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Consumer willingness to pay for food safety: the case of mycotoxins in milk

Paolo Sckokai[1,*], Mario Veneziani[2], Daniele Moro[1], Elena Castellari[1,3]

[1] Dipartimento di Economia Agroalimentare, Università Cattolica del Sacro Cuore, Piacenza, Italy
[2] Dipartimento di Economia, Sezione di Economia Agroalimentare, Università degli Studi di Parma, Parma, Italy
[3] College of Agriculture and Natural Resources, University of Connecticut, Storrs-Mansfield, CT, USA

Abstract. Mycotoxins contamination in food is a serious source of health risks. This paper evaluates the Italian consumers' perception of the mycotoxins' risk through their willingness to pay (WTP) for a hypothetical bottle of milk obtained by cows fed with, *inter alia*, maize certified for the "good practices" (GPs) that reduce this risk. Therefore, a web-based stated choice experiment (SCE) has been carried out involving a representative sample of 973 Italian consumers and the WTP has been measured using the panel data version of a Random Parameters Logit (RPL) model. Results show that Italian consumers are willing to pay a 29% average price premium for "reduced-mycotoxins" milk. This premium increases for consumers between 44 and 54 years of age, who are students, have completed tertiary education, are economically well-off and shop fairly infrequently.

Keywords. Food safety, Mycotoxins, willingness to pay, choice experiments, mixed logit

JEL codes. C35, C93, D12

1. Introduction

Food safety is one of the most relevant determinants of consumer food demand. When food products are perceived unsafe, because of the occurrence of a food safety scandal (e.g., Bovine Spongiform Encephalopathy (BSE) crises, avian influenza, dioxin in meat, foodborne pathogens), their demand drops and recovery to pre-scandal levels may be slow and partial. Public institutions have strived to maintain and promote food safety through regulation: in 2002 the European Union (EU) has established the European Food Safety Authority (EFSA) as the central agency aiming to improve EU food safety, ensure a high level of consumers' protection and restore and maintain confidence in the EU food supply (EFSA, 2014). Moreover, the EU Common Agricultural Policy (CAP) places a high value on food safety, recognising its nature of public good produced by a multifunctional agriculture, such that future agricultural support could be heavily linked to these issues: 59% of the respondents to a recent survey of European citizens (Euro-

* Corresponding author: paolo.sckokai@unicatt.it.

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barometer, 2010) deem ensuring safe and high quality food one of the priorities of the CAP. Furthermore, since consumers value food safety, private incentives in ensuring food safety might arise; thus, a better understanding of consumers' risk perception and valuation may help both private firms and public agencies to design and implement actions aimed to enhance food safety.

Since 1979 the EU has been managing the Rapid Alert System for Food and Feed (RASFF), a tool to exchange information about measures taken as a response to serious health risks detected in food or feed products (RASFF, 2013). The annual RASFF report provides comprehensive statistics on notifications by EU member states concerning detection, in their own territory or at the EU borders, of these potential health risks due to a number of hazards. Mycotoxins were the second most important hazard, accounting for roughly 15% of the total number of notifications in 2012 (i.e., 525 out of 3516), just behind pathogenic micro-organisms (roughly 17% of notifications) (RASFF, 2012). While some 39% of the mycotoxins notifications constitute border rejections of nuts, nut products and seeds, some 6% refer to cereals and bakery products while almost 15% can be ascribed to feed. Nonetheless, the number of notifications reporting a contamination by mycotoxins has declined sharply (-16.8%) due to a reduction in the occurrence of those by aflatoxins (AFs) which were down 17.3% year on year. However, five instances of high concentration of AF M1 have been recorded renewing a concern last experienced back in 2007. The latter can be ascribed to AF B1, found in European maize used as feed for milk cows, which transferred to milk as AF M1 (Galvano *et al.*, 1996). In fact, the severe drought affecting the 2012 maize growing season in South-Eastern Europe has been instrumental to raising the concentrations of AFs in this crop and area.[1]

Although AFs have been considered a minor threat to the safety standards of the upstream phases of the agricultural/food marketing chain (i.e., before the agricultural commodity reached the storing and processing stage of its marketing chain (Battilani *et al.*, 2012)), recent studies have increasingly "…recognise[d] that Good Agricultural Practise[s] (GAP[s]) represent the primary line of defence against the contamination of food products by inherent plant toxins and mycotoxins" (Speijers *et al.*, 2010:4).[2] Moreover, this awareness has spread along the whole supply chain of maize and animal feed produced out of it, which appear particularly prone to AFs contamination, spurring the "… implementation of Good Manufacturing Practise[s] (GMP[s]) during the handling, storage, processing and distribution of cereals for food and animal feed" (Speijers *et al.*, 2010: 4).

A major concern for private firms along the supply chain is to inform the consumer that their final products are derived from agricultural commodities or food raw materials employing GAPs/GMPs. "Safer" food products will then command a higher price, to remunerate all the actors in the marketing chain for their good practises (GPs), compared to conventional ones, if the consumer values the risk of falling ill from eating unsafe

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[1] Climate change, raising temperatures and declining rainfalls are likely to transfer a problem typical – especially at the farm production stage – of tropical and sub-tropical regions to previously unaffected areas of the globe (Battilani *et al.*, 2012).

[2] Note that the European Commission has compiled a Recommendation (17 August 2006) collecting all the GAPs aimed to prevent and/or reduce the incidence of *Fusarium* toxins in cereals and cereal products (European Commission, 2006).

food.[3] Since several attributes related to food safety may not be observable but mostly are communicated by the producer through labelling and advertising, the existence of information asymmetry in this market segment turns some of the products' attributes into credence attributes. If the safety-related products' attributes can be identified correctly, and the information asymmetry largely overcome, consumers may be willing to pay a (higher) price premium for a food item produced by a marketing chain applying, at each stage, the relevant GPs.[4] Therefore, the price premium also provides a measure of the value placed by consumers on the associated health risks. Given the production of "safer" food items is more expensive than that of traditional ones, the food industry and its suppliers may be interested in gauging consumers' interest and willingness to pay (WTP) for a product with these characteristics ahead of the official release on to the market. In presence of hypothetical yet technically feasible products, stated preference (SP) methods (i.e., contingent valuation (CV), stated choice experiments (SCEs), auctions) are commonly employed to elicit consumer preference for products defined on the basis of the levels of a bundle of attributes (Enneking, 2004) and to acquire or calculate consumers' WTP by modelling individual choices (i.e., choice modelling, grounded on random utility theory (Quagrainie *et al.*, 1998)). Nonetheless, the hypothetical nature of choices submitted to consumers in a SCE, which translates into consumers not being required to make an actual choice involving a monetary outlay, may lead to WTP estimates biased upwards. Moreover, consumer WTPs may vary according to the number and type of attribute levels the consumer is confronted with in the experiment (i.e., "context dependency", Mørkbak *et al.* (2012)). However, the joint evaluation of multiple product attributes gives rise to welfare measures, of which WTP is arguably one, which have generally smaller variances – relative to their means – compared to those obtained from CV (Adamowicz *et al.*, 1998). Furthermore, considering different levels of the attributes eliminates the part-whole bias (Hanley *et al.*, 1998; Enneking, 2004).

Empirical studies on consumer valuation of and preference for "safer" food products include Enneking (2004), Brown *et al.* (2005), Aizaki and Sato (2007), Goldberg and Roosen (2007), Nakamura *et al.* (2009), Tonsor *et al.* (2009), Tonsor (2011) and Mørkbak *et al.* (2012). Those focused on "safer" milk comprise Wang *et al.* (2008) and Wolf *et al.* (2011).[5,6]

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[3] Khlangwiset and Wu (2010) collect evidence on the cost and percentage reduction in AFs levels in food and agricultural products due to the implementation of GAPs and GMPs. It is evident that applying both types of GPs implies additional, sometimes significant, costs for farmers and feed processors. Nonetheless, the existing attempts to quantify the economic costs of, especially, GAPs seem to disregard the reduced income which a farmer cultivating a high yield/value crop like maize in rotation with a low(er) yield/value output such as alfalfa or clover is likely to experience, compared to a farmer producing a (maize) monoculture.

[4] Wang *et al.* (2008) report that Hosono (2005), employing Japanese scanner (i.e., revealed preference) data, unveiled a price premium of 12% on purchase of milk and milk products carrying a Hazard Analysis Critical Control Point (HACCP) label. It should be noted that the HACCP certification is the signal of enhanced food safety most frequently analysed in the applied literature investigating consumer valuation of food safety concerns.

[5] In compiling this list, we have tried to focus on food safety concerns triggered mainly by food contaminations due to pathogens. Nonetheless, we recognise that because of, *inter alia*, genetically modified and cloned crops or animals, animal illnesses or traceability and country-of-origin issues, additional food safety concerns can arise in some consumers. Hence, food safety is a multifaceted concept subject to different meanings across consumers.

[6] Aizaki (2012) provides a systematic review of, *inter alia*, studies employing SCEs to value consumer WTP for safer milk. Unfortunately, all the relevant references discussed therein are in Japanese but the salient evidence of these contributions is reported and also used for the discussion of the present results.

In this paper, the consumers' perception and economic valuation of mycotoxins' risk in food is investigated estimating, in the context of a SCE, the WTP of a sample of Italian consumers for a "hypothetical" bottle of milk obtained by cows fed with, *inter alia*, maize certified for farmers and processors applying GAPs and GMPs such that a lower risk of mycotxoin contamination could be expected. The WTP has been measured using the panel data version of a Random Parameters Logit (RPL) model (Train, 2003) on data collected with a web-based survey distributed in the summer of 2009. To the best of our knowledge, and mainly drawing from Aizaki (2012), the only papers explicitly considering consumer valuation of GAPs/GMPs, as measures to maintain/improve food safety, are Nakamura *et al.* (2009) on the production of bottled and carton apple juice, Aizaki and Sato (2007) on valuing GAPs-certified tomatoes and Aizaki *et al.* (2004) that estimate the attitudes towards beef derived from cattle, *inter alia*, fed "… in accordance with hypothetical food safety measures" (Aizaki, 2012:9). Therefore, this work contributes to the literature adding further evidence on a fairly unexplored food safety aspect.

2. Mycotoxins and GAPs/GMPs

Mycotoxins are naturally occurring secondary metabolites produced mainly by moulds of the *Aspergillus*, *Penicillum* and *Fusarium* genera: *Aspergilli* develop at high temperatures and most frequently at the storage stage of an agricultural commodity or food marketing chain while *Fusaria* thrive in presence of plentiful water and high humidity levels, largely at the growing stage (e.g., Speijers *et al.*, 2010). Whilst moulds can be considered as plant pathogens, the ingestion of their toxin can result in acute and chronic disease in animals and humans (Speijers *et al.*, 2010). Mycotoxins like AFs and ochratoxin A are known to be carcinogenic (Williams *et al.*, 2004) and have been defined "… the main chronic health risk related to food …" (Speijers *et al.*, 2010:6). Mycotoxins are particularly dangerous for human health because they cannot be destroyed either by (animal) digestion or by heating and/or refrigeration while cooking: if they are present in the raw agricultural commodity, they remain virtually unchanged in the food chain. Serious health concerns arise from AFs in maize, due to its prevalence in animal feed, and especially in cows' daily rations such that AFs can contaminate frequently consumed products like milk and dairy products. For instance, in 2003, very high concentrations of AF M1 were detected in Italy in milk bottles and in Grana Padano cheese, one of the most famous Italian Protected Denomination of Origin (PDO) dairy product.

Agronomic and technological research aimed to curtail the risk of AFs concentrating in maize suggests preventing or containing the damages, on the growing crop, due to high temperature, water stress and insects' diffusion to limit the initial infection by the concerned moulds (Battilani *et al.*, 2012). In turn, tillage and fertilisation practises, crop rotation and hybrid choice, planting and harvesting date/technique, limited cropping density and adequate irrigation are GAPs which have proven to limit the occurrence of AFs in maize (Battilani *et al.*, 2012 and specific references therein; Speijers *et al.*, 2010). In particular, planting maize in rotation with cotton, wheat and soybeans appears to minimise the soil populations of the fungi producing AFs (e.g., Abbas *et al.*, 2004). Eeckhout *et al.* (2013) suggest that wheat, hence possibly maize, cultivated after, *inter alia*, alfalfa and clover or beets is a rotation plan subject to a low risk of *Fusarium* contamination. Nonetheless, the effects of crop

rotation may only be limited in the short term. Appropriate fertilisation, delivering sufficient levels of nitrogen, and tillage practices, which removing plant debris from the field limits the fungal inoculum, may appropriately prepare the soil to the early planting of hybrids which do not mature in very hot and dry months or, as Bt-maize, appear to be more resistant to fungal infection.[7] Throughout the growing season, (sprinkler) irrigation, weed and pests control (i.e., against the European corn borer in maize)[8] appear crucial activities to control fungi diffusion in maize hence the possibility of AFs development.

Among the GMPs, reducing the time intervening between harvesting and drying; proper sanitation of the relevant machinery and storage areas; segregating the product according to moisture and protein content; storing in a clean, well maintained and sanitised, cool, dry and ventilated premise; fumigation with phosphine or essential oils to control insect pests and mould infections as well as using appropriate filtering systems at the mills seem to effectively impede the development/spread of mycotoxins in processed products (Speijers *et al.*, 2010; Eeckhout *et al.*, 2013).

3. Theory

Safety is a food "attribute". According to Lancaster's consumer theory (Lancaster, 1966), goods are considered a bundle of attributes, and consumers' preferences are stated over attributes. In this context, goods' characteristics can be evaluated using discrete choice models, where choices are made among mutually exclusive finite alternatives within an exhaustive choice set. McFadden (1974) proposed the econometric framework for discrete choice analysis in the context of random utility models.

For an individual i the (indirect) utility obtained from a good j, U_{ij}, can be decomposed in a deterministic part, V_{ij}, related to the K observed good's characteristics (including price), and in a stochastic part, ε_{ij}, accounting also for unobserved variables

$$U_{ij} = V_{ij} + \varepsilon_{ij} = f\left(x_{jk}, \beta_{ik}\right) + \varepsilon_{ij} \tag{1}$$

where x_{jk} is the level of attribute k in good j and β_{ik} is the individual preference parameter for the k^{th} characteristic (i.e., the deterministic part of individual utility is a function of product's characteristics). The choice rule is utility maximization: good j is chosen by individual i among all alternatives iff

$$U_{ij} \geq U_{ih} \qquad \forall h \neq j \tag{2}$$

Different assumptions on the structure of the stochastic component lead to a variety of specifications. In the so-called Mixed Logit (ML) model the stochastic part ε_{ij} is decom-

[7] Resistant hybrids have not been developed and commercialised yet and may also require appropriate and unique crop management practises which might become ineffective whenever peculiar environmental conditions develop in the field. Moreover, note that Bt maize hybrids are not permitted in several European countries (Battilani *et al.*, 2012).

[8] Currently, no commercially admitted fungicide can be legally employed to limit the biosynthesis of AFs by the two most aflatoxigenic fungi. Only biocontrol agents such as natural oils from thyme, lemongrass and other herbs may limit the AFs content in maize (Battilani *et al.*, 2012).

posed as $\varepsilon_{ij} = \eta_{ij} + u_{ij}$ where η_{ij} is an additive random term that can be related to attributes and alternatives and can account for, *inter alia*, correlation and heteroscedasticity, while the u_{ij} term is an *i.i.d.* random component with an extreme value distribution. In our study, we have employed the RPL, where a ML specification is obtained by allowing the set of individual preference parameters $\boldsymbol{\beta}_i$ to be distributed across individuals according to a statistical distribution, $\boldsymbol{\beta}_i \sim f(\boldsymbol{\beta}|\boldsymbol{\mu}_\beta, \boldsymbol{\sigma}_\beta)$ characterized by mean $\boldsymbol{\mu}_\beta$ and variance-covariance matrix $\boldsymbol{\sigma}_\beta$. The RPL model has become the standard reference for SC studies because of its ability to account for preference heterogeneity and its flexibility in accommodating a variety of model specifications (McFadden and Train, 2000).

Then, the probability P_i that individual i may choose alternative j, conditional on a given set of values of the $\boldsymbol{\beta}_i$ parameters, is given by

$$P_i\left(j\middle|\boldsymbol{\beta}_i\right) \equiv L_{ij}\left(\boldsymbol{\beta}_i\right) = \frac{\exp^{V_{ij}(\boldsymbol{\beta}_i)}}{\sum_h \exp^{V_{ih}(\boldsymbol{\beta}_i)}} \tag{3}$$

The RPL-ML specification can be also generalized to panel data (i.e., each sampled individual i makes repeated choices), assuming that parameters are constant across time/choices. If T is the number of repeated choices made by each individual, by integrating the product of the T conditional probabilities, we obtain the probability of choosing alternative j as

$$P_i\left(j\right) = \int \prod_{t=1}^{T} L_{ijt}\left(\boldsymbol{\beta}_i\right) f\left(\boldsymbol{\beta}_i\middle|\boldsymbol{\mu}_\beta, \boldsymbol{\sigma}_\beta\right) d\boldsymbol{\beta} \tag{4}$$

The RPL-ML specification does not require the Independence of Irrelevant Alternatives (IIA) property to be fulfilled, thus it does not restrict substitution patterns as in the Multinomial Logit model; therefore, the ratio of the probabilities of two alternatives, j and h, depends also on attributes of alternatives other than j and h.

In order to evaluate consumer WTP for product attributes, we need to consider that in the random utility model each preference parameter represents the marginal utility of the attribute, that is, $\partial U / \partial x_k = \beta_k$. Mean WTP estimates for attribute k in a RPL can be calculated as β_k/β_{price} and can be considered representative for the entire sample in presence of jointly insignificant $\boldsymbol{\sigma}_\beta$, implying absence of preference heterogeneity (Wolf *et al.*, 2011).[9] Nonetheless, because of effects coding all the relevant variables in the model, the formulation for the calculation of mean WTP for attribute k, applicable to dummy coded variables, needs to be amended as $WTP_k = 2\beta_k/\beta_{price}$ (Lusk *et al.*, 2003; Tonsor, 2011; Wolf *et al.*, 2011). Furthermore, given the individual-specific nature of the preference parameter vector $\boldsymbol{\beta}$ due to expected significant preference heterogeneity, the individual (simulated) estimate of the WTP for any attribute k is given by (Greene *et al.*, 2005)

[9] Note that the present calculation of the mean WTP for attribute k does not feature the usual negative sign because the price variable employed in this study is, in fact, minus the original price variable.

$$\hat{E}_s\left[WTP_{i,k}\right] = \frac{\frac{1}{R}\sum_{r=1}^{R}\frac{2\hat{\beta}_{ikr}}{\hat{\beta}_{i,price,r}}L\left(\hat{\beta}_{ir}\right)}{\frac{1}{R}\sum_{r=1}^{R}L\left(\hat{\beta}_{ir}\right)} \tag{5}$$

where r is the r^{th} draw out of the total number of R replications.[10]

To provide useful insights into which socio-demographic variables may be fruitfully employed to segment the potential market in order to secure the highest price premium, the average $WTP_{k|g}$ for each socio-demographic group g can be calculated by averaging $WTP_{i,k}$ over the number of individuals in each group. Similarly, to obtain a synthetic measure of the WTP_k, the sample mean estimate is obtained averaging $WTP_{i,k}$ across all individuals in the sample.

4. Methods

In a SCE individuals are requested to choose among alternatives. When products' characteristics are not available on the market (i.e., hypothetical new products) a SCE is the only available approach to investigate consumers' preferences. A number of applications in agricultural and food marketing studies have been implemented in recent years (e.g., Burton *et al.*, 2001; Burton and Pearse, 2002; West *et al.*, 2002; James and Burton, 2003; Alfnes, 2004; Rigby and Burton, 2005; Alfnes *et al.*, 2006; Mtimet and Albisu, 2006; Loureiro and Umberger, 2007; Jaeger and Rose, 2008; Gracia *et al.*, 2009).

To evaluate consumers' perception of mycotoxins' risk in milk, a SCE was conducted in July 2009 on a representative sample of 973 Italian consumers relying on a web-based survey administered by Lightspeed Research Ltd.. The survey was introduced by a statement describing mycotoxins, their potential health effects and the role of some GPs in reducing the risk of contaminations in milk. The first section of the questionnaire collected information on consumers' shopping habits: frequency of grocery shopping and milk purchase, preferred type of milk and attitude towards mycotoxins' labelling. In the second section of the survey, consumers were required to choose among three one litre bottles of milk differing for *heat treatment* (UHT, fresh pasteurised and fresh high quality (HQ)), *fat content* (whole, semi-skimmed and skimmed) and *price*. A further attribute, *mycotoxins level* measured the lower risk of mycotoxins contamination due to the use of GPs maize in cow breeding, compared to the higher one associated with employing maize from conventional practises (CPs) for animal feeding. Table 1 lists the attributes and their levels.[11]

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[10] The procedure outlined here estimates the utility coefficient of each attribute from a model cast in the "utility space". This modelling choice may yield counterintuitive distributions of the WTP due to the WTP originating from the ratio of two of the model's coefficients. In particular, the distribution of the WTP may have a very long right tail. To overcome this issue, a re-parameterisation of the model in the "WTP space", such that the (marginal) WTP for each attribute is directly estimated, has been recently proposed in the literature (Train and Weeks, 2005; Scarpa *et al.*, 2008). Empirical applications of the latter approach appear to provide distributions of the WTP with slimmer tails (Train and Sonnier, 2005; Sonnier *et al.*, 2007).

[11] A referee of this journal pointed out that it is recommended practice to administer consumers choice sets which feature individual specific "status-quo" options modelled according to, in this case, preferred heat treatment and fat content (Kontoleon and Yabe, 2003; Rose *et al.*, 2008). This would increase consumers' familiarity

Table 1. Milk attributes and their levels in the SCE.

Attributes	Acronym¥	Levels
Heat Treatment	ht_	UHT (A)† – Fresh Pasteurised (B) – *Fresh High Quality (HQ) (C)*
Fat Content	fc_	*Whole (A)*† – Semi Skimmed (B) - Skimmed (C)
Mycotoxins Level	ml	*Conventional*† – Reduced
Price (€/litre)	pr	1.05 – 1.15 – 1.25 – 1.35 – 1.45 – 1.53 – 1.55 – *1.58* – 1.63 – 1.68 – 1.73 – 1.78 – 1.83 – 1.88

Source: own elaboration.
Note: in italics, the attributes' levels for the "status quo" alternative; ¥, Acronym employed for the heat treatment and fat content attributes in conjunction with the letters representing the levels, to identify the β parameters in equation (6) and the related estimates in Table 4; †, denotes the base levels for effects coding the product attributes with a value of -1.

The full factorial experimental design based on the attributes and levels in Table 1 produces 3·3·2·14 = 252 alternative treatments. To reduce the dimension of the experiment while allowing the main consumer responses to be identified, a D-optimal experimental design selects only 13 alternative treatments which are constructed considering only the linear individual effects for the attribute variables. Three choice sets were submitted to each participant, thus three choices were made, providing a balanced panel of observations. Each of the three choice sets administered was composed of three alternatives, the first always being the "status-quo" alternative (i.e., fresh HQ, whole, CPs, 1.58 €/l) and the remaining two being randomly selected, without replacement, within a set of 13 possible alternative treatments. The "status-quo" alternative, constant across choice sets, is always included to help to scale the utilities among the various choice sets. Often, the "status-quo" alternative is specified as the "no choice" option in market penetration studies. Because this is not the main focus of the present work, the "status-quo" alternative is defined according to consumer demand data and to determine choices with respect to the product modern retailers were keener to promote on their premises, at the time the experiment took place (i.e., fresh HQ). Moreover, fully characterising the "status-quo" alternative prevents respondents from providing no information at all through the "no choice" option (Haaijer *et al.*, 2001). An example of a choice set is given in Table 2.

The third section of the questionnaire collected the socio-demographic characteristics of the respondent: age, location, gender, marital status, education level, employment status and position, number of household residents (including the respondent) and household income level. The summary statistics of the sample appear in Table 3.[12]

The sample of respondents features a few more females than males (55.5%) and a limited number of very young (18-24 years of age) consumers (8.9%), while the 35-44 year

with the "status quo" option reducing further the extent of a possible bias. While this is an attractive experimental design, we were not able to implement such a complicated framework when we selected the surveying partner. Future experiments may be designed following this suggestion.

[12] Note that the respondents who are not responsible for their household's grocery shopping and who have either never gone shopping or never consumed milk have been removed from the sample.

Table 2. Example of a choice set.

Milk (1 litre)	1	2	3
Heat Treatment	Fresh HQ (C)	UHT (A)	Fresh Pasteurised (B)
Fat Content	Whole (A)	Semi Skimmed (B)	Semi Skimmed (B)
Mycotoxins Level	Conventional	Conventional	Reduced
Price (€/l)	1.58 €/l	1.15 €/l	1.63 €/l
Choice (Tick the Box)	☐	☐	☐

Source: own elaboration.

old are the relative majority (21.8%). Responses have been collected mainly from residents in the South of Italy (35.9%), married (72.5%) and either employed (52.4%) or retired (23.6%). Moreover, the largest share of our sample of consumers earns an income in the 20,000-40,000€ range (37.4%), has completed higher education (57.5%), purchases and consumes milk more than once a week (51.7% and 40.0%, respectively). Nonetheless, only 18.8% of the respondents consumes milk every day.

5. Results

The RPL model has been estimated using the econometric software NLOGIT 5.0.[13] The set of explanatory variables includes both product attributes **X** and socio-demographic characteristics **Z**; randomness is assumed for all the attribute parameters: the parameters for the attributes *heat treatment*, *fat content* and *mycotoxins level* are modelled as following a normal distribution while the one for *price* a triangular distribution. Moreover, we constrain the triangular distribution for the price coefficient to spread over negative values in order to limit the possibility that, upon calculating the WTPs for the product's attributes, the distributions of WTPs are not well behaved because 0 is in the domain of the triangular distribution (Daly *et al.*, 2012).[14] The socio-demographic characteristics included in the final specification of the model have been selected evaluating the significance of the Likelihood Ratio (LR) test for the model with a single demographic variable (or group of mutually exclusive effects coded variables accounting for the same socio-demographic characteristic) being superior to the model with the sole product attributes. This model selection procedure has identified gender, age (continuous) and frequency of

[13] NLOGIT 5.0 fits this model employing a maximum simulated likelihood estimator. Crucial features of the estimator include the nature and number of the discrete points in the integration space. Following best practice, Halton sequences are selected, and 1000 draws are employed. The latter have been selected by following the estimates' "robustness checks" suggested in Hensher and Greene (2003) and have been carried out by verifying the stability of the ratio of the estimated mean to the standard deviation of the model's random parameters when the model is estimated with 25, 50, 100, 250, 500, 1000 and 2000 points.

[14] Imposing this constraint implies that a model with correlated random parameters cannot be estimated and that the scale parameter for the price coefficient is set to be equal to the absolute value of the related β coefficient (mean) (Greene, 2012:N-545). While ignoring the correlation between random parameters has been suggested to lead to correlation among the implied WTP distributions (Scarpa *et al.*, 2008), we maintain the constraint to obtain better-defined WTPs.

Table 3. Main summary statistics for the sample composition.

Characteristics	%	Characteristics	%
Gender		*Education level*	
Female	55.5	None/Elementary†	2.9
Male†	44.5	Middle	11.5
Age		College	57.5
18 – 24†	8.9	Tertiary	28.2
25 – 34	17.1	*Income*	
35 – 44	21.8	Up to 10,000€	6.2
45 – 54	18.3	10,001€ – 20,000€	18.4
55 – 64	15.7	20,001€ – 40,000€	37.4
Older than 65	18.0	40,001€ – 70,000€	16.9
Geographical area		Over 70,001€	3.1
North – West†	26.1	I prefer not to disclose†	18.1
North – East	18.8	*Number of household residents*	
Centre	19.2	2†	35.3
South	35.9	3	31.9
Marital status		4	25.4
Married	72.5	More than 4	7.5
Not married†	27.5	*Purchasing frequency*	
Employment status		Once every 15 days†	2.1
Home duties	10.5	Once a week	16.6
Looking for new employment	5.1	More than once a week	51.7
Looking for my first employment	1.3	Every day	29.7
Employed	52.4	*Frequency of milk consumption*	
Retired†	23.5	Once a month†	5.5
Student	7.1	Once every 15 days	9.7
		Once a week	26.1
		More than once a week	40.0
		Every day	18.8

Source: own elaboration based on 973 questionnaire responses.
Notes: †, denotes the base levels for effects coding the socio-demographic variables with value -1.

milk consumption as the sole socio-demographic variables statistically significant, one at a time, in the model.[15] Moreover, these variables could be included also simultaneously in the estimated RPL[16] resulting in a LR test for joint significance of 76.39 which, being Chi-

[15] The results from the model selection procedure are available from the authors upon request.
[16] Since in RPL models the effect of socio-demographic variables is identified by means of interacting these variables with the product attributes for every choice in the experiment's choice set, it is possible that the model associated with an experiment with numerous treatments is too big to be estimated. Because the choice set of this experiment comprised only 13 alternatives, a model with multiple socio-demographic explanatory variables could be estimated and its results are presented in Table 4. Although the coefficients for the socio-demographic variables of interest are not presented to conserve space (but are available from the authors upon request), we can report that roughly 31% of the interactions between socio-demographic variables and product attributes are statistically significant, at conventional levels.

Squared distributed with 39 degrees of freedom, is statistically significant at the 1% level.[17] All explanatory variables, except *price* and age, have been introduced in the model using sets of mutually exclusive effects coded variables.[18]

Thus, the final preferred specification of the individual's utility, in each choice situation, is (Tonsor *et al.*, 2009)

$$U_{ij} = \left(\boldsymbol{\beta}_i + \boldsymbol{\gamma}'\mathbf{Z}_i\right)\mathbf{x}_j + \mu_{ij} \tag{6}$$

where the vector $\boldsymbol{\beta}_i = \left[\beta_{i,ht\_A}; \beta_{i,ht\_B}; \beta_{i,fc\_B}; \beta_{i,fc\_C}; \beta_{i,ml}; \beta_{i,pr}\right]$ collects the individual-level values of the coefficients estimated for the $\mathbf{x}_j$ vector of product attributes presented in Table 1; $\boldsymbol{\gamma}'$ is the vector of estimated coefficients for the vector of socio-demographic characteristics (age (continuous), the relevant effects coded variables for gender and frequency of milk consumption) of the individuals $\mathbf{Z}_i$.[19]

Model estimates (means and spread coefficients) appear in Table 4. Focusing on the β coefficients, it is interesting to note that the attributes *price* and (reduced) *mycotoxins level* are the sole to be statistically significant, at the 1% level, in their ability to explain the mean probability of purchasing a bottle of milk. Moreover, the coefficient for the *price* attribute records the largest estimated beta, suggesting that consumers are very sensitive to changes in the price of a bottle of milk. Furthermore, because this variable has been included in the model as minus the price levels in the choice experiment, it appears that a decline in *price* is associated with an increased probability of purchasing. Consumers are more likely to purchase a litre of fresh pasteurised milk compared to an UHT one, on average and *ceteris paribus*, while the coefficient for HQ milk is not statistically significant. Somewhat surprisingly, respondents seem to dislike skimmed, compared to whole, milk, on average and *ceteris paribus*. This may be due to consumers' unfamiliarity with the product which is also fairly difficult to find on display at the preferred point of sale. All the included attributes contribute to explain the strong heterogeneity, among respondents and around the mean levels of probability, as reflected in all the estimated spread coefficients (i.e., standard deviations (σ_β) or scale parameters) being statistically significant at the 1% level.

Overall, the model performs quite well given the McFadden Pseudo R^2, a measure of goodness-of-fit in discrete choice models, reaches 0.665 such that the χ^2 test for joint model's significance (with 50 degrees of freedom) strongly rejects the null that the estimated model does not explain respondents' choices.

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[17] This testing procedure is in line with the one carried out in Greene *et al.* (2006:88).

[18] Effects coding, contrary to dummy coding, allows to distinguish the effects that the base level of an attribute (i.e., the level associated with the excluded dummy variable in case of dummy coding) and the overall or *grand mean* have on the level of recorded utility (Hensher *et al.*, 2005; Tonsor, 2011; Wolf *et al.*, 2011). For the choice of the base levels employed in effects coding the attributes and demographic variables please refer to the Notes to Table 1 and Table 3, respectively.

[19] A referee of this journal pointed out the value of allowing for "… sources of observations-specific influence on the variance of the unobserved effects in the choice models …" (Greene *et al.*, 2006:89). While we agree this could be a valuable exercise to gain further insights into individual behaviour in choice models, the many challenges introduced by difficult convergence, somewhat limited gains in terms of overall model's explanatory power (adjusted pseudo R^2), sign changes and extreme values of the calculated WTPs (Greene *et al.*, 2006) suggested we leave this more demanding analysis for a future research effort.

Table 4. Estimated parameters for product attributes for the RPL model.

Parameter¥	Estimate
β_{ht_A}	1.6648** (0.7483)
β_{ht_B}	-0.1802 (0.5566)
β_{fc_B}	0.4620 (0.6448)
β_{fc_C}	-2.0705** (0.8302)
β_{ml}	1.2548*** (0.3455)
β_{pr}	7.9813*** (2.2621)
σ_{ht_A}	1.1320*** (0.2437)
σ_{ht_B}	2.1672*** (0.1948)
σ_{fc_B}	0.9917*** (0.2185)
σ_{fc_C}	2.1002*** (0.3515)
σ_{ml}	1.7388*** (0.1504)
σ_{pr}†	7.9813*** (2.2621)
Diagnostics	
Log likelihood	-2576.6639
Model joint significance ~ $\chi^2(50)$	10253.4888***
McFadden Pseudo R^2	0.6655
N° points in the Halton sequence	1000
LR test for demographic variables ~ $\chi^2(39)$	76.3854***

Source: own elaboration using NLOGIT 5.0.
Note: ***, significant at the 1% level, **, significant at the 5% level, *, significant at the 10% level; estimated standard errors in parentheses; ¥, please refer to Table 1 for the acronyms representing the attributes and employed to identify the estimated parameters; †, because the price random parameter is assumed to be distributed according to a triangular distribution, this standard deviation coefficient is, in fact, a scale parameter. Demographic variables employed to estimate the model: gender, age (continuous), frequency in consuming milk; all the (set of) demographic variables included in estimation determined a significant LR test for individual (joint) significance against the attribute only model.

6. Discussion

The focus of the paper is on the evaluation of consumers' attitude towards mycotoxins' risk; to this extent the WTP, that is the price premium that consumers are willing to pay to obtain a product with a reduced mycotoxins' risk, has been computed. Because of

the existence of preference heterogeneity and the $T = 3$ repeated choices made by respondents, we can compute a WTP for each of the individuals in the sample according to (5) and then average it out across the sample and socio-demographic groups.

The sample average WTP for lower risk of contamination is 0.44 €/l, which corresponds to a premium of 28.8% on the average milk price employed in the experiment (1.53 €/l). This premium is almost six times the (weighted average) one Wang *et al.* (2008) estimate, for a HACCP certified milk sold in China, using a CV method and more than 50% higher than the premium Wolf *et al.* (2011) calculate for a gallon of US carrying a food safety claim (+18.5%).[20] Moreover, it is larger than the (average) 23% premium Ennekin (2004) quantifies, employing a conditional logit model, for the quality and safety improvements of a brand of liver sausages in Germany. The present findings are in line with the premium Wolf *et al.* (2011) determine, relying on a SCE and RPL model, for a half a gallon of US milk endowed with a generic enhanced food safety attribute. Concerning the evaluation of food safety due to the implementation of GAPs/GMPs, our evidence supports the existence of a price premium which is around three times the one Aizaki and Sato (2007) attribute to citizens of Sendai for purchasing tomatoes produced in Kumamoto following the same practices.

In Table 5, the average WTP for socio-demographic groups are reported. Trying to summarise the results, we focus on those representing larger deviations with respect to the sample average. It is interesting to note that, contrary to their statistically significant contribution in explaining consumer choices through a RPL, gender and frequency of milk consumption do not give rise to group-average WTPs which are markedly different from the estimated sample average.

On the contrary, respondents in the 45-54 and 65 and above age ranges do display average values of the WTP for (reduced) mycotoxins levels different from the overall sample one. Nonetheless, the former group has a higher than sample average WTP (0.52 €/l) while the latter has a lower than sample average one (0.38 €/l). Similarly, segmenting the market according to the employment status of the individuals, consumers who are either looking for their first employment or retired have a (markedly) low WTP (0.28 and 0.36 €/l, respectively) as opposed to students who have the highest WTP for (reduced) mycotoxins levels. Respondents who either have not completed any education or have abandoned school after the completion of the elementary level have the lowest average WTP (0.36 €/l), while consumers who have completed their tertiary education have the highest (0.48 €/l), which is slightly above the sample average WTP. Somewhat similarly, it is found that the respondents reporting the lowest income (and not reporting their income at all) have the lowest average WTP (0.34 €/l), while the two highest income classes are associated with higher than sample average WTPs (0.52 and 0.48 €/l, respectively). Nonetheless, it is interesting to note that the richest respondents do not have the highest WTP. Lastly and quite surprisingly, consumers who purchase milk only once every 15 days do record a WTP for (reduced) mycotoxins levels of 0.52 €/l while those who shop more frequently have a lower – also than sample average – WTP. Finally, the WTP for those who purchase milk only once a week is only 0.38 €/l.

[20] Because some of the relvant literature is in Japanese, we resort to Aizaki (2012) to report that Iwamoto (2004) and Hosono (2003, 2004) unveil a positive WTP for a HACCP compliant litre of milk, with the ones for the latter studies being 6 to 5 times larger than the one for the former.

Table 5. Average WTP for the reduced mycotxins level attribute across groups (€/l).

Characteristics		Characteristics	
Gender		*Education level*	
Female	0.42	None/Elementary	0.36
Male	0.44	Middle	0.40
Age		College	0.42
18 – 24	0.46	Tertiary	0.48
25 – 34	0.42	*Income*	
35 – 44	0.40	Up to 10,000€	0.34
45 – 54	0.52	10,001€ – 20,000€	0.46
55 – 64	0.44	20,001€ – 40,000€	0.44
Older than 65	0.38	40,001€ – 70,000€	0.52
Geographical area		Over 70,001€	0.48
North – West	0.42	I prefer not to disclose	0.34
North – East	0.44	*Number of household residents*	
Centre	0.46	2	0.44
South	0.42	3	0.42
Marital status		4	0.44
Married	0.44	More than 4	0.46
Not married	0.44	*Purchasing frequency*	
Employment status		Once every 15 days	0.52
Home duties	0.40	Once a week	0.38
Looking for new employment	0.48	More than once a week	0.44
Looking for my first employment	0.28	Every day	0.42
Employed	0.46	*Frequency of milk consumption*	
Retired	0.36	Once a month	0.40
Student	0.50	Once every 15 days	0.46
		Once a week	0.44
		More than once a week	0.44
		Every day	0.42

Source: own elaboration.

7. Conclusions

European statistics show that one of the most serious sources of health risks related to food is mycotoxins. In this paper, we have evaluated the Italian consumers' perception of the health risks associated to the presence of high levels of mycotoxins. In particular, we have calculated the WTP for a hypothetical bottle of milk obtained by cows fed with maize certified for being produced employing the GPs that reduce mycotoxin contamination. Therefore, a web-based questionnaire has been distributed to a representative sample of 973 Italian consumers who were required to make hypothetical choices among choice sets composed of three products. Responses have been analysed relying on the panel data version of a RPL model to determine consumer WTP. The results show that Italian consumers are willing to pay a moderate average price premium (29%) for "reduced-mycotoxins" milk and this

premium increases for consumers between 44 and 54 years of age, who are students, have completed tertiary education, are economically well-off and shop fairly infrequently.

Despite the estimated price premium might indeed cover the additional costs of implementing the GAPs and GMPs deemed instrumental to reduce mycotoxins contaminations, it should be acknowledged that its value could represent an overestimate of the health risks due to mycotoxins contamination (Wolf *et al.*, 2011). Because mycotoxins may be an elusive concept to the general public, the description of the health risks provided in the questionnaire might have generated a perceived risk higher than the actual risk. For instance, due to the higher incidence of mycotoxins in warmer and more humid climates and because of the related notifications in foreign countries (i.e., China and the Middle East area), consumers may have attributed some of the concerns related to country-of-origin to the occurrence of a mycotoxin contamination (Tonsor, 2011). Likewise, because consumers may consider GPs a general proxy for safer food, the associated WTP may represent the price premium for the more comprehensive concept of "safer milk".[21]

The analysis shows that the risks from mycrotoxins contamination of food exist and are perceived differently among Italian consumers. On the one hand, the results of this study can demonstrate to policy makers that the adoption of GPs is valued by consumers and may be economically viable even without public subsidies.[22] On the other hand, the food industry can benefit from these findings since they can provide insights into the market opportunities related to the introduction of a "mycotoxin free" product. However, further analyses, extended to other European countries and to different products, are necessary to evaluate differences among EU states and across products categories.

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References

Abbas, H.K., Zablotowicz, R.M. and Locke, M.A. (2004). Spatial variability of *Aspergillus flavus* soil populations under different crops and corn grain colonization and aflatoxins. *Canadian Journal of Botany* 82(12): 1768-1775.

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[21] Indeed, Mørkbak *et al.* (2014) find that in presence of a positive WTP for reduced risk of *Salmonella* in pork meat consumed in Denmark, the actual value depended upon the number and type of risk reduction strategies the meat was produced/treated with.

[22] In fact, the 29% price premium we estimate is markedly larger than the 17% increase in costs borne by Chilean maize farms estimated by Ramirez and Caro (2003), according to Iglesias *et al.* (2006), such that additional and unaccounted for costs may be covered by market returns.

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

Aizaki, H. (2012). Choice Experiment Applications in Food, Agriculture, and Rural Planning Research in Japan. *AGri-Bioscience Monographs* 2(1): 1-46.

Aizaki, H. and Sato, N. (2007). Consumers' valuation of good agricultural practice by using contingent valuation and contingent ranking methods: a case study of Miyagi prefecture, Japan. *Agricultural Information Research* 16(3): 150-157.

Aizaki, H., Sato, K., Kikkawa, T. and Sawada, M. (2004). Effects of attitudes concerning food safety on choice behavior of beef: a choice experiment including social-psychological factors. *Japanese Journal of Farm Management* 42(2): 22-32 (in Japanese).

Alfnes, F. (2004). Stated preferences for imported and hormone-treated beef: application of a mixed logit model. *European Review of Agricultural Economics* 31(1): 19-37.

Alfnes, F., Guttormsen, A.G., Steine, G. and Kolstad, K. (2006). Consumers' willingness to pay for the color of salmon: a choice experiment with real economic incentives. *American Journal of Agricultural Economics* 88(4): 1050-1061.

Battilani, P., Rossi, V., Giorni, P., Pietri, A., Gualla, A., van der Fels-Klerx, H.J., Booij, C. J.H., Moretti, A., Logrieco, A., Miglietta, F., Toscano, P., Miraglia, M., De Santis, B. and Brera, C. (2012). Modelling, predicting and mapping the emergence of aflatoxins in cereals in the EU due to climate change. Scientific report submitted to EFSA, available at http://www.efsa.europa.eu/it/search/doc/223e.pdf.

Brown, J., Cranfield, J.A.L. and Henson, S. (2005). Relating consumer willingness-to-pay for food safety to risk tolerance: An experimental approach. *Canadian Journal of Agricultural* Economics 53(2-3): 249-263.

Burton, M. and Pearse, D. (2002). Consumer attitudes towards genetic modification, functional foods, and microorganisms: A choice modeling experiment for beer. *AgBioForum* 5(2): 51-58.

Burton, M., Rigby, D., Young, T. and James, S. (2001). Consumer attitudes to genetically modified organisms in food in the UK. *European Review of Agricultural Economics* 28(4): 479-498.

Daly, A., Hess, S. and Train, K. (2012). Assuring finite moments for willingness to pay in random coefficient models. *Transportation* 39(1): 19-31.

EFSA (2014). About EFSA, [on line], available at http://www.efsa.europa.eu/en/aboutefsa.htm, last accessed on Thursday, 16 January 2014.

Eeckhout, M., Landschoot, S., Deschuyffeleer, N., De Laethauwer, S. and Haesaert, G. (2013). Guidelines for prevention and control of mould growth and mycotoxin production in cereals. Mimeo.

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.

Eurobarometer (2010). Europeans, Agriculture and the Common Agricultural Policy. Full Report, March.

European Commission (2006). Commission recommendation of 17 August 2006 on the prevention and reduction of *Fusarium* toxins in cereals and cereal products. *Official Journal of the European Union* L234: 35-40.

Galvano, F., Galofaro, V. and Galvano, G. (1996). Occurrence and stability of aflatoxin M1 in milk and milk products: a world wide review. *Journal of Food Protection* 59(10): 1079-1090.

Goldberg, I. and Roosen, J. (2007). Scope insensitivity in health risk reduction studies: A comparison of choice experiments and the contingent valuation method for valuing safer food. *Journal of Risk and Uncertainty* 34(2): 123-144.

Gracia, A., Loureiro, M.L. and Nayga Jr., R.M. (2009). Consumers' valuation of nutritional information: a choice experiment study. *Food Quality and Preference* 20(7): 463-471.

Greene, W.H. (2012). NLOGIT 5 Reference Guide. Econometric Software, Plainview, New York.

Greene, W.H., Hensher, D. and Rose, J. (2005). Using classical simulation-based estimators to estimate individual WTP values. In: Scarpa, R. and Alberini, A. (Eds.). *Applications of simulation methods in environmental and resource economics*, Springer Publisher, Dordrecht, The Netherlands, p. 17-34.

Greene, W.H., Hensher, D. and Rose, J. (2006). Accounting for heterogeneity in the variance of unobserved effects in mixed logit models. *Transportation Research Part B: Methodological* 40(1): 75-92.

Haaijer, R., Kamakura, W. and Wedel, M. (2001). The 'no-choice' alternative in conjoint choice experiments. *International Journal of Market Research* 43(1): 93-106.

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

Hensher, D.A. and Greene, W.H. (2003). The Mixed Logit model: The state of practice. *Transportation* 30(2): 133-176.

Hensher, D.A., Rose, J.M. and Greene, W.H. (2005). Applied Choice Analysis A Primer. Cambridge University Press, New York.

Hosono, H. (2003). Consumer preference for milk attributes: a choice experiment approach with focus on food safety and nutrition. *Journal of Rural Economics* Special issue 2003: 317-319 (in Japanese).

Hosono, H. (2004). Nutritional and safety information and consumers' evaluation of commodity attributes: a choice experiments approach to milk demand. *Journal of Food System Research* 10(3): 34-47 (in Japanese).

Hosono, H. (2005). The effectiveness of labels on choices of milk and milk products – the HACCP certification label as an example. *Long-term Finance (The Finance volumes of Japanese agriculture, forestry, and fishery industries)* 88: 79-92 (in Japanese).

Iglesias, D., Henry, G., Engler, A. and Gutierrez, G. (2006). Policies for QAS implementation in export chains: Mycotoxin management by Mercosur wheat actors. Proceedings from 7th International Conference on Management in AgriFood Chains and Networks. Ede, The Netherlands, June 1-2.

Iwamoto, H. (2004). Consumers' willingness-to-pay for HACCP and eco labeled milk. *Hokkaido Journal of Agricultural Economics* 11(2): 48-60 (in Japanese).

Jaeger, S.R. and Rose, J.M. (2008). Stated choice experimentation, contextual influences and food choice: a case study. *Food Quality and Preference* 19(6): 539-564.

James, S. and Burton, M. (2003). Consumer preferences for GM food and other attributes of the food system. *Australian Journal of Agricultural and Resource Economics* 47(4): 501-518.

Khlangwiset, P. and Wu, F. (2010). Costs and efficacy of public health interventions to reduce aflatoxin–induced human disease. *Food Additives and Contaminants: Part A* 27(7): 998-1014.

Kontoleon, A. and Yabe, M. (2003). Assessing the Impacts of Alternative 'Opt-out' Formats in Choice Experiment Studies: Consumer Preferences for Genetically Modified Content and Production Information in Food. *Journal of Agricultural Policy Research* 5: 1-43.

Lancaster, K.J. (1966). A new approach to consumer theory. *The Journal of Political Economy* 74(2): 132-157.

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(4): 496-514.

Lusk J.L., Roosen, J. and Fox, J.A. (2003). Demand for beef from cattle administered growth hormones or fed genetically modified corn: a comparison of consumers in France, Germany, the United Kingdom and the United States. *American Journal of Agricultural Economics* 85(1): 16-29.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In: Zarembka, P. (Ed.). *Frontiers in Econometrics*. New York: Academic Press, p. 105-142.

McFadden, D. and Train, K. (2000). Mixed MNL models of discrete response. *Journal of Applied Econometrics* 15(5): 447-470.

Mørkbak, M.R., Christensen, T. and Gyrd-Hansen, D. (2012). Context dependency and consumer acceptance of risk reducing strategies – A choice experiment study on Salmonella risks in pork. *Food Research International* 45(2): 1149-1157.

Mtimet, N. and Albisu, L.M. (2006). Spanish wine consumer behavior: a choice experiment approach. *Agribusiness* 22(3): 343-362.

Nakamura, T., Maruyama, A. and Yano, Y. (2009). Analysis of consumer's preference for apple juice after trade liberalization in Japan: an approach to choice-based conjoint analysis. *Journal of Rural Problems* 45(1): 52-57 (in Japanese).

Quagrainie, K.K., Unterschultz, J. and Veeman, M. (1998). Effects of product origin and selected demographics on consumer choice of red meats. *Canadian Journal of Agricultural Economics* 46(2): 201-219.

Ramirez, E. and Caro, J.C. (2003). Estudio de Caracterización en el Sistema Agroalimentario: Lecciones de Experiencia y Efectos Sobre Competitividad. Documento de Informe final, RIMISP, Chile.

RASFF (2012). RASFF The Rapid Alert System for Food and Feed 2012 Annual Report, available at http://ec.europa.eu/food/food/rapidalert/docs/rasff_annual_report_2012_en.pdf.

RASFF (2013). Rapid Alert System for Food and Feed (RASFF) – Introduction, [on line], available at http://ec.europa.eu/food/food/rapidalert/index_en.htm, last accessed on Thursday, 16 January 2014.

Rigby, D. and Burton, M. (2005). Preference heterogeneity and GM food in the UK. *European Review of Agricultural Economics* 32(2): 269-288.

Rose, J.M., Bliemer, M.C.J., Hensher, D.A. and Collins, A.T. (2008). Designing efficient stated choice experiments in the presence of reference alternatives. *Transportation Research Part B* 42(4): 395-406.

Scarpa, R. and Alberini, A. (Eds.) (2005). Applications of simulation methods in environmental and resource economics. Springer Publisher, Dordrecht, The Netherlands.

Scarpa, R., Thiene, M. and Train, K. (2008). Utility in WTP space: a tool to address confounding random scale effects in destination choice to the Alps. *American Journal of Agricultural Economics* 90(4): 994-1010.

Sonnier, G., Ainslie, A. and Otter, T. (2007). Heterogeneity distributions of willingness-to-pay in choice models. *Quantitative Marketing Economics* 5(3): 313-331.

Speijers, G., Alink, G., de Saeger, S., Hardy, A., Magan, N., Pilegaard, K., Battilani, P. and Riemens, M. (2010). Evaluation of Agronomic Practices for Mitigation of Natural Toxins. Report Commissioned by the ILSI Europe Process-Related Compounds and Natural Toxins Task Force, International Life Sciences Institute, available at http://www.ilsi.org/Europe/Publications/Evaluation%20of%20Agronomic%20Practices.pdf.

Tonsor, G.T. (2011). Consumer inferences of food safety and quality. *European Review of Agricultural Economics* 38(2): 213-235.

Tonsor, G.T., Schroeder, T.C., Pennings, J.M.E. and Mintert, J. (2009). Consumer Valuation of Beef Steak Food Safety Enhancement in Canada, Japan, Mexico, and the United States. *Canadian Journal of Agricultural Economics* 57(3): 395-416.

Train, K.E. (2003). Discrete choice methods with simulation. Cambridge: Cambridge University Press.

Train, K. and Sonnier, G. (2005). Mixed Logit with Bounded Distributions of Correlated Partworths. In: Scarpa, R. and Alberini, A. (Eds). *Applications of simulation methods in environmental and resource economics*. Springer Publisher, Dordrecht, The Netherlands, p. 117-134.

Train, K. and Weeks, M. (2005). Discrete choice models in preference space and willing-to-pay space. In: Scarpa, R. and Alberini, A. (Eds). *Applications of simulation methods in environmental and resource economics*. Springer Publisher, Dordrecht, The Netherlands, p. 1-16.

Wang, Z., Mao, Y. and Gale, F. (2008). Chinese consumer demand for food safety attributes in milk products. *Food Policy* 33(1): 27-36.

West, G.E., Gendron, C., Larue, B. and Lambert, R. (2002). Consumers' valuation of functional properties of foods: results from a Canada-wide survey. *Canadian Journal of Agricultural Economics* 50(4): 541-558.

Williams, J.H., Phillips, T.D., Jolly, P.E., Stiles, J.K., Jolly, C.M. and Aggarwal, D. (2004). Human aflatoxicosis in developing counties: a review of toxicology, exposure, potential health consequences, and interventions. *American Journal of Clinical Nutrition* 80(5): 1106-1122.

Wolf, C.A., Tonsor, G.T. and Olynk, N.J. (2011). Understanding U.S. Consumer Demand for Milk Production Attributes. *Journal of Agricultural and Resource Economics* 36(2): 326-342.

Zarembka, P. (Ed.) (1974). Frontiers in Econometrics. New York: Academic Press.