

“Food-borne diseases pose a considerable threat to human health and the economy of individuals, families and nations. Their control requires a concerted effort on the part of the three principal partners, namely governments, the food industry and consumers.” (WHO, 2002).

Food quality is important to consumers. Food safety, however, is essential (Early and Shepherd, 1997). Not only recent food scares and crises have brought this aspect into consumers' mind and have arrested public attention. Also the attention of mass media to food safety aspects and the distribution of information on abuses and misbehaviour made their contributions to raising consumers' awareness and concern. In Germany, recently the “rotten meat scandal” occurred where meat was sold after its best-before date mainly to buyers in the gastronomy sector. This was not primarily dangerous or harmful for consumers, but the meat has certainly not met their quality expectations.

Health risks originating in food can only be avoided or reduced to a certain degree. For instance, the exposition to pesticide residues in fruits and vegetables can be reduced by choosing organic products. Residues of antibiotics or hormones in meat can be avoided by a vegetarian diet. It is, however, difficult for a consumer to avoid an unknown risk (i.e., risk which is generally unknown or not well investigated) or a risk he is not aware of (i.e., a specific risk that is not known by a person). New food safety issues like the avian flu and some years ago BSE make it difficult for experts **and** consumers to estimate risks and to give or follow recommendations regarding consumption behavior.

On the other side, some food-borne diseases are already well recognized. Even though, they are considered as emerging by the WHO because recently the incidence rate has increased. Salmonellosis outbreaks, for instance, have been reported for decades, but within the past 25 years the reported number of cases has increased on many continents. A number of reasons are responsible for new food-borne diseases threats. There is an increase in international travel and a globalization of the food supply. We are faced with microbial adaptation and changes in the food production system. Pathogens are inadvertently introduced into new geographic areas. Also, travellers, refugees,

and immigrants are more susceptible to food-borne diseases because they are exposed to unfamiliar food-borne hazards. Finally, human demographics and behaviour are reasons for these developments. Changes in the human population make their contribution to an increase of the incidence rates. Immunity is reduced due to increasing age, malnutrition, or infections. A weak immune system increases the risk of becoming infected by food-borne pathogens at lower doses. These doses may not lead to adverse health effects for healthier persons. Changes in lifestyle (e.g. eat meals prepared in restaurants, canteens, fast food outlets, and by street food vendors) and the application of poor hygiene practices causes contamination, growth, or survival of pathogens. The WHO concludes that food-borne diseases threaten human health and individuals' economy, families and nations. The control of food-borne diseases requires coordinated efforts of governments, the food industry and consumers (WHO, 2002).

Governments aim at protecting consumers by legislations. Within the European Union, food safety is an important issue. The European Commission describes its "overall mission" towards food safety with regard to health and consumer protection as "[...] integrated approach [...] to assure a high level of food safety, animal health, animal welfare and plant health [...] through coherent farm-to-table measures and adequate monitoring, while ensuring the effective functioning of the internal market" (European Commission, 2006). Further, "Assuring that the EU has the highest standards of food safety is a key policy priority for the Commission" (European Commission, 2000).

However, governmental actions can not always assure the quality and safety of food since many factors have an influence. Food safety practices applied by consumers in the home are not less important. Due to the application of safe-handling practices, a considerable number of food-borne diseases can be avoided. Clayton, Griffith, and Price (2003) observed food handling practices of 40 consumers applying an attitude and a knowledge questionnaire. Consumers were found to have a lack of and/or implemented inadequately a number of hygiene practices. Even 11% of the respondents believed that not carrying out safe handling practices poses not much risk to themselves or others (Clayton, Griffith, and Price, 2003).

Also non-governmental organisations aim at protecting consumer health. The WHO illustrates its recommendations for a proper food handling on a "Five keys to safer food" poster. As part of a food safety education campaign, the poster was introduced in 2001 and is now available in more than 40 languages. The poster provides simple headings, specific suggestions for

improvement and gives explanations to the suggested measures. The five keys are:

- Keep clean (e.g. wash hands before handling food, during food preparation, after going to the toilet),
- Separate raw and cooked (e.g. separate raw meat, poultry and seafood from other foods),
- Cook thoroughly (e.g. especially meat, poultry, eggs and seafood, bring foods like soups to boiling to make sure that they have reached 70°C),
- Keep food at safe temperatures (e.g. do not leave cooked food at room temperature for more than 2 hours, do not thaw frozen food at room temperature),
- Use safe water and raw materials (e.g. use safe water or treat it to make it safe, wash fruits and vegetables, especially if eaten raw) (WHO, 2001).

These few simple suggestions can help to draw attention on self-protecting behavior. If failures occur before food reaches consumers, these are the last barriers to avoid food-related diseases. In case the food was safe when purchased, consumers' own misbehavior can make them sick. By applying these simple techniques this can be avoided.

Beside governmental and non-governmental organisations, efforts made by the industry are often beyond legal requirements. Governments set minimum standards while firms exceed these legal standards. Starting from this point Fulponi (2006) raised the question why companies do so even if quality signals are not transmitted to consumers. In order to answer this question, interviews were conducted with 16 directors of leading food retailers, 4 standard owners, and a global standards organisation. More than 85% of the retailers stated that their required standard is higher than the legal one, and about half of them described their standard(s) as significantly higher. It turned out that 70% consider the legal liability system as stimulating for the growth and stringency of standards but many regard the liability issue as a part of any business activity (Fulponi, 2006). With regard to market forces, it was found in a study for the Canadian meat and poultry processing sector that market-based (private) incentives clearly influence the food safety responsiveness of firms more than government regulatory actions (Jayasinghe-Mudalgi and Henson, 2006). Since the concern about food safety is shared by governments, industry and consumers, the quality assurance

processes should be coordinated along the food chain (Miyagishima et al., 1995).

In studying food safety, many domains play a role like microbiology, toxicology, medicine, food science, chemistry, veterinary medicine, and health economics (Miyagishima et al., 1995). Economics can make a contribution to the understanding of food safety issues because of the nonmarket good characteristic of food safety. Misallocations of societal resources, and marginal costs and benefits of public and private control strategies can be estimated (Buzby et al., 1998).

Economic research on food quality and safety can be grouped into three main streams. The first one deals with consumer demand. Consumer preferences towards quality and/or safety improvements can be determined by measuring consumers' willingness to pay. Determining consumer willingness to pay for certain quality attributes can be done by analysing e.g. scanner data. For products not yet on the market, methods like contingent valuation or experimental auctions can be applied. The second stream is concerned with the supply side. The provision of food quality and safety goes along with organisational changes in agricultural and food production and in the governance structure of value chains. These two streams signify the traditional economic approach to deal with food quality and safety issues. How quality and safety are perceived by consumers and how this perception effects their decision making is the third research stream that functions as mediator between supply and demand (Grunert, 2005). In this regard, not only the provision of safe food and consumer demand for it are important but also consumer perception of quality and safety. In this thesis, the focus is on the traditional economic approach while some perceptual issues are also included.

It is not always possible for consumers to ascertain food safety or its degree a priori to the purchase of a food. Loader and Hobbs (1999) suggest three possible solutions to overcome this information asymmetry. *Labeling regulations and pathogen-reduction standards* yield legislative protection. A firm-level response in form of a *label introduction or product certification* can signal food safety. Labels can serve as food quality and safety signals but are only effective if consumers understand its message. Otherwise consumers' information costs increase, the opposite result of what was intended. The third solution is a *tort liability law* that encourages firms to increase food safety and discourages them from false or misleading statements with regard to their labeling and certification.

This PhD thesis follows a multilateral approach. Its aim is to provide a deeper insight into the different “solutions” suggested by Loader and Hobbs (1999) delineated above. Three different economic studies were conducted dealing with health-risk-reduced food, labelling issues, and food safety standards. The focus is on three emerging issues from the perspective of consumers and the food industry:

- Salmonella and Campylobacter in chicken breast,
- Enterobacter sakazakii in powdered infant milk formula, and the
- International Food Standard Logistic applied by producers and retailers of bagged salad.

In the first study, a dichotomous choice contingent valuation format and choice experiments were applied to reveal consumers’ willingness to pay for safer chicken breast. Salmonella and Campylobacter cause the majority of zoonoses cases in humans (European Commission, 2003). A quality assurance program served as vehicle to reach a health risk reduction for these two food-borne diseases Salmonellosis and Campylobacteriosis of different degrees. In addition, consumer concerns regarding different food safety issues, meat attributes taken into account when buying meat and information sources which consumer uses concerning food safety issues were evaluated. As a methodological aspect, the occurrence of embedding is investigated in the two different elicitation methods (cf. Essay I).

In the second study, a Vickrey auction was conducted to examine parents’ willingness to pay for a quality assurance label on powdered infant milk formula. The label signals a health risk reduction to infants since the pathogen Enterobacter sakazakii can be present in powdered infant milk formula and can cause severe illnesses. The influence of ambiguity with the incidence rate information and provision of safe-handling information on WTP are evaluated using three different experimental treatments (cf. Essay II).

In the last study, product quality and safety aspects of bagged salad are discussed. Further, the application of food safety standards on the retailer and manufacturer level is examined. Case studies were conducted in order to identify who is the driving force for the introduction and implementation of new food safety standards. Two suppliers of bagged salad, a retailer, and a logistics company participated in the study. It turned out that beside the International Food Standard, the International Food Standard Logistic emerges as food quality and safety standard which gains more and more importance (cf. Essay III).

The thesis is organised as follows. The scope, study design, findings, and conclusions of study I, II, and III are outlined in detail in three different essays (cf. table 1). The applied questionnaires and experimental instructions are provided in the appendices of each essay. This thesis ends with a summary and conclusion.

Table 1. Overview of the three empirical studies.

Essay	Participants	Scope	Applied methods	Food	No. of participants
I	Consumers of chicken, do at least half of the grocery shopping	Measuring consumers' WTP for safer chicken breast applying two different methods, investigating the embedding effect	Double-bounded dichotomous choice contingent valuation method and choice experiments	Chicken breast	240
II	Mothers/ fathers who feed/fed powdered infant milk formula, responsible for the purchase of the formula	Measuring parents' WTP for safer infant milk formula, measuring the influence of different information on WTP (i.e., ambiguity effect and safe-handling information)	Second-price sealed bid auction,  Hedonic price analysis on powdered infant milk formula	Powdered infant milk formula	84
III	Two suppliers of bagged salad, a retailer, a logistics company	Get insights into food quality and safety issues, the application of food safety standards, problems in the supply chain	Case studies (semi-structured interview and questionnaire)	Bagged salad	4