle income respondents indicated a more positive attitude towards chemically treated broiler.

In the case of GM-feed broiler, the reluctance to buy was mostly associated with older age of the respondent. The unwillingness to buy GM-feed broiler was also related to the high "GM-fear", i.e. strong negative beliefs regarding the impacts of GM-feed.

Table 3. Logistic regressions for buying intentions of risk products (buy=1). The reference level for age is >55 years and for income >80 000 euros.

	Zoonosis model		**Chemical model**		**GM-model**	
	coefficient	***p-value***	***coefficient***	***p-value***	***coefficient***	***p-value***
Constant	4.719	0.000	3.254	0.003	10.300	0.000
Amount of broiler in diet	-1.361	0.000	-0.441	0.283	-0.272	0.393
Health-orientation	-0.265	0.009	-0.263	0.065	-0.196	0.099
Domestic preference	-0.096	0.389	-0.995	0.000	-0.603	0.000
Safety orientation	-1.112	0.005	-1.239	0.018	-1.341	0.004
Gender, female	-0.464	0.001	-0.792	0.000	-0.404	0.013
Age year 18 – 24	0.695	0.055	0.908	0.018	-0.123	0.721
years 25 – 34	0.181	0.457	0.020	0.521	-0.152	0.561
years 35 – 54	-0.006	0.973	-0.105	0.694	-0.578	0.006
Higher education	-0.275	0.060	-0.327	0.119	0.948	0.751
Income under 20 000e	-0.227	0.491	0.717	0.185	0.542	0.166
20 000e – 40 000e	-0.025	0.928	0.888	0.058	0.329	0.307
40 000e – 60 000e	-0.173	0.517	0.920	0.046	0.150	0.637
60 000e – 80 000e	-0.409	0.145	0.652	0.194	0.029	0.932
Family with children	-0.045	0.802	0.184	0.490	-0.319	0.122
Western Finland	0.123	0.411	0.182	0.408	0.037	0.832
Eastern Finland	-0.125	0.575	0.200	0.548	0.168	0.533
Middle Finland	-0.183	0.468	-0.346	0.401	-0.860	0.779
Northern Finland	-0.227	0.521	-0.871	0.255	-0.661	0.182
GM-fear	-	-	-	-	-1.504	0.000
Price effect	-0.006	0.964				
N	1226		1226		1226	
Share of buyers, data, %	70.5		11.5		37.4	
Share of buyers, model, %	94.2		2.5		31.7	
Nagelkerke R^2	0.095		0.215		0.489	

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 (22% of respondents) of risk food was significantly lower than in the second group of *risk neutrals*, which consisted of approximately 40% of respondents, and in which 64% of the respondents intended to use the broiler despite the

risks. In the group of risk avoiders, particularly chemical treatment reduced the willingness to purchase. The increased risk of zoonoses compared to other risks increased the probability of buying, i.e. its negative effect was smaller than the impact of GM-feed. Also the risk neutral group experienced chemical treatment as the source of risk that reduces the purchasing intentions most. They felt the risk of zoonoses as more important negative cue than GM-feed.

Covariate function for latent classes confirmed the picture given in the individual models regarding the background variables. Also here the attitude-level variables explained the buying intentions. In particular, the fear of 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.

Table 4. Latent class logistic regression. The reference level for age is <25 years.

	Class 1: risk avoiders	**Class 2: risk neutrals**	***Wald***	***p-value***	***Wald(=)***	***p-value***
Class share, %	59	41				
Model for risk source						
▪ GM-feed as reference						
Constant	-4.1701	1.9643	68.94	0.0000	29.65	0.0000
Chemically treated	-0.3874	-3.0361	147.83	0.0000	4.20	0.0400
Zoonotic	4.7377	-0.6505	22.38	0.0000	21.98	0.0000
Covariate function						
Constant	0	10.7879	41.42	0.0000		
Age			9.66	0.0220		
years 25 – 34	0	-0.2712				
years 35 – 54	0	-0.9814				
years over 55	0	-0.5314				
Gender, female	0	-0.6375	9.84	0.0017		
Northern Finland	0	-1.1782	3.97	0.0460		
GM-fear	0	-2.0995	85.84	0.0000		
Domestic preference	0	-0.8508	23.68	0.0000		
Importance of price	0					
1 = not at all important	0	0	18.45	0.0010		
2	0	0.8863				
3	0	1.1932				
4	0	1.63				
5 = very important	0	2.2885				
Overall R^2			0.56			
R^2	0.50	0.33				
Share of buyers %	22	64				

The membership in latent classes could be explained with several background factors that confirmed the results of the individual models to describe purchase intentions under increasing

risk. Table 4 describes the profile of classes using class 1 as the reference group. 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. The exceptionality of Lapland may be associated with more abundant amount of natural products in the diet.

5. Discussion and Conclusions

Overall, the results of the study showed that safety is an important factor influencing the purchase decision. The reactions to various sources of risk, biological, technological and chemical, varied among the consumers. Measured by the purchase intention, the reaction to chemical risks is stronger than the reaction to biological risks. In particular, zoonotic 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), but nonetheless interesting, because objectively it is the only unambiguous risk of the three risks considered.

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. In fact, 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. Similarly, no self-evident health impacts have been observed in relation to GM feed. Nonetheless, this result is 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 is probably possible to affect these experiences through provision of objective information regarding the levels of risk, as was done for the zoonotic risk. However, it is also 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).

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 are rated high on the dread factor because of their severe consequences, which is in some conflict with the results obtained here.

The latent class model provided information of the two different groups of consumers in 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.

Models for individual risk products as well as the models for consumer classes suggested 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). Finally, 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.

The purchase intentions were statistically related to several attitude-based variables. 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.

The study provided ideas for designing more standardized approaches. 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.

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