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CONSUMERS' BEHAVIOUR TOWARDS FOOD SAFETY:
A LITERATURE REVIEW

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Consumers' behaviour towards food safety: A literature review.

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Abstract

This paper deals with the actual expectations of consumers on food safety and their predictable behaviour in case of foodborne outbreaks. We present an overview of the purchase process for risky products and we show the reason why the consumer has a specific behaviour with respect to the sanitary risk. Moreover, by taking the results of different works that focused these effects in the meat and fruit & vegetables sectors, we show how the real quality signals on the European market (organic production, designation of origin, private retail labels, etc.) could promote consumer confidence.

Keywords: Food Safety, Consumers' Behaviour, Risk.

JEL Classification Codes: C91, D12, Q01, Q13

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1. Introduction

Considering the last thirty years, different food scares have taken place in Europe having different origins (such as Salmonella, Listeria, E.coli, Dioxins in animal feed, Alar pesticide, Mercury poisoning in fish, Nitrofurans, Bovine Spongiform Encephalopathy (BSE)). The recurring nature of the different food crisis has made food safety an issue of intense public concern (see for example Knowles *et al.* 2007). The contaminant based “food scares” (antibiotics, hormones and pesticides) are of more concern to consumers than hygiene standards and food poisoning (Huang, 2003; Miles *et al.* 2004). Consumers are also becoming alarmed with the “cocktail effect”, that is, the synergistic effects of different pesticide residues (Luijk *et al.* 2000).

Concerning animal disease related scares, BSE remains the main one across Europe. As Knowles *et al.* (2007) argue, although not being the “first food scare to affect food safety on an European scale”, it was from BSE onwards that legislation and regulatory schemes suffered different reforms and new regulatory institutions were established (Reg. (CE) N° 1760/2000, the EU Food Law, Reg. (CE) N° 178/2002, The European Food Safety Authority). It was also with BSE that consumers became more aware of food safety issues and in the particular case of beef, by expressing the refusal to buy this type of meat and/or diversifying their options within the meat group. According to Eurostat¹, in 1990, beef and veal per capita consumption in the EU was 22.1 kg/inhabitant/year; in 1995 it fell off to 20,2 kg and in 2001 to 17.9 kg. A market survey undertaken in France by the end of 1997 (Peretti-Watel, 2001) showed also that 18.5% of the respondents had stopped eating beef after the BSE crisis (1996) and 39.3% has stopped eating some parts. But it also revealed that some consumers after a longer period had decreased their beef consumption and others (less than 5%), taking advantage of lower prices, increased. The short-term impact of the second wave of the BSE crisis (during the following two or three months of year 2000) in different European countries was studied more precisely by Angulo and Gil (2007). In all cases consumption had dropped considerably: France lost 40%; Germany, 60%; Italy, 42%; and Portugal, 30%. In France, the second wave of BSE crises created a national panic. It led to a ban of beef in school canteens and to a major drop in beef sales; beef consumption dropped by 40%, compared to 25% in the 1996 crisis (Institut de l'élevage, 2000). Other important foodborne outbreaks have occurred in Europe and

¹ <http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/>

USA. Arnade *et al.* (2010) show the impact on demand of the announcement transmitted by the Food and Drug Administration (USA), in September 2006, about the possible contamination of spinach with *E. coli* O157:H7. The short-term impact was a decrease in demand for all leafy greens, as consumers temporarily substituted other vegetables for leafy greens. The other bulk leafy greens are identified by the authors as “shock complements” because the reputation of these products was affected by the spinach problem. However, over the long term, consumers switched purchases among leafy greens, but total expenditures for leafy greens did not change.

Hence, consumers have been faced with different food safety problems that have major consequences on their behaviour, attitudes and preferences towards particular food products (this was particularly evident in consumers` reactions to BSE). Moreover, food outbreaks imply consequences at different levels of the food system from the production level, going through processing, to retail marketing and international trade, with particular relevance on consumer behaviour. Indeed with the world trade globalization, mass access to information and global information networks operating, consumer behaviour can never be underestimated or not taken into account. In developed economies consumers` food demand is increasingly towards higher quality, including taste, nutritional, and safety characteristics, and value added products. Food safety can be treated as a dimension of quality (Hooker and Caswell, 1996) where safety attributes include foodborne pathogens, heavy metals, pesticide residues, food additives and veterinary residues. According to the expression of Grunert (2005), one of the things consumers find desirable in a food product is food safety, a “sleeping giant” that becomes highly relevant in situations of food outbreaks.

What is meant by “sleeping giant”? This means that there are situations where the food outbreaks are so relevant, mainly in the short-run, that food safety issues overcome all the other attributes leading to a boycott on consumption. But, in the long-run, the food safety attribute is underneath all the other attributes in the sense that consumers do not take it into consideration, assuming that a food product to be available in the market is in accordance with the food safety minimum legal requirements. Altogether this is indeed like a sleeping giant: present in the long-term but not directing consumer decisions, present in the short-run when outbreaks take place and highly influencing consumer decisions. In his paper, Grunert considers that there are two major ways in which food safety perceptions influence consumer behavior towards food. One role is this sleeping giant; the other role has to do with the way “consumers apply safety

considerations to certain production technologies”. And in this regard consumers, perhaps mainly due to the lack of knowledge on what can be the long-term health effects of some technologies, for example the use of GMO or the food irradiation, might develop negative attitudes towards foods with such characteristics. The immediate consequence can be at the innovation level: firms delay the introduction of such processes due to consumers’ reactions.

This explosive issue is the result of imperfect knowledge and information about foodborne risks (Smallwood and Blaylock, 1991). Food safety is thus a credence quality attribute in the sense that the consumer can never ascertain by himself the presence of such attribute, having to rely on the information given. Due to the credence aspect of the attribute “food safety”, standards and certifications may be used to provide information to consumers, legitimating health and safety regulation. First, Public Authorities establish “minimum quality standards” (MQS) of safety performance for a product characteristic. Moreover, the governments can set-up certifications and standards, in the context of voluntary agreements (i.e. non mandatory standards) which allow to certify behaviour of producers/companies, virtuous in social or/and environmental aspects and which can have an indirect link with food safety from the consumers point of view. For example, the organic certification is very often interpreted as an improvement of the sanitary safety. Finally, the private strategies of standardization and the private brands can be also organized to reassure the consumers following the various sanitary crises.

Indeed, the standards can help consumers to evaluate the quality of food products by increasing the transparency of the production processes and the traceability of products. With an outbreak, consumers are more willing to pay for products that provide information in comparison to products that do not (Caswell and Joseph, 2006). A potential premium paid by consumers for the attribute “food safety” may be an important incentive to develop and/or adopt private standards provided that these efforts are explicitly or implicitly communicated to consumers. Some authors argue that signaling the quality (through labels, for example) is particularly important when consumers react to the perceived rather than the objective risk that the supply chain fails to provide safe food in the final market. It is therefore essential to assess consumers’ risk perception to determine their willingness to pay and to evaluate the role of specific standards. It is recognised in the scientific community, that accurately getting valid and reliable estimates of the maximum price a consumer is willing to pay for a particular product, becomes more difficult when dealing with private goods that have credence

attributes associated with public good characteristics, such as beef marketed with higher food safety. This raises the issue of ethical responsibility *versus* consumer demand and therefore also the possibility (or not) of market differentiation. Considering fresh meat, although having a low degree of differentiation (Grunert *et al.*, 2004), there might be incentives for producers to differentiate beef based on credence attributes such as production method, food safety or animal welfare. Of course this food safety is, if we may say, subjective in the sense that it translates consumers' perceptions of food safety as opposed to the objective food safety proved by food scientists (Wezemaal, *et al.*, 2010). And, if this is a credence attribute, what can help communicate to consumers the presence of such attribute? Very often the certification labels, either public or private, perform this role. However, with such labels a full amount of information is given, very often confusing the consumer and the main objective may be lost. Of course this is also linked with the perception that a number of credence attributes are jointly produced and given to the consumer, exacerbating this problem.

Throughout this paper we will try to provide a literature review, giving some examples, and elaborate on the questions raised. We explain that consumers have been reacting to food outbreaks changing their preferences and behaviour. For some products there has been what we may call a boycott, with a significant decline in consumption or even a total refusal of the product. In such situations the "sleeping giant" becomes a major food quality attribute highly influencing consumer preferences and behaviour. In other situations taste or other attributes overcome the food safety issue, since in the consumers' memory there are no recent "scary" situations. In what follows we give a literature review on consumers' behaviour and economic interpretations towards food safety. We go through different examples using meat and fruit and vegetables as case studies and we summarize the main obtained results, and already published, to reinterpret them in the light of the above questions. Finally the article ends by widening the research topics of this problem.

2. A literature review

Over the last two decades, an important economic literature has emerged on food safety risk valuation by consumers. The aim is generally to estimate the factors that affect consumers' behaviour *vis-à-vis* the food safety risk. These papers focus namely on analysis of boycott behaviour or demand decreasing and willingness to pay (WTP) for innocuousness of food products. All studies, though each one having different

specificities, show that food safety has an expected influence on consumers` behaviour and market demand (e.g. Antle, 2001). Also

2.1 – Meat safety risk valuation

The study of the impact of food safety information on demand for food has been a subject of important interest to economists. Several studies have been concerned with the American and European meat market. Dahlgran and Fairchild (1987), Robenstein and Thurman (1996), Lusk and Schroeder (2000), Mckenzie and Thomson (2001), Piggott and Marsh (2004) develop theoretical models to study the impact of food safety information on U.S. meat demand. In Europe, authors like Burton *et al.* (1999), Mangen and Burrell (2001), Verbeke and Ward (2001), and Mazzocchi (2004) use an AIDS model to analyse the effects of BSE crisis on meat demand. Burton *et al.* (1999) find significant effects of BSE on the allocation of consumer expenditure among meats. In the Netherlands, Mangen and Burrell (2001) used a switching AIDS model to investigate preference shifts among Dutch consumers. They found that preference shifts caused by the BSE crises reduced beef expenditures with offsetting gains in the shares of pork, prepared meat and fish. Verbeke and Ward (2001) analyzed meat demand in Belgium after the BSE crisis with an AIDS model that included an index of television coverage and advertising expenditures as explanatory variables. Their results show that advertising had only a minor impact on demand compared to the negative media coverage. Pennings *et al.* (2002) show that in comparison with Dutch and US consumers, Germans are extremely risk averse. In the beginning of 2001, German consumers were willing to reduce their beef consumption by 73.2% to 91.1%, depending on the supposed vCJD infection probability. Mazzocchi (2004) uses Italian aggregate household demand of beef and chicken in a stochastic framework for modeling the time-varying impact of two BSE crises (1996 and 2000) and the dioxin crisis in between. The author shows that the impact of the first BSE crisis on Italian consumers seems to have quickly disappeared, but the second wave of the scare at the end of 2000 had a much stronger effect on preferences than the first one. The dioxin crisis had a strong impact on the chicken demand with a positive persisting shift after 14 months of the crisis beginning. It seems we can say that very often the type of reaction consumers have when facing a food safety issue, is highly dependent upon the discomfort or concern that the food crisis has originated and the time-length, again the “sleeping giant” at force. Barreira *et al.* (2005) evaluated the BSE and nitrofurans crises

effects in Portugal. The authors estimated an ‘Almost Ideal Demand System’ (AIDS model) for four groups of meat (beef, pork, poultry and other meat). Results show that these crises have significantly altered the preferences of Portuguese consumers towards meat in the period considered. With the BSE the proportion of expenditure in beef has significantly declined, whilst that of pork and poultry has significantly increased. The nitrofurans crisis was translated in a significant decline on poultry expenditure, without a significant change in the other types of meat expenditure.

Considering measuring willingness to pay (WTP) for safety attributes, this has been an important issue in agricultural economics. Henson (1996) argues that assess the consumers’ WTP for an improvement in food safety is the theoretically correct approach to obtain the value that consumers attach to safer food. The methods usually used to obtain these values include qualitative surveys to elicit broad indicators of food safety preferences (see for example Penner *et al.*, 1985), and also contingent valuation surveys, choice experiments (i.e. conjoint analysis, contingent ranking or choice modelling), and experimental auctions. The vast literature that exist within this subject have focused on assess consumers’ WTP for risk reduction in the meat sector, others on risk reduction from the use of food safety technologies, others on pesticides risk reductions in food, amongst others.

Latouche *et al.* (1998) conducted a survey in France in 1997 to know if French consumers were willing to pay a premium for a beef that would not transmit the human variant of BSE. Consumers were presented with two different modalities of beef: medium-quality, low-priced minced steak with little risk of variant of Creutzfeldt-Jacob Disease (vCJD), and high-quality, higher-priced beef with no risk of vCJD. For the two meat products, the mean WTP premiums were: 22% of the original price and 14% of the original price, respectively. The authors also found that employed and highly educated respondents as well as respondents who preferred labeled or organic products indicated higher WTP, while respondents who were involved in agricultural activities were less willing to pay a premium. McCluskey *et al.* (2005) use the data obtained from a consumer survey in Japan to investigate the effects of BSE on consumers’ willingness to pay for and consume beef. The authors point out that media coverage can increase the severity of the consumer response against beef.

Several studies have assed consumers’ WTP for mandatory and voluntary beef labeling programs associated with food safety attributes (Dickinson and Bailey, 2002, Alfnes and Rickertsen, 2003; Enneking, 2004; Loureiro and Umberger, 2007; Roosen,

et al., 2003). Dickinson and Bailey (2002) develop experimental auctions to assess American consumers' preferences and willingness-to-pay for traceability, additional food safety assurance, and animal treatment (animals were produced using humane treatment procedures and with no added growth hormones) in beef and ham products. Their results show that consumers are willing to pay a positive premium for traceability assurances; however the premiums were larger for additional food safety assurances. Alfnes and Rickertsen (2003) used surveys and experimental auctions to examine Norwegian consumers' preferences for beef originating from various countries and produced with or without hormones. The results show that hormone-treated beef was less preferred than hormone-free beef regardless of the country-of-origin. Enneking (2004) analyse the impact of food safety label applied to brand products. He concluded that WTP estimates vary considerably across food labels and that quality labelling influences consumer's choice behaviour. The consumer research by Umberger *et al.* (2003) and Loureiro and Umberger (2007) found that the majority of consumers who preferred "Certified US" beef interpreted the origin-labeling programs to provide additional food safety assurances. They argue that indication of origin may only become a signal of improved quality if the source-of-origin is associated with higher food safety or quality.

The works of Shogren *et al.* (1999), Fox *et al.* (2002), Nayga *et al.* (2005; 2006) have focused on consumers' WTP for irradiated meat. In the empirical study of Shogren *et al.* (1999) three different types of markets are defined: a retail market, an experimental auction market and a hypothetical market survey. In each market, individuals are confronted with a choice between conventional and irradiated chicken breast. They concluded that consumer choices were similar across market settings at a price premium for irradiation. Their findings also suggest that individuals are initially skeptical of irradiated food but their concerns can easily be put to rest through simple educational devices. Nayga *et al.* (2006) use a non-hypothetical experiment with irradiated ground beef to estimate willingness to pay for reducing risk of getting foodborne illness. Their results show that consumers are willing to pay for a reduction in the risk of foodborne illness once informed about the nature of food irradiation technology.

2.2 Valuation of pesticide reduction

Regarding the reduction of pesticide residues in food, Yiridoe, Bonti-Ankomah and Martin (2005) present an exhaustive review of different studies that focus on organic consumer demand and marketing issues. Indeed, using surveys and contingent valuation methods, many empirical studies show that consumers declare they would pay a significant premium price for both organic and certified pesticide residue-free (CPRF) produce. In these studies, the information on certification for pesticide reduction was disclosed without specifying the presence of labels that consumers faced in actual markets. Papers from Ott (1990), Misra et al. (1991), Weaver et al. (1992), Huang (1993), Eom (1994), evaluate different alternative price premiums for American consumers. These authors show that, on average, consumers would pay 5% to 20% more than current prices, and that more than half of the consumers would pay a premium for CPRF. Jolly (1991) evaluates the market diffusion of organic foods among California consumers and shows that consumers' premiums varied with the commodity and with the reference price of the conventional product. This author points out that when the price difference between organic and conventional for apples increases by 74%, only 13% of consumers were willing to buy the organic product. Buzby and Skees (1994) analyse the results of one national survey conducted by the University of Kentucky where food shoppers' WTP for reduced risks from pesticides were evaluated. The authors found that more than half the respondents declared a preference for both organic and CPRF over conventional products. However, only 25% of respondents had actually purchased organic or CPRF produce on a regular basis. They verify that the respondents were willing to pay a few cents more for grapefruit free of pesticide than for grapefruit with a reduction of 50%. More recently, Gil, Garcia and Sánchez (2000) use a contingent valuation in two Spanish regions to assess the maximum premium of several organic food products (vegetables, fruits, meat). They show that these values range from 15% to 25% over the price of conventional. In the same time, Boccaletti and Nardella (2000) observed that 70% of Italian consumers would not pay a price premium higher than 10% of the regular price. In Greece, Tsakiridou et al. (2006) find that the average premium for organic products may reach 35%. In the context of their paper, these authors argue that the premium for organic products increased if confidence on organic prices increases.

Most of these studies find significant heterogeneity in price premiums for CPRF and organic products. Products' appearance and consumers' characteristics are pointed as the most influential factors to explain heterogeneity. Concerning the influence of products' appearance Ott (1990) shows that less than 40% of shoppers would accept any cosmetic defects. Inversely, Weaver et al. (1992) do not find a significant trade-off effect between residue-free and appearance when evaluating consumers' WTP. Almost half of the respondents indicated a willingness to buy CPRF tomatoes with cosmetic defects. Along the same line, Huang (1996) analyses the extent to which consumers are willing to accept sensory defects for reduction in pesticide residues. This author uses a qualitative choice model with different explanatory variables that may affect consumers' WTP for pesticide use reduction. It appears that the majority of potential organic consumers were not willing to purchase organic products if they had sensory defects.

Concerning consumers' characteristics Jolly (1991) argues that organic food buyers are younger than non-buyers; however the results show that educational level and gross household income do not explain differences in organic buying behaviour. In Thailand, Posri et al (2007) show that WTP for 'pesticide residue limit compliant safe vegetables' increases with income and age. However, Thomson (1998) argues that income (and also gender) does not influence the probability of buying organic products, while age, family composition and education may affect significantly organic purchasing behaviour.

Some studies have tried to measure consumers' reaction to more specific information on pesticide use or impact. Using contingent valuation and improving consumers' information on pesticides' reduction Buzby et al. (1995) focused on the elimination of only one specific postharvest pesticide on the production of grapefruit. They show that consumers' WTP could be around 40% more for grapefruit free of the specific pesticide. Giving also greater emphasis to information about the consequences of pesticides on health (risk of developing cancers), and using a sample of married females from Taiwan, Fu et al. (1999) highlight that WTP could be significantly related to the scope of the risk reduction. Chinnici et al. (2002) explain that all consumers know that there is a price premium of 20-30% for organic produce but only the consumers that have a consolidated consumption of organic produce and are "health conscious" have stated they are willing to pay this premium.

Several papers have also investigated the possibility of a third way between conventional and organic products, namely the intermediary certifications connected with IPM in US. The positive consumer response to this certification was reported in the works of Hollingsworth et al. (1993) and Mullen et al. (1997). Govindasamy and Italia (1998, 1999) and Govindasamy et al. (2001) empirically evaluate consumers' WTP for different production methods: organic, IPM and conventional. Following a contingent valuation format, the survey participants reported a higher WTP for IPM produce than for organic produce. They also found that the household that is most likely to pay a premium for organic products is also willing to consider alternative agriculture, such as IPM. Cranfield and Magnusson (2003) explore on the Canadian market a new classification of environmentally friendly food products, so-called "pesticide-free products." This system of farming lies between organic and IPM farming practices. They found that 67% of respondents have a modest WTP of a one to 10% premium and five per cent are willing to pay a premium of 20% over conventional prices (see also Magnusson and Cranfield, 2005).

The explicit influence of signals carrying certification information to consumers (labels, stickers or logos as mentioned by Henneberry and Mutondo, 2007) in the formation of their WTP for pesticide reduction has mainly concerned the premium for organic products. Buzby and Skees (1994) point out that more information about the use of pesticides was demanded for consumers when they take into account different levels of risk reductions from pesticide residues. Almost 90% of their survey respondents said that all products should be labelled with information on pesticide use. Kristallis et al. (2006) study the influence of organic labels on the valuation of several organic food products (olive oil, raisins, bread, oranges and wine). They conducted a conjoint analysis in Greece and they study the impact of the presence of the organic label attribute on the consumers' WTP for these products. The respective premiums vary with the foodstuff under evaluation (for example, 19.1% for raisins and 63.7% for wine). Anderson et al. (1996) show that consumers would be willing to pay 10% more for corn that was marked with an "IPM Certified" sticker advertised in the media. Focusing on environmental-impact assessment (production process, use, and disposal) of the product, Blend and Van Ravenswaay's (1999) measure consumers' acceptance for eco-labeled apples. Their research reported that 63% of the respondents were willing to pay a premium for eco-labeled apples. Similarly, Loureiro et al. (2001, 2002) assess WTP

for apples with an eco-label close to a GAP certification. Based on the answers of apple-buying consumers to a survey conducted in two grocery stores in Portland (USA), they used a modified version of the double-bounded choice model to estimate mean WTP. They found a small mean premium for eco-labelled apples (5%) and argue that the context of the procedure used, with conventional and organic apples as substitutes, had an influence on these results. Many consumers considered organic apples the more environmentally friendly alternative and they would be more willing to pay a higher premium for them. Recently, Tonsor and Shupp (2009) evaluate consumers' WTP for products marketed with "sustainably produced" labelling claims. They concluded that U.S. consumers are not willing to pay a positive premium for tomatoes or apples labelled as "sustainably production", because this information is vague and not associated with production practices. The authors propose the realization of additional experiments designed to evaluate label valuations when alternative forms and levels of information are provided to consumers.

While many papers have investigated WTP for pesticide-use reduction through consumers' statements, very few have used market data to measure the actual price premium for organic or CPRF products. Based on retail price differences between organic and conventional fruits and vegetables, Hammit (1993) estimated the price premium that consumers assign to several organic products. The median ratio of the organic premium to the conventional price across produce types was about one-third. More recently, Monier et al. (2009) studied French organic consumer patterns, evaluating the impact of price on buying organics. Their work showed a small impact of prices on demand because price elasticities are estimated with marginal price variations that are much lower than the price gap between organic and conventional products. Their results are in line with the work of Bunte et al. (2010) who demonstrated that consumer demand for organic products in Netherlands does not changes when the price gap between organic and conventional products is deliberately reduced. These authors show that the reduction of organic price for some products, like organic milk, potatoes and rice do not shift demand much.

To control more precisely the impact of information on pesticide-use reduction, non-hypothetical experiments are increasingly popular. Using Vickrey auctions, Roosen et al. (1998) study the impact of insecticides' elimination and cosmetic damages on consumers' WTP for apples. The results show that appearance of apples had non-

negligible effect on the WTP and that information about pesticides changes the WTP of consumers. After the disclosure of the information about the consequences of insecticide use, the consumers' WTP increases by about 50%, while cosmetic damage decreases average WTP by 63%. Gil and Soler (2006) analyse the Spanish consumers' decisions to pay a premium for organic olive oil. They observed that information about conventional product ("reference price") increased the perceived value of the organic product. Their results also show that only the consumers that have already bought organic products were willing to pay a price premium and only 5% of them would be willing to pay the correspondent market price.

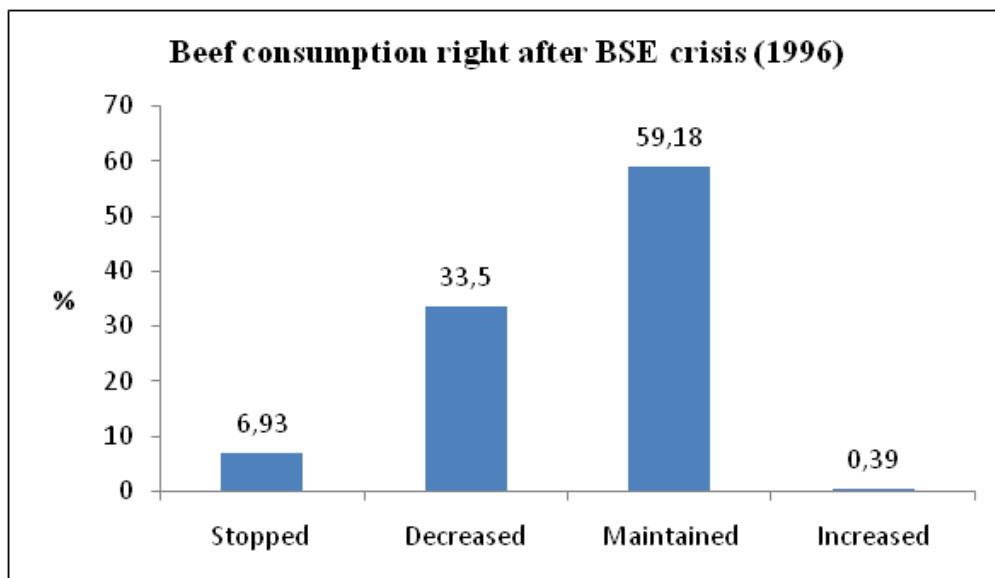
Using experimental auctions Bazoche et al (2013) study several systems of good agricultural practices, possibly signaled to consumers, ranging from public and private Integrated Pest Management (IPM) strategies to organic production methods. The results suggest a relatively homogeneous behavior of European consumers. These authors show how improving the information on pesticides reduction could have unexpected consequences. Results also show that sensory characteristics or reference to an origin of production should not be overlooked.

A last, but important issue concerns the impact of interaction between signals on consumers' WTP. Two papers investigated the effects of additional signals that are commonly used in the supply of organic products. Bernard and Bernard (2010) determine consumers' WTP for organic potatoes and sweet corn, focusing on two characteristics: pesticide-free and non-GM. They found that the premium for the organic version was not significantly different from the sum of the two components (pesticide-free and non-GM) when they are evaluated independently. This suggests that these two characteristics are what consumers are paying for when buying organic products. Tagbata and Sirieix (2008) compared French consumer's willingness to pay for organic and fair-trade chocolate products. The authors found that a large proportion of their sample (41%) consider taste and health issues at least as much as social and environmental dimensions when choosing organic and fair trade products.

3. Specific results for perceptions of beef safety

It is worth mentioning a research undertaken in Portugal (project AGRO 422) in 2005, concerning beef consumption in Portugal, looking at habits, attitudes and perceptions of Portuguese consumers (Aguiar Fontes *et al.*, 2008).

The research project mentioned has shown, using a sample of approximately 800 consumers, that right after BSE crisis different reactions occurred, though 59% of the respondents say they did not alter their level of beef consumption (Figure 1). Those who stopped eating were mainly the elderly (66-75 group age) and those who decreased were mainly in the 46-65 age group.



Source: Project AGRO 422 (2005)

In the same study, when asked about their beef consumption in 2005 (ten years after the first BSE crisis), around 64% mentioned they were consuming basically the same as prior to the crisis. This corroborates the idea that immediately in the “heat” of the food crisis, consumers are more reactive in terms of their consumption habits but as time goes by and the memory becomes more dissipated, consumption slowly tends to return to levels more close to previous ones, though often not exactly the levels they used to have prior to the crisis, but of course differing according to products and consumers. Notice that Henson and Northen (2000), had already concluded that, on average, consumption of beef declined across the EU in the years right after the first BSE crisis, and remained below the pre-BSE consumption levels in most countries. However, the authors highlighted that there were different consumer`s reactions- though

the majority decreased their consumption levels, a proportion of consumers have totally stopped beef consumption, whilst others, taking advantage of the price decrease that took place by that time, increased beef consumption. The different types of reactions are dependent upon the way consumers perceive risk. This perception is linked to consumers' assessment of food safety, a credence attribute that cannot be ascertained by the consumer at the point of purchase. As so, extrinsic and intrinsic cues become highly relevant to turn a credence attribute into a search one (in accordance with the already mentioned work by Wezemeal *et al.*, 2010).

More recently, six focus groups were undertaken in two main cities of Portugal (Lisbon and Oporto) within a broader research Project (PhD research project reference SFRH/ BD/37715/2007) and full details are to be published elsewhere (Viegas *et al.* submitted). All of the participants had to be beef consumers and at least partially responsible for the household's meat shopping. One of the subjects of these focus groups was a discussion around consumers' perceptions of beef safety.

Quite interestingly the majority of participants in the focus groups undertaken in Portugal did not seem to be particularly concerned at that time with beef food safety, indeed they considered that at that moment it was not an issue, considering that if the beef is available for shopping then it must be safe, or at least with minimum risk. This is so because minimum standards are generally perceived as guaranteed, but also because in the period focus groups were undertaken there were no events around beef that could bring this issue to the core front. Again, confirming the thesis of the sleeping giant as argued by Grunert (2005).

Worth mentioning is the fact that these participants in general, stressed their confidence in the existing legal framework and in the existing audits and inspections. Nevertheless, issues such as drugs and antibiotics residues, hormone administration, feed quality and slaughter hygiene were considered to be worrisome during the production stages by many participants. They considered a safe beef as a national beef, within the expiry date, with a good aspect/ appearance, and looking reddish (live color). Notice that some cues are used by these focus groups participants to infer upon beef safety such as origin, aspect and color- intrinsic attributes, and expiry date- an extrinsic cue (Table 1). These findings, though from a focus groups and hence only exploratory and descriptive, are in accordance with the work by Bernués *et al.* (2003) where they concluded that expiry date and beef origin were also the most relevant cues for the

quality and safety of beef, but close to maturation time, cut, nutritional information, amongst others.

Table 1. Beef safety perceptions, associations and concerns

Mentioned concerns	<ul style="list-style-type: none"> • Drug residues: hormone / antibiotics • Dioxins • Slaughter hygiene • Feedstuffs' hygiene • Regulations and control • Previous experience
Beef safety cues	<ul style="list-style-type: none"> • Meat aspect • Fat and meat colour • Expiry date • Pre-packed beef • National origin • Shopping at butcher
WTP for safer beef	<ul style="list-style-type: none"> • Yes <ul style="list-style-type: none"> Value for money Buying less to buy more quality • No <ul style="list-style-type: none"> Pleased with current Additional safety has to be for all consumers • Don't know <ul style="list-style-type: none"> Trial shopping Only if certified

Source: Viegas *et al.* (submitted).

Wezemael *et al.* (2010) undertook eight focus groups in four European Union countries (France, Germany, Spain and the United Kingdom). In these authors work, the main findings are quite similar in the countries involved in the analysis and beef safety was mainly defined as related with consumer's health. Quite interestingly, like in Portugal, beef safety was considered a "precondition that allowed for the consumption of beef products without the need of being concerned". Overall, beef safety was

associated with legislation, control, experience of beef safety and safety cues such as color and certificates.

4. Specific results for pesticides' reduction in Fruits & Vegetables

When consumers deal with fruits' food safety they usually do an evaluation that confronts food safety attributes and others attributes like appearance, cosmetic damage and taste. Do consumers "forgot" the safety risks of food when sensory characteristics are in evaluation? Next, we present two studies that used experimental auctions to assess consumers' WTP for food safety attributes (reduction of pesticides) of fruits (apples and pears) and for sensory attributes (appearance and taste).

The first study that we present, the work of Roosen et al. (1998), is consider as a seminal work because it was the first that used experimental auctions to investigate consumers' WTP for apples that were produced with different types of insecticides. The possible consequences of the insecticides in the long-term due to chronic exposure to these pesticides in early childhood were confronted with the cosmetic damages of apples at the short-term. The apples' evaluation was a multiple attributes (pesticide use and appearance) and the authors assess the impact of insecticides' elimination and cosmetic damages on consumers' WTP using a multiple round Vickrey auction method. The auction design was also original because at the beginning 54 participants from a Midwestern university town (USA) were provided with one bag of apples that were identified as the "base quality". And during the auction, the participants were the opportunity to reveal their WTP to exchange their apples for each of four alternatives of apples. These four types of apples differed in function of the insecticides used in their production and also differed in terms of appearance, because some of them had some cosmetic damages. Also, during the auction, the participants were informed about the pesticide' intensity of damage and risk, and its consequences on brain function, in the long-term.

Table 2 . Average bids and number of zeros in first and final steps

Experiment	Apple 2 No one neuroactive insecticide; no cosmetic damage	Apple 3 No one neuroactive insecticide; cosmetic damage	Apple 4 No neuroactive insecticides; no cosmetic damage	Apple 5 No neuroactive insecticides; cosmetic damage
Step 1				
Average Bid	\$0.22	\$0.08	\$0.22	\$0.14
Number of zeros bids	26	39	27	37
Step 7				
Average Bid	\$0.34	\$0.21	\$0.45	\$0.34
Number of zeros bids	24	37	19	26

Source: Adapted from Roosen et al., 1998

The analysis of Roosen et al (op cit ) showed that WTP for produce free from neuroactive pesticides is significantly higher than for conventional produce and that apples, not so appealing, have a significant (negative: -63%) effect on WTP. The authors measured also consumers' WTP for a partial reduction of pesticides use in apples. They found a 50% increase of WTP between the partial pesticides reduction and the complete pesticides lack. The results show that appearance of apples had non-negligible effect on the WTP and that information about pesticides changes the WTP of consumers. After the disclosure of the information about the consequences of insecticide' use, the consumers' WTP increases by about 50%, while cosmetic damage decreases average WTP by 63%.

Another case study focuses on consumers' willingness to pay (WTP) for fruits that carried food safety information conveyed through different food labels. Considering this topic, Combris et al. (2010) developed an experimental market for pears in Portugal and its protocol was applied to both non-certified and certified products. The non-certified pears were used to support the idea that the absence of food safety guarantees could lead to an important decrease of the WTP. For the pears that were certified for different quality assurances related to on-farm production methods, the aim was to show the role of two kinds of labels in order to transmit the information on attributes to consumers: (i) a collective label with a protected designation of origin (namely the "Rocha do Oeste" pear) and (ii) a well known premium retail label. In the experimental economic procedure of this work, the BDM (Becker, deGroot and Marschak, 1964)

elicitation mechanism was combined with sensory evaluation in order to evaluate the interaction between food safety and sensory attributes and to know if this interaction affects consumers' WTP.

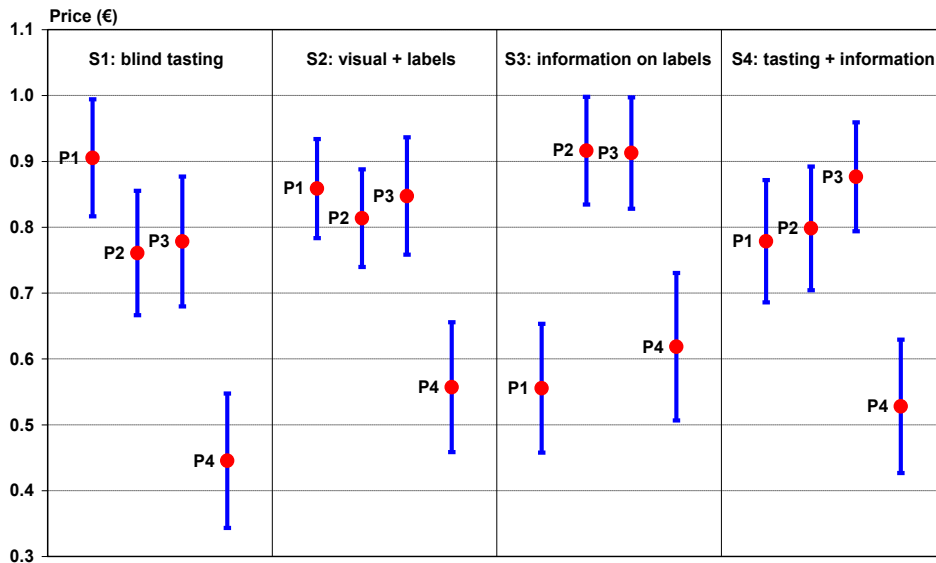
The experiment took place in the region of Lisbon and seventy-four consumers were recruited from the general population of this region. Consumers participated in one of eight sessions that were held in the week of November 6-12, 2006. Four types of 'Rocha' pear were evaluated in the experiment: a conventional 'Rocha' pear without a label (P1), a pear with a premium retailer label (P2) and two pears with the Protected Designation of Origin (PDO) (P3 and P4) with two levels of maturity, expressed by different sugar content (°Brix) and skin colour. During the experiment, participants had to evaluate the four types of 'Rocha' pear in four different information situations. In each, participants could evaluate the four types simultaneously and had to complete a small questionnaire indicating, for each type of pear, whether they want to buy 1 kilo of this pear and if "yes" at what maximum price. The experiment consisted of four steps (or information situations): (i) blind tasting of the four types of pears, ii) visual, labels and tactile examination, iii) additional information, iv) tasting with all the information. A complex pattern of relationships between taste and food safety in consumers' evaluation were highlighted in the results. For this study we will concentrate on the results linked with the transmission of information about food safety. Before presenting the results, it is important to refer that in the second step three modalities of pears were presented to the consumers with a personalized retailer/producer label. The participants had made a visual and tactile inspection of the fruits and had examined the labels, but no information was transmitted. In the third step, some information was given about food safety for each fruit,

The Figure 1 illustrates how the absence of food safety guarantees explains the decrease of the WTP for the conventional pear (P1), from situation 2 ("visual + labels") to situation 3 ("information on labels").

In situation 2, where the guarantee of food safety is insufficiently conveyed by the labels, it is possible to estimate the difference in WTP between a safe pear and an unsafe one. The absence of food safety guarantees explains the decrease of the WTP for the conventional pear (P1), since the WTP for the conventional pear (P1) is smaller in situation 3 ("information on labels") than in situation 2 ("visual + labels"). Note that information on integrated pest management increases the WTP for pears P2 and P3. Moreover, it appears that the guarantee of origin (or the absence of guarantee of origin

in the case of the retail label) has no specific effects compared to the food safety guarantees.

Figure 1. Confidence intervals (95%) of mean WTP for each pear



Source: Combris *et al.* (2010).

The sequel of the experiment shows that the limited knowledge of consumers on integrated pest management is largely responsible for their relative lack of responsiveness to fruit labelling. To control for a priori beliefs of participants at this stage of the experiment, the authors asked them to complete a short questionnaire. For each pear, they had to answer three questions: about guarantee of quality, guarantee of origin, and food safety guarantee (associated with integrated pest management). Table 3 shows the distribution of responses for each pear and each guarantee. Right answers are written in bold characters, and percentages showing that only a minority of consumers is well informed about one of the guarantees given by the labels are underlined>. Data from Table 3 highlight the fact that participants are strongly uninformed on the guarantee of higher food safety standards given by labels. Indeed, from the column "Guarantee of Food Safety" of Table 3, it is possible to see that a minority (less than 50%) considers that these labels take into account integrated pest management. Moreover, only 8.2% of participants know that generic 'Rocha' pear doesn't have a specific guarantee of food safety (i.e. a higher standard compared to the public regulations).

After having completed the questionnaire and still in the situation S3, the right answers were given to the participants and again they performed another evaluation of

the four pears. As a result of this new evaluation, pear P1 obtains a much lower WTP than pears P2 and P3 (- €0.36, $P < 0.0001$). The control of participants' knowledge before this evaluation, allowed a good estimation of the effect of information about the food safety guarantee brought by the labels. It highlights the increase in labels' reputation that more communication could bring. Nevertheless, the fact that in this situation, informed participants did not value pear P4 very much when compared to P2 and P3 (- €0.30, $P < 0.0001$), raises the question of the trade-off between food safety guarantee and sensory quality.

Table 3. A priori knowledge on guarantees on pears

	Guarantee of quality			Guarantee of origin			Guarantee of safety		
	Yes	No	Don't know	Yes	No	Don't know	Yes	No	Don't know
P1 Generic Rocha Pear	41.9	<u>16.2</u>	41.9%	<u>58.9%</u>	1.4%	39.7%	20.5%	<u>8.2%</u>	71.2%
P2 Retail label Rocha Pear	51.4	21.6	27.0%	41.1%	<u>15.1%</u>	43.8%	<u>49.3%</u>	2.7%	47.9%
P3 DOP Rocha Pear	74.0	6.8%	19.2%	89.2%	0.0%	10.8%	<u>47.9%</u>	2.7%	49.3%
P4 DOP Rocha Pear ("un-ripped")	57.5	17.8	24.7%	86.5%	2.7%	10.8%	<u>43.8%</u>	4.1%	52.1%

Source: Combris *et al.* (2010).

Situation S4 brings some answers to this question. When fully informed on labels and after tasting all the pears, participants finally value the pears according to their sensory characteristics rather than their labels. WTP for pear P4 remains significantly lower than WTP for P1, P2 and P3, (- €0.25, - €0.27, - €0.35 respectively, $P = 0.0001$ or less). Moreover, WTP for pears P1, P2 and P3 is not significantly different. This could mean that the better taste of pear P1 compensates for the absence of specific guarantee on sanitary risks.

This study reveals that consumers are willing to pay significantly more for better quality assurances related to on-farm production methods, such as the absence of pesticides. The results confirm that labels such as PDO improve the signaling of credence attributes to consumers. They should do so, not because the WTP is higher for goods produced with less pesticides, insecticides, etc., but because the absence of these guarantees could lead to an important decrease of the WTP. Combris *et al.* (2010) argue that "when the damages cannot be scientifically proved (e.g. how pesticides affect health) it seems reasonable to assume that the absence of a label guaranteeing safe food has a limited effect on demand. On the contrary, when the damages can be proved and are known to consumers (e.g. the "mad cow crisis") these may overestimate the risk. Then the decrease in demand due to inadequate food safety may be more significant."

Another important finding these authors mention is that "taste beats food safety", that is, when faced with sensorial characteristics of the product these become more important in consumer preferences than food safety issues, particularly if no recent food scares have taken place.

5. Conclusion

The many health crises of the past decade (BSE in 1996 and 2000, foot-and-mouth disease in 2001, avian flu in 2005, cucumber crisis in 2011), patterns of fraud relating to the authenticity of the food ("horsegate" in 2013) and the ongoing debate concerning the safety of certain processes (e.g. accusation of GMOs in 2012) led to an increasing distrust of the consumers for the quality of food products. The consequences of these concerns result in a very low level of radical innovations in this sector of the economy and in many situations these innovations are not even put forward by companies. Yet these may be the source of a substantial strengthening of safety. This is the case of the irradiation which eliminates some of the microorganisms responsible for the degradation or contamination of the food. This is also the case when certain additives can enhance the conservation or use as antibacterial and antifungal agents in foodstuffs. However, these positive effects are often contested, given secondary suspected or proven effects. Under these conditions of widespread suspicion issues 'naturalness' and 'authentic' food products are now highlighted and demanded by the consumers, as well as the origin of production where the way the product is crafted.

Considering the specificity of food consumption we showed how to security in the purchase of food is a "non-negotiable" attribute. This review of the literature confirms that consumers in developed countries have become more demanding of food safety, which could result in a boycott in case of suspected or proven assumed. Elements such as social amplification of the risk or media coverage can be greatly influence the purchase of food products.

It is clear that immediate health risk more easily causes a consumer rejection rather than risk distributed over time. However it is not at all clear that uncertainty (even health) causes a non-purchase decision. The consumer may not reflect this uncertainty (pretend that it does not exist) or reduce its willingness to pay (as if he considered that his health has a price ...). In the latter case, we showed how a large number of quality parameters could largely offset this effect.

References

- Agra Europe (2001). Several issues from October to December, London.
- Alfnes, F. and Rickertsen, K. (2003). European consumers' willingness to pay for US beef in experimental auction markets. *American Journal of Agricultural Economics* 85: 396–405.
- Angulo, A. M. and Gil, J. M. (2007). Risk perception and consumer willingness to pay for certified beef in Spain. *Food Quality and Preference* 18: 1106–1117
- Antle, j. M. (2001). Economic analysis of food safety. In: Gardner, B. and Rausser, G. (eds) *Handbook of Agricultural Economics* 1(Ch.: 19): 1084-1136.
- Arnade, C., Calvin, L. and Kuchler, F. (2009). Consumer Response to a Food Safety Shock: The 2006 Food-Borne Illness Outbreak of *E. coli* O157:H7 Linked to Spinach. *Review of Agricultural Economics* 31 (4): 734-750.
- Barreira, M. M., Banovic, M. and Aguiar Fontes, M. (2005). As preferências dos consumidores portugueses face às crises. *Livro do XV Congresso de Zootecnia* 187-191.
- Bazoche, P., Combris, P., Giraud-Héraud, E., Seabra Pinto, A., Bunte, F., and Tsakiridou, E. (2013), “Willingness to pay for pesticide reduction in the EU: nothing but organic ?”, *European Review of Agricultural Economics* pp. 1–23.
- Bougherara, D. and Combris, P. (2009). Eco-Labelled Food Products: What are Consumers paying for? *European Review of Agricultural Economics* 36(3).
- Buzby, J., Fox, J., Ready, R. and Crutchfield, S. (1998). Measuring Consumer Benefits of Food Safety Risk Reduction. *Journal of Agricultural and Applied Economics*, 30 (1): 69-82.
- Burton, M., Young, T. and Cromb, R. (1999). Meat consumers' long-term response to perceived risks associated with BSE in Great Britain. *Cahiers d'économie et sociologie rurales* 50: 7-19.
- Caskie, P., Davis, J. and Moss, J. E. (1999). The economic impact of BSE: a regional perspective. *Applied Economics* 31: 1623-1630.
- Caswell, J.A. and Joseph, S. (2006). Consumers' food safety, environmental and animal welfare concerns: major determinants for agricultural and food trade in the future. Paper presented at the Summer Symposium of the International Agricultural Trade Research Consortium (IATRC). *Food Regulation and Trade: Institutional Framework, Concepts of Analysis and Empirical Evidence*, Bonn, Germany, 28–30 May, 2006. Available from:http://www.agp.unibonn.de/iatrc/iatrc_program/Session%205/Caswell_Joseph.pdf.
- Combris, P., Seabra Pinto, A. Fragata, A. and Giraud-Héraud, E., (2010). Does Taste beat Food Safety? Evidence from the "Pera Rocha" case in Portugal. *Journal of Food Products Marketing* 16: 60-78.
- Dahlgran, R.A. and D.G. Fairchild (1987). The Demand Impacts of Chicken Contamination Publicity—A Case Study. *Agribusiness* 18:459–74.

- Dickinson, D.L. and Bailey, D. (2002). Meat traceability: are US consumers willing to pay for it?. *Journal of Agricultural and Resource Economics* 27 (2): 348–364.
- Enneking, U. (2004). Willingness-to-pay for safety improvements in the German meat sector: the case of the Q&S label. *European Review of Agricultural Economics* 31(2): 205-223.
- Eom, Y. (1994). Pesticide Residue Risk and Food Safety Valuation: A Random Utility Approach. *American Journal of Agricultural Economics* 76(4): 760-771.
- Fox, J., Hayes, D. and Shogren, J. (2002). Consumer preferences for food irradiation: How favourable and unfavourable descriptions affect preferences for irradiated pork in experimental auctions. *Journal of Risk and Uncertainty* 24:75-9.
- Grunert, K (2005). Food quality and safety: consumer perception and demand. *European Review of Agricultural Economics* 32 (3): 369-391.
- Grunert, K.G., Bredhal, L. and Brunso, K. (2004). Consumer perception of meat quality and implications for product development in the meat sector – a review. *Meat Science* 66, 259-272
- Hammitt, J. (1990). Risk Perceptions and Food Choice: An Exploratory Analysis of Organic- Versus Conventional-Produce Buyers. *Risk Analysis* 10(3): 367-374.
- Hayes, D., Fox, J. and J. Shogren, J. (2002). Experts and activists: How information affects the demand for food irradiation. *Food Policy* 27 (2): 185–93.
- Henson, S. (1996). Consumer willingness to pay for reductions in the risk of food poisoning in the UK. *Journal of Agricultural Economics* 47: 403–420.
- Hobbs, J.E., Sanderson, K. and Haghiri, M. (2006). Evaluating Willingness-to-Pay for Bison Attributes: An Experimental Auction Approach. *Canadian Journal of Agricultural Economics* 54: 269-287.
- Hooker, N. H. And Caswell, J. A. (1996). Trends in Food Quality Regulation: Implications Processed Food Trade and Foreign Direct Investment. *Agribusiness* 12 (5): 411-419.
- Horowitz, J. (1994). Preferences for Pesticide Regulation. *American Journal of Agricultural Economics* 76(3): 396-406.
- Huang, C.L. (1993). Simultaneous equation model for estimating consumer risk perceptions, attitudes and willingness to pay for residue-free produce. *Journal of Consumer Affairs* 27 (2): 377-96.
- Kalogeras N., Pennings J.M.E. and Van Ittersum Koert (2008). Consumer Food Safety Risk Attitudes and Perceptions Over Time: The Case of BSE Crisis. 12th Congress of the European Association of Agricultural Economists – EAAE 2008.
- Knowles, T., Moody, R. and McEachern, M. G. (2007). European food scares and their impact on EU food policy. *British Food Journal* 109 (1): 43-67.
- Latouche, K., Rainelli, P. and Vermersch, D. (1998). Food safety issues and the BSE scare: some lessons from the French case. *Food Policy* 23 (5): 347–356.

- Loureiro, M.L. and Umberger, W. J. (2007). A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-of-origin labeling and traceability. *Food Policy* 32: 496–514
- Luijk, R., Schalk, S. and Muilerman, H. (2000). Have We Lost Our Minds? Neurotoxin Residues Harmful to the Developing Brains of Our Children. *Consumentenbond ans Sticting Natuur en Milieu*, The Netherlands.
- Lusk, J.L. and Schroeder, T. C. (2000). Effects of Meat Recalls on Futures Market Prices. Paper presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL, April 2000.
- Mangen, M.J. and Burrell, A.M. (2001). Decomposing preference shifts for meat and fish in the Netherlands, *Journal of Agricultural Economics* 52, 16–28.
- Mazzocchi, M. (2004). Food scares and demand recovery patterns: an econometric investigation. Paper prepared for presentation at the 84th EAAE Seminar *Food Safety in a Dynamic World* Zeist, The Netherlands, February 8 - 11, 2004
- McCluskey, J.J., Grimsrud, K. M., Ouchi, H. and Wahl, T. I. (2005). Bovine spongiform encephalopathy in Japan: consumers' food safety perceptions and willingness to pay for tested beef. *The Australian Journal of Agricultural and Resource Economics* 49: 197–209.
- McKenzie, A.M. and Thomsen, M.R. (2001). The Effect of E. Coli 0157:H7 on Beef Prices. *Journal of Agricultural and Resource Economics* 26:431–44.
- Miles, S., Brennan, M., Kuznesof, S., Ness, M., Ritson, C. and Frewer, L.J. (2004). Public worry about specific food safety issues. *British Food Journal* 106 (1): 9-22.
- Misra, S.M., Huang, C. L. and Ott, S. L. (1991). Consumer Willingness to Pay for Pesticide-Free Fresh Produce. *Western Journal of Agricultural Economics* 16(2): 218-227.
- Mourato, S., Ozdemiroglu, E. And Foster, V. (2000). Evaluating Health and Environmental Impact of Pesticide Use: Implication for the Design of Ecolabels and Pesticides Taxes. *Environmental Science & Technology* 34(8): 1456-1461.
- Nayga, R., Aiew, W. and Nichols, J. (2005). Information effects on consumers' willingness to purchase irradiated food products. *Review of Agricultural Economics* 27: 37–48.
- Nayga, R. M., Woodward, R. and Aiew, W. (2006). Willingness to Pay for Reduced Risk of Foodborne Illness: A Nonhypothetical Field Experiment, *Canadian Journal of Agricultural Economics* 54: 461–475.
- Penner, K., Kramer, C., and Frantz, G. (1985). Consumer food safety perceptions. MF774. Kansas State Univ. Ext. Service, Manhattan, Kansas
- Pennings, J. M. E., Wansink, B. and Meulenberg, M. T. G. (2002). A note on modeling consumer reactions to a crisis: The case of the mad cow disease. *International Journal of Research in Marketing* 19: 91-100.

- Peretti-Watel, P. (2001). La crise de la vache folle: une épidémie fantôme? *Sciences sociales et santé* 19 (1): 5-38.
- Piggott, N.E. and Marsh, T.L. (2004). Does Food Safety Information Impact U.S. Meat Demand? *American Journal of Agricultural Economics* 86(1): 154-74.
- Robenstein, R.G., and Thurman, W. N. (1996). Health Risk and the Demand for Red Meat: Evidence from Futures Markets. *Review of Agricultural Economics* 18:629-41.
- Roosen, J., Lusk, J.L. and Fox, J.A. (2003). Consumer demand for and attitudes toward alternative beef labeling strategies in France, Germany, and the UK. *Agribusiness: An International Journal* 19 (1): 77-90.
- Rozan, A., Stenger, A. And Willinger, M. (2004). Willingness to Pay for Food Safety: an Experimental Investigation of Quality Certification on Bidding Behaviour. *European Review of Agricultural Economics* 31(4): 409-425.
- Schou, J.S., Hasler, B. and Kaltoft, P. (2002). Valuing biodiversity effects of pesticide use. What does perception of uncertainty mean for survey design? Conference Proceedings. Risk and Uncertainty in Environmental and Resource Economics, Wageningen, The Netherlands.
- Shogren, J., Fox, J., Hayes, D. and Roosen, J. (1999). Observed choices for food safety, in retail, survey, and auction markets. *American Journal of Agricultural Economics* 81 (5): 1192-1199.
- Smallwood, D. M. and Blaylock, J. R. (1991). Consumer demand for food and food safety: models and applications. In. Caswell, J. A. (ed.), *Economics of Food Safety* 1: 3-27.
- Verbeke, W. and Ward, R.W. (2001). A fresh meat almost ideal demand system incorporating negative TV press and advertising impact, *Agricultural Economics* 25: 359-374.
- Viegas, I.; Santos, J.M. e Aguiar Fontes, M. (2010). Consumers' willingness to pay for safer, cleaner and animal friendlier beef: Preliminary results from Focus Groups? Comunicação em painel apresentada na "84th Annual Conference of the Agricultural Economics Society", Edimburgo, 27 a 31 de Maio de 2010.
- Wezemeal, L. V.; Verbeke, W.; Kügler, J. O., de Barcellos, M. D. and Grunert, K. G. (2010). European consumers and beef safety: Perceptions, expectations and uncertainty reduction strategies. *Food Control* 21 (2010) 835-844.
- Wilcock, A., Pun, M., Joseph Khanonax and May Aung (2004). Consumer attitudes, knowledge and behaviour: a review of food safety issues. *Trends in Food Science & Technology* 15 (2004) 56-66.