Risk perceptions, risk attitudes and the formation of consumer acceptance of Genetically Modified (GM) food

Montserrat Costa Font[1], José M. Gil[2]

[1]CREDA-UPC-IRTA, e-mail: montserrat.costa-font@upc.edu. Edifici ESAB,Parc Mediterrani de la Tecnologia, C/ Esteve
Terrades, 8, 08860-Castelldefels (Barcelona), Tfn: +34-935521213.
[2]CREDA-UPC-IRTA, e-mail: chema.gil@upc.edu. Edifici ESAB,Parc Mediterrani de la Tecnologia, C/ Esteve Terrades, 8,
08860-Castelldefels (Barcelona), Tfn: +34-935521210.

Paper prepared for presentation at the 113th EAAE Seminar "A resilient European food industry and food chain in a challenging world", Chania, Crete, Greece, date as in: September 3 - 6, 2009

Risk perceptions, risk attitudes and the formation of consumer acceptance of Genetically Modified (GM) food.

Montserrat Costa Font[1], José M. Gil [2]

1 CREDA-UPC-IRTA, e-mail: montserrat.costa-font@upc.edu. Edifici ESAB,Parc Mediterrani de la Tecnologia, C/ Esteve Terrades, 8, 08860-Castelldefels (Barcelona), Tfn: +34-935521213.

2 CREDA-UPC-IRTA, e-mail: chema.gil@upc.edu. Edifici ESAB,Parc Mediterrani de la Tecnologia, C/ Esteve Terrades, 8, 08860-Castelldefels (Barcelona), Tfn: +34-935521210.

Abstract. The influence of risk perception and risk attitudes in the process of accepting genetically modified (GM) food is often ignored, and particularly whether both constructs (latent variables) have a combined effect in explaining consumer acceptance. Similarly, the inclusion of organic product standards juxtaposed to GM food is unknown. This paper attempts to shed some light on this question by examining the decision making process through the use of structural equation modeling (SEM). We use survey data from Spain and a set of theoretical constructs that allow us to identify independent mechanisms underlying individuals' risk decision making. Our results suggest that the conceptualized model captures the decision making process, and that both perceptions and attitudes toward risk have independent effects on consumer acceptance. However, the effect from risk perception is larger in intensity. Finally, attitudes towards organic production emerge as an informative determinant of attitudes towards GM food.

Keywords: Keywords: risk perceptions, consumer acceptance, risk attitudes, and GM food.

1. Introduction

Consumer behaviour regarding food has been widely analysed over time. However technology changes bring new behavioural dimensions that shift decision making processes. Few theories have been proposed to unveil the formation process of behaviour. Among the most cited work stands the "Theory of Reasoned Action" (TRA) (Fishbein and Ajzen, 1975). The TRA focuses on the determinants of behavioural intentions to objects of choice where individuals have sufficient control over their decisions when they have perfect information. This is not the case with newly commercialised products made from the use of new technologies. Therefore, it seems natural to expand the TRA to technology decision making concerning the choice scenarios where information is far from perfect, which has been developed through the "Theory of Planned Behaviour" (TPB) (Ajzen, 1991). Indeed, the latter implies the introduction of an "incomplete volitional control" parameter as a determinant for consumers' behaviour. Hence, individuals decide their actions with regard to future consequences, conditioned upon available information. Moreover, it states that either intentions or behaviour are a function of personal attitudes towards the behaviour; personal perception of social pressure; and individually perceived behavioural control of the corresponding intention (Ajzen, 2005).

Risk perception is qualified as an important construct to understanding decision making when individuals lack full information (Fischhoff et al., 1993). This last element of control, which very much depends on the available information that people receive, is hypothesised to be a central element for GM food consumer intentions as well as for other consumer food choices. "Perceived behavioural control" is defined by Ajzen (2005), as a function of beliefs concerning the presence or absence of factors that help or obstruct the execution of behaviour. Interestingly, perceived potential hazards related to behaviour, namely risk perceptions, have been shown to be important determinants of this control issue. Fischoff et al. (1993) argue that individuals need to not only understand the costs and benefits of behavioural choices but also the limits to their knowledge and that of experts.

The way in which the mind interprets intuitive feelings varies depending on the type and availability of information about the risk at the time of decision-making (Slovic et al., 2004). A wide range of literature has concluded that people overestimate low risks and underestimate high probability risks (Kahneman and Tversky, 1979; Viscusi, 1992; and Hurley and Shogren, 2005). The risks of GM food are of particular importance due to its technical nature that determine a set of behavioural processes that need to be disentangled and better understood. Hence the association between risk consumer perceptions regarding GM food consumption is of particular importance, especially when intermediate risk attitudes influence the decision making process.

The adequacy of conventional risk models, which assume full knowledge of outcomes and probabilities, has been questioned by studies, including Yeung and Morris (2006), in the context of consumer behaviour when potential hazards that threaten food safety. This is because consumers are subject to high levels of "uncertainty" regarding the consequences of their behaviour. In that case, neither identities nor relative probabilities of possible consequences are known by consumers and consequently an ambiguity situation exists. Ambiguity has been defined by Frisch and Baron (1988) as "the subjective experience of missing information relevant to a prediction". When this ambiguity situation exists, consumers do not perceive control over the situation and therefore perceptions of risk increase due to the existence of ambiguity aversion described in several studies (see Slovic and Tversky, 1974; Saring and Weber, 1993; and Costa-Font and Mossialos, 2007). This explains the need for new models to analyze factors affecting potential food risk perception and its relation with consumer intentions from a more psychological standpoint.

The subjective dimensions affecting the intensity of risks perceptions in the case of GM food include the involuntariness of some aspects of risk-taking behaviour, the lack of knowledge about a certain risks and particularly the existence of dread associated with the risk, the immediacy, irreversibility and intensity of impacts, the possibilities to control or reduce the risk, and others (Kasperson et al., 1988). There is also evidence of gender-specific effects on risk perceptions (Hurley and Shogren, 2005). Another important bias affecting the way people perceive risks of GM food is referred to as availability bias, which acts as a heuristic in the risk assessment process when individuals judge the likelihood of an event taking place based upon the mind's ability to recall previous occurrences of the same event (Tversky and Kahneman, 1973; Slovic et al., 1981).

In addition to how people perceive risks of GM food, another important dimension to evaluate includes risks attitudes – in the form of risk aversion, proxied by insurance behaviour- in influencing consumer acceptance. Yet, the net effects of risk attitudes, once risks perceptions are controlled for, are still a matter of academic scrutiny. Weber and Hsee (1998) argue that culture might significantly affect risk perceptions situational determinants, which might also impact risks aversion. As a result, the final amount risk individuals take on, results from the combination of both risks attitudes and perceptions. Though, it is important to separate individual preferences and certain technologies, it is also important to separate the specific influence of risk perception from the influence of risk attitudes. Measurement is another issue concerning risks and attitudes. Risk attitudes are measured through different theoretical approaches (Hartog et al., 2002) or indirectly via survey data (Barsky et al., 1997). However, a straightforward way to identify risks attitudes is by assuming revealed preferences so that those who are risk averse would tend to purchase different forms of insurance. The latter is the approach followed in this study by disentangling the individual's effects of risk attitudes and perceptions in determining acceptance of GM food.

This paper attempts to shed some light on this question by examining the decision making process drawing form structural equation modelling. We use survey data from Spain and a set of constructs that allow us to identify independent mechanisms underling individuals' decision making. Our results suggest that the conceptualised model captures the decision making process, and that both risk perceptions and risk attitudes have independent effects on consumer acceptance. However, the effect of risk perception is larger in intensity. A further step in this study will be to examine the other two elements of the TPB: namely that wider attitudes towards a specific behaviour and the perception of social pressure (of "perceived social norms") offer a more complete picture of individuals' behavioural process towards GM food, alongside its environmental influences.

The paper is structured as follows: section two present a theoretical framework and the hypothesis of analysis. Next, section three exposes the methodology of analysis as well as the sample description, followed by section four that provides the results of the study. Finally, section five contains conclusions and discussion.

2. Background

2.1. The formation of risks perception, attitudes and consumer acceptance

One of the main theories regarding the formation of consumer attitudes towards a product is the Fishbein Multi-attribute Model (Fishbein, 1963), which implies that an attitude towards any product is based on knowledge about the product itself and its attributes. In fact, many studies, by means of choice experiments or experimental beats among other methods, attempt to analyse the most important attributes that consumers take into account when purchasing food products. Indeed, there is a broad variety of attributes such as price, ingredients, brand, origin, appearance, freshness and so forth. Moreover, the importance of each attribute depends on the type of food under selection. Consumers generally take into consideration the price as a basic criterion when undertaking purchasing decisions. However, in food related decisions, other elements such as external appearance are considered as quality indicators for which consumers are willing to pay a premium (Alfnes et al., 2006). Contrary, Gianni et al. (2002) found that visual appearance is not significant when defining consumers' preferences for organic food. Similarly, food expectations of taste or flavour have been found to be important predictors of general food consumption behaviour by Shepherd and Raats (1996). Taste or sensory appeals are also frequently mentioned as criteria when food is described either positively or negatively (Steptoe et al., 1995). Finally, price, tenderness or food safety was noticed as significant for US consumers beef selection (Loureiro, 2007). That is, preferences are expected to influence consumption (Olsen, 2003).

However, these preferences towards a product and its attributes - particularly for the case of GM food - are shaped by personal characteristics and individual values (Grunert et al., 2003 and 2004; Bredahl, 2001; and Saher et al., 2006). A relevant theory regarding the role of values on consumer attitude formation is the 'means-end' approach . Grunert et al. (2001), prove this theory with some European consumers that reveal to prefer conventional products to GM products essentially because of the conventional means of production. Conventional products are associated with safety and health, while GM products are associated with uncertainty and poor health. A handful of studies have evaluated the influence of affective and moral considerations on product perceptions and purchase decisions. Arvola et al. (2008) stated that Organic Food (OF) purchases are motivated by expected positive consequences for the self and for others, based on moral considerations. That is "measure reflecting positive, self-rewarding feeling of 'doing the right thing', seems to be useful especially in understanding, but in some cases also in predicting intentions to buy organic foods" (Arvola et al., 2008). This building perception approach explains the fact, revealed by Saher et al., (2006), that even with little scientific support, OF is strongly considered by consumers to be healthier and more nutritious than regular food.

Following Chen and Li (2007) it should come as no surprising that people resort to their more general attitudes for evaluating new and unfamiliar GM foods. As Brendahl (2001) concluded, attitudes towards food are related to several antecedent factors: attitude toward technology, attitude towards nature, food neophobia, among others. Therefore, it is important to understand consumers' general attitudes regarding science, technology, and technological progress, in order to be aware of their associated risk perception (Bredahl, 2001 and Sparks et al., 1994). The same can be applied to food technology and GM food technology. Consumers with high levels of food neophobia are less likely to try "unfamiliar" foods, such as GM food (Chen and Li, 2007). Moreover, Krishna and Qaim (2008), by means of a contingent valuation approach, observed that consumers who do not pay a lot of attention to the risk of pesticide residues are also not significantly concerned with potential GM food risks. This is contrary to risk-averse consumers concerned about both types of risk who directly prefer organically produced vegetables for which the reduction in pesticides residues would not be associated with a new type of risk. A similar conclusion was made by Roe and Teisl (2004) for U.S. respondents. They showed that US consumers were more favourably disposed to purchasing novel products made entirely of GE ingredients if they believed that conventional products in the market place also contained high levels of GE content. Moreover, consumers with lower levels of concern do not display an externality unless exposed to a label highlighting that he long term consequences of GE ingredients are unknown (full information). Certainly, consumers appear to be cautious about accepting novel technologies applied to food because of perceived risks and lack of benefits, or to avoid unknown risk than to get an additional benefit (Christoph et al., 2006). In fact, Cox et al. (2007) observed that people favoured regular prawns to those treated with novel technologies such as irradiation, triploid and electron beam. Moreover, they also observed that addressing an "information deficit" does not overcome aversion to novel technologies applied to food concepts

A negative relationship has been observed when valuing GM and organic food. Dreezens et al. (2005) observed that consumers relate GM to power and universalism values contrary to OF. This was also demonstrated by Saher et al. (2006) and Burton et al. (2001). Their results from a choice experiment indicate that attitudes towards organic food may be taken as a useful indicator of attitudes towards GM technology. In addition, Saher et al. (2006) explained this negative relation by means of the so-called behavioural inhibition responses to novel and negative situations. He stated that since GM is associated with risk and OF with avoidance of it, there must be a negative relation between behavioural inhibition tendencies and GM attitudes and a positive relation for OF attitudes. This inhibition was also asserted by Lind et al. (2005), who relate subjective food hypersensitivity with concern to food additives and GM food. Finally, Devcich et al. (2007) found that people with high "modern health worries " were more likely to choose functional foods with disease-preventing properties than either risk-reducing or appearance-enhancing properties. Moreover, they also found that modern health worries were significantly associated with a higher use of organic foods.

In the case of GM food risks or other food related risks, such as pesticide risk, existing information does not allow individuals to form objective risks estimates. Therefore risk perceptions are the result of perceptions of uncertain damage (Costa-Font and Mossialos, 2007). Indeed, ambiguity might lead individuals to develop the perception that technology is not under their control thus leading to a social amplification of risk (ambiguity-adverse) (Costa-Font and Mossialos, 2007), and therefore, are adopted as a potential risk to be avoided (Chen and Li, 2007). Furthermore, Eom (1994) compared the effects of risk information across models and observed that technical risk information does not significantly affect purchase intentions for safer produce until we explicitly introduce subjective beliefs about risk and demographic characteristics in risk perceptions. This study also concludes that consumers were willing to pay substantially higher price premiums for safer produce, in return for only small reductions in risk. Moreover, the price premium was insensitive to the amounts of risk reduction evaluated. Indeed, Baker and Burnham (2001) found the level of risk aversion to be a significant factor in determining which consumers were accepting or disapproving genetic engineering technology. Finally, a direct relation between perceived risks and consumer attitude or purchase intentions towards GM food and GM-free food has been confirmed by many studies such as Siegrist (1999 and 2000); Tanaka (2004); Yeung and Morris (2006); Loureiro and Bugbee (2005); and Bukenya and Wright (2007) among others. Moreover two characteristics of risk were also shown to have direct influence on purchase likelihood. "Perceived knowledge" and "own control" which has a positive relationship with purchase likelihood. (Yeung and Morris, 2006).

Base on the previous findings discussed above, the main factors affecting potential food risk perception and its relation with consumer purchasing intentions were presented in Figure 1 and summarized in the following hypothesis of analysis:

H1: Consumers that reveal a positive attitude towards sensory considerations associated to naturalness and safe food - flavour, freshness and appearance- are expected to reveal a positive attitude towards organic food production standards.

H2: Consumers that perceive more risks associated with general food production technologies are expected to reveal a positive attitude towards organic production standards.

H3: Consumers that perceive more risks associated with general food production technologies are expected to perceived more risk of GMF.

H4: Consumers that reveal a positive attitude towards organic production standards are expected to perceive more risks associated with GMF.

H5: A perceived risk of GMF is expected to negatively influence consumer purchase intentions towards GM food.

H6: Consumer risk- aversion is expected to negatively influence consumer purchase intentions towards GM food.

-Insert Figure 1 about here-

3. Data and Methods

3.1. The sample

The data used in this study is a separate part of the survey described in chapter 3. It was administered, during spring 2007 by a face to face questionnaire. A total of 314 final questionnaires were used and distributed among 6 regions in almost equal percentages –Galicia, Murcia, Andalusia, Madrid, Extremadura and Catalonia. The sample age distribution was almost equal among predefined age groups starting at 18 years old and up to +65. Moreover, 80% of respondents are located in the medium income level and 15% of the sample are in the high household income, while the remaining 5% is allocated into the lowest income category. There is a clear majority of females among Spanish respondents (about 80%). More than 60% of Spanish respondents continue educational studies after 16 years old. However, only about 25% of respondents attended higher education. About 5% do not respond to this question. Finally, around 60% of the respondents do not have children in school or at pre-school age. Moreover, 18% have only one child, from where 36% are pre-school age and 44% in school age. The remaining 10% have two or more children, while 18% of them are pre-school age.

3.2. Measurement

We have considered, as the literature points out, that responses range from agree to disagree going through some uncertainty threshold (Gaskell et al., 2004; Gaskell et al., 2006; and O'Connor et al., 2006). Therefore, "don't know" answers are classified as "undecided or indifference" which are accordingly placed somewhere between acceptance and rejection (Costa-Font and Mossialos, 2007).

All attitudinal questions and food technology risk perceptions were measured on a 5-level Likert scale, where "totally disagree" or "not at all important" responses are codified by an ordinal value of 1, "tend to disagree" or "not very important" by 2, "undecided or indifference" by 3, "tend to agree" or "important" by ordinal value 4 and finally, "totally agree" or "very important" by value 5. Questions regarding purchase intentions were measured in a 3-level Likert scale: "not willing to pay" (1), "willing to pay les than for conventional products" (2) and finally "willing to pay more than for conventional products" (3). Finally, in order to value risk aversion respondents were asked about their contracted insurances. A dichotomous variable was constructed to differentiate between those having contracted a compulsory insurance and those who did not. The list of indicators for each construct is shown in Table 1.

[Insert Table 1 about here]

3.3. Analytical procedures

Structural equation modelling has been used in this study in order to arrange the decision making process. Indeed, the structural regression (SR) model has been tested following a two-step modelling approach (Anderson and Gerbing, 1988), where we first define an acceptable confirmatory factor analysis (CFA) and next an adequate SR model.

Following Jöreskog and Sörbom (1996), we have specified a Structural Equation Model which consists of three main types of relationships. First, a measurement model is identified after performing confirmatory factor analysis. The outcome relates, on one hand, observed indicators with the exogenous latent variables;

$$x = \Lambda_x \ \xi + \delta \qquad (1)$$

where x, is a $q \times 1$ vector of observed exogenous or independent variables, Λ_x is a $q \times n$ matrix of coefficients of the regression of x on ξ, ξ is an $n \times 1$ random vector of latent independent variables and δ is a $q \times 1$ vector of error terms in x.

On the other hand, observed indicators are related with the endogenous constructs;

$$y = \Lambda_y \eta + \varepsilon \qquad (2)$$

where y, is a $p \times 1$ vector of observed endogenous or dependent variables, Λ_y is a $p \times m$ matrix of coefficients of the regression of y on η, η is an $m \times 1$ random vector of latent dependent variables and ε is a $p \times 1$ vector of measurement errors in y.

A third equation defines the structural model, which specifies the causal relations that exist among the latent variables, while describing its causal effects and assigns the explained and unexplained variances (Jöreskog and Sörbom, 1996).

$$\eta = B\eta + \Gamma\xi + \zeta \qquad (3)$$

where B is a $m \times m$ matrix of coefficients of the η variables in the structural relationship, Γ is a $m \times n$ matrix of coefficients of the ξ - variables in the structural relationship, and ζ is a vector of errors.

This study uses ordinal data, arguably a rudimentary measurement of continuous variables, where the scale is considered as thresholds of the continuous variables (Jöreskog, and Sörbom, 1996). Correlations among ordinal variables are called polychoric correlations, which are theoretical correlations of the continuous version (Jöreskog, and Sörbom, 1996). In order to perform the analysis we use the Generalized Weighted Least-Squares (WLS) method instead of Maximum likelihood (ML) since both the data present a nonnormal distribution and because ML does not allow us to employ the weighting matrix required for the analysis, which is the inverse of the estimated asymptotic covariance matrix, W, of the polychoric correlations (Kline, 2005).

$$F(\theta) = (s - \sigma)' \, W \, (s - \sigma) \qquad (4)$$

where s' is a vector of the elements in the lower half of the covariance matrix S of order $k \times k$, σ' is the vector of corresponding elements of Σ (θ), W^{-1} is the positive definite matrix of order $u \times u$ where $u = k(k+1)/2$. The WLS function is the weighted computation of the square residuals (Barrio and Luque, 2000).

Finally, we will assess the goodness-of-fit of the model by analysing factor loadings, which relate each indicator with the constructs. Reliability will be measured by means of composite reliability and Cronbach's α. Moreover, the extracted validity for each construct will be also measured (Hair et al., 1999).

Regarding the structural model, we begin with an assessment of the significance of the estimated parameters in the structural equations (Hair et al., 1999). We proceed with estimating the reliability coefficients of each equation and the associated correlation matrix among constructs examined in our model (Barrio and Luque, 2000). Finally, diagnostic parameters such as Chi square (X^2); Root Mean Square Error of Approximation (RMSE); Goodness of Fit Index (GFI); the Adjusted Goodness of Fit Index (AGFI); the Comparative-Fit-Index (CFI); the Normed-Fit-Index (NFI) and the Non Normed-Fit-Index (NNFI) will be also considered as indicators of the model goodness-of-fit for the CFA and the SR model.

4. Results

4.1. Descriptive Analysis

The survey employed for this analysis asked respondents questions regarding food purchasing behaviour such as: food qualities that can influence food purchasing, awareness of GM issues, information sources about genetic engineering in food production and finally attitudes towards GM technology and organic products/methods. Although not all these questions have been used for the development of the structural equation model, a brief description of its results is reported in this section in order to better understand the general behaviour of participants.

Based on the theoretical framework, this study assumes that when purchasing food people value a diverse range of attributes. In order to develop which are more relevant, this survey presents respondents a list of food attributes that can arguably influence food purchasing and asks them a value based on five Likert scale ranges – from 1 not at all important to 5 very important[1]. Actually, as Figure 2 shows, freshness and flavour are the most important parameters for food purchasing decision. This is the case for almost 70% of respondents. These dimensions are followed by use-by-date and appearance, which are very important for 50-60% of respondents. Moreover, ingredients and price rank high for about 40% of respondents. Finally, brand dimensions and production location are very important for only 12% of respondents.

[Insert Figure 2 about here]

The next behavioural element which has been accounted for in our survey design was people's knowledge about GM food technology. Here it is important to acknowledge the complexity of measuring this issue. Indeed, at least two broad types of knowledge can be defined. First, *objective knowledge* refers to what people know about something based on some type of examination or facts. The latter type is not as easy to disentangle due to difficulties in coming up with unbiased indicators and is ignored in this study. Instead, an index of subjective knowledge –namely, what people suggest to know about some object- was elicited, by means of a direct question: How knowledgeable are you on the issue of genetic engineering in food production? Up to 60% of respondents see themselves as not very well or not at all informed about GM food. In addition, about 15% of respondents consider themselves as quite or well informed. The remaining 25% are not able to value their knowledge degree. This question supports the hypothesis of Spaniards as exhibiting an extremely low level of knowledge regarding GM food, consistent with Martinez et al. (2004); Noomene and Gil (2004); and Vilella-Vila et al. (2005).

Not only was the level of knowledge accounted for but also its trust with information sources. Indeed, if individuals would follow some kind of Bayesian updating, then the sources of information are key. Hence, our survey requested respondents to reveal their information sources of trust about genetic engineering in food production. As Figure 3 shows, Spanish respondents trust more consumer organizations, followed by medical doctors and commercial scientists. Next in the rank comes university scientists and environmental groups, both closely followed by the mass media. The last reliable source of information was producers or retailers (who might be perceived as self interested parties) along with government and EU institutions. These findings are consistent with previous results such as Eurobarometer surveys (Gaskell et al., 2003; 2004; 2006)[2].Finally, it is important to highlight that Spaniards, when compared with other Eueopean respondents are found to reveal significantly lower level of trust with respect to national and European institutions.

[Insert Figure 3 about here]

Public attitudes towards GM and organic foods were measured through five-point Likert scale – from 1 strongly disagree to 5 strongly agree[3]. As Table 2 exhibits, the statement that people agree most refers to the consumers' right to choosing between GM and not GM food. Finally, the survey finds that what respondents tend to agree less regarding the possibility of GM technology developing healthier foods. In addition, it is also important to highlight the high level of "Neither agree nor disagree" and "Don't Know" answers. These answers, commonly come from people with not a clear position regarding GM food, named as "undecided". This is consistent with preceding results about subjective knowledge. Indeed, for the statement regarding environmental effects of GM crops, more than 50% of respondents can be labelled as "undecided". Moreover, the chance to develop healthier food is not clear for almost half of the respondents. Finally, about 40% of respondents do not really know if GM food might harm their environment.

[1] In order to contrast the internal consistency of responses we employed Cronbach's alpha. It is important to note that we attain a coefficient of 0.64, which indicates an acceptable reliability.

[2] Indeed, gasket el al 2006 find that Europeans' most trusted stakeholders are doctors, university scientists and consumer organisations, followed by scientists working in industry, newspapers and magazines, environmental groups, shops, farmers and the EU

[3] We have looked at the reliability of responses using Crombach alpha coefficient, interestingly it is of 0.74, which indicates a very good reliability or internal consistency.

[Insert Table 2 about here]

In relation to organic food (see Table 3) [4], 82% of Spanish respondents are highly worried about the harmful effects of chemical residues in food. In the same fashion, effects of agriculture on the environment are also envisioned as an issue which alarms at least 68% of the Spanish sample. For the other raised statements – if organic production managed to taste better than conventional food – there is a clear propensity to agree with the statement. Nevertheless, many people do not have an opinion. That is, 43% of the sample “neither agree nor disagree” or “Don’t know” (see Table 3).

[Insert Table 3 about here]

In relation to organic food, a declared behavioural question was also included: the food expenditure allocated to organic products. Results indicate, as expected, that Spanish consumers do not spend much money on organic products. More precisely, respondents’ budget allocated for organic consumption is around 10%. Indeed, more than 25% of Spanish respondents reveal no purchase of organic food at all. Moreover, almost 30% do invest from 1 to 10% of their food budged on organic food and only 20% devote more than 10% of their budget to organic consumption.

The last part of the survey analyses questions related to risk perception and attitudes or risk taking. To tackle these issues, two related questions are introduced. On the one hand, respondents were requested to reveal which type of non compulsory insurances they hold (as a proxy to measure risk aversion). The widely held insurances are car and life insurances. Health care insurances are less demanded, possibly due to the relevant public sector role in health care. On the other hand, respondents were requested to rank in a Likert scale from 1 to 5 –1 very high risk and 5 very low risk- the following technologies in terms of risk to human health. Irradiation is perceived as the most risky technologies for around 80% of Spanish respondents, artificial colours, flavours and preservatives follow in the rank.

4.2. Measurement Model or scales validation analysis

As mentioned in Section 3, first a Confirmatory factor analysis for all constructs was performed, that is: 1) Sensory considerations for food purchasing; 2) attitude towards organic production standards; 3) perceived risks of food production technologies; 4) perceived risks of GM food; 5) risk aversion; and 6) consumer intentions towards GM food, assuming all errors to be uncorrelated. The confirmatory factor analysis with all indicators resulted suitable and the correlation matrix among all variables is presented in Table 4. In addition, all constructs but one was measured by three indicators as proposed by Kline (2005) among others.

[Insert Table 4 about here]

The main parameters to test for the robustness of the constructs, following Hair et al. (1999); and Kline (2005) appear to show acceptable results as shown in Tables 5. Analysis of test statistics showed that constructs exhibited good reliability of estimation. In fact, reliability of factor loadings are high for all constructs (above 0.5) and t-values associated with the loadings are all significant ($P<0.001$), implying a satisfactory convergent validity (Olsen, 2003; and Bagozzi et al. 2001). Regarding internal consistency of the model, we can state that is robust, including composite reliability (which must be > 0.7), internal consistency reliability, measured by Cronbach’s α, (which must be about 0.7), extracted validity (which must be >0.5) and discriminant validity (correlations among constructs < 0.85) (Hair et al.1999; and Bagozzi and Yi, 1988). Moreover, for every construct, all composite reliabilities are greater than 0.7 and all Cronbach’s α are over 0.7 but for construct C3 (perceived risk of GM food) which is 0.5, thus we can say that reliability is acceptable. Regarding the variance extracted, it is 0.50 or higher for all cases (Table

[4] The reliability of responses using Crombach alpha coefficient is of 0.63, which indicates an acceptable reliability level.

5). Finally, since the correlations among latent factors do not exceed 0.85, in any case, it can be stated that discriminant validity has been accomplished too.

[Insert Table 5 about here]

The model meets the widely accepted goodness of fit standards indicating that the conceptual model satisfactory fits the data (see Table 5). However, it must be pointed out that the chi-square statistic was significant and the Normed chi-square (NC) NC = $\chi^2 / df = 3.4$ is about 3, demonstrating a good model fit (Carmines and McIver, 1981; and Bollen, 1989). The Root Mean Square Error of Approximation (REMSEA) is 0.08, which is well inside the 0.05-0.08 limit interval offered by Hair et al. (1999) and Kline (2005). The goodness-of-fit index (GFI) was 0.98, the Comparative-Fit Index (CFI) 0.98, the Normed-Fit Index (NFI) 0.97 and the Non-Normed Index (NNI) 0.97, all were greater than 0.90 as offered by Marcoulides and Schumacker (1996); and Chen and Li (2007).

4.3 Structural Model

Following the results of the measurement model, the proposed theoretical causal relationships have been analysed using Lisrel 8.51 statistical program. We find a satisfactory fit for the model as Table 6 shows. Moreover, Figure 4 reveals the paths coefficients obtained for the structural model. It must be highlighted that all causal relations (Hypothesis) were supported with paths significant at $p = 0.001$ level.

First of all, we found that an important negative relationship between "Perceived Risks of GMF" and "Consumer Intentions towards GMF" exists (H5), with a correlation coefficient of almost -0.70. This result is consistent with all previous literature and verifies the importance of negative information on behavioural intentions, as already stated by some studies such as Yeung and Morris (2006) and Rousu et al. (2004) among others. Nevertheless, and as stated in the theoretical framework, the role of "Risk Aversion" has also been shown to be a significant factor in determining if consumers are willing to accept the consumption of GM food (H6). In fact, a negative relationship between "Risk Aversion" and "Consumer Intentions towards GMF" with a path of 0.13, has been obtained from the structural model.

[Insert Table 6 and Figure 4 about here]

Hypotheses 2 and 3 are also supported with relevant correlation coefficients: 0.43 and 0.28. Consequently, we can tentatively conclude that Spanish respondents risk perception towards food technology as general science is very important for the perception of a single food technology application. As stated in section 2, more general attitudes are considered by respondents when evaluating new and unfamiliar GM foods, Chen and Li (2007). That is, perceived risks associated with GM foods rely on the perceived risks associated with general food technology. Indeed, this relating is tested either by a direct causal relation (H3) or by means of an indirect path (H2+H4). This conclusion supports the empirical evidences explained by Krishna and Qaim (2008) and Roe and Teisl (2004) who stated that consumers with low levels of concern for an "uncertain-risk" food technology will present a similar level of concern for other "uncertain-risk" food technologies.

It has been stated that consumers relate OF with healthy food and also that individuals consider OF as a way of avoiding risks related to food technology (Devcich et al., 2007). Our results support these statements since respondents that perceive more risks associated to food production technologies reveals a positive attitude towards organic production standards (H2). Moreover, the negative relation among GMF and organic food perceptions reported by many studies such as Dreezens et al. (2005); Saher et al. (2006); and Burton et al. (2001) is also supported in the case of Spain (H4). That is, a significantly positive relation between attitude towards organic production standards and risk perception associated to GM food has been observed with an associated path of 0.28.

Finally, this study also confirmed the existence of a positive relation between, “natural” factors affecting behaviour (such as flavour freshness or appearance) with a positive attitude towards organic production standards (H1).

5. Discussion

The combined and net effect of risks attitudes and perceptions in determining consumer acceptance of GM food has been the motivation of this paper. We examined these effects by using structural equation modelling to determine the decision making process that leads to consumer acceptance of GM food using survey evidence from a sample of Spanish consumers. In doing so, we propose a model that accounts from a set of constructs that altogether leads to a final acceptance, theoretically underpinning consumer decision making. Our contribution relies on exploring the independent influence of two main variables, the effect of risk attitudes and the effect of risk perceptions at portraying information on other relevant consumption processes

Our results suggest clearly independent effects of both risks attitudes and risks perception in determining consumer acceptance. This result is consistent with some findings from previous studies outside the food sector (Weber and Hsee , 1998). Hence, besides a relatively lower risks aversion level, individuals who reveal acceptance of GM food tend to perceive fewer risks. However, the net effect of risks perceptions is overall higher possibly due to the cumulative influence present when risk attitudes are not controlled for, as well as the other constructs including age, gender and other relevant variable as hypothesised in out structural model. Therefore, aspects that influence risk perceptions might not impact risks attitudes, and instead are affected by more structural personality treats. On the other hand, the fact that risk attitudes are significant indicates that neo-phobic type would tend to include people with higher risk aversion besides perceiving risks where other does not.

In addition, the roles of wide attitudes towards food are important in the formation of consumers' perceptions and attitudes towards GM food have also been empirically tested. That is, we find that as expected, in order to be able to value a particular scientific application, individuals rely on their general attitudes towards an object of study, which suggests that individuals are likely to follow some shortcuts based on values and attitudes in forming their behaviour when they have limited information to come up with solely a reasoned risk benefit decision. This result is very important and consistent with the fact that about 85% of the Spanish sample reveal to have low levels or are not able to value their knowledge about GM food. Finally, food applications associated with opposite values are contrarily valued by consumers. This is the case of GM and organic food production.

Some important caveats of the study should be mentioned. First of all, although the model analyzes a key element of the TPB, the introduction of the variables and attitudes towards the behaviour and subjective norm improve the model. Moreover, the impossibility of achieving a larger sample did not lead us to perform some form of multi-group analysis which might identify heterogeneity regarding age groups, gender or income levels among other variables might still exist. However, this paper shows that the process of decision making regarding new foods produced with genetic modification is the result of complex behavioural mechanisms.

6. Figures

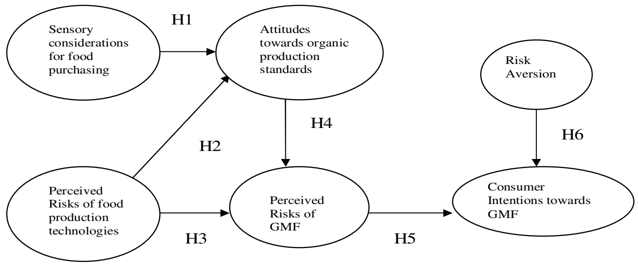

Figure 1. Theoretical process for shaping GM food purchase intentions.

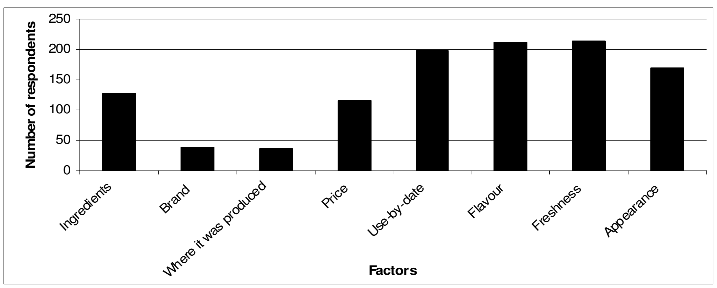

Figure 2. Importance of a range of factors in food purchasing decisions in Spain

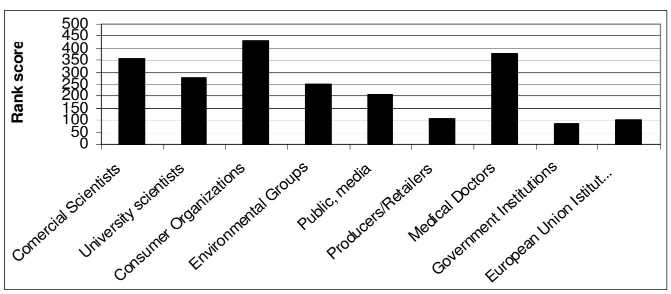

Figure 3. Sources trusted by Spanish consumers to provide reliable information about genetic engineering in food production.

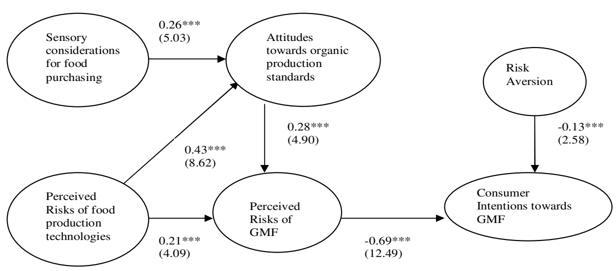

Figure 4. Structural model results.

7. Tables

Table 1. List of indicators used for each construct.

Construct	Indicators
Sensory considerations for food purchasing (***C1***)	***X1:*** Please tell me how important is flavour in your food purchasing decisions? ***X2:*** Please tell me how important is freshness in your food purchasing decisions? ***X3:*** Please tell me how important is appearance in your food purchasing decisions?
Attitude towards organic production standards (***C2***)	***X4***: I am concerned about the harmful effect of chemical residues in food ***X5***: Organic products taste better than conventional ones ***X6:*** I am concerned about the effects of agriculture on the environment
Perceived Risks of GMF (***C3***)	***X7***: Eating genetically modified food might harm my health ***X8:*** Growing genetically modified crops will be harmful to the environment ***X9***: Genetically modified technologies will lead to healthier foods
Risk Aversion (***C4***)	***X10:*** Do you currently have health insurance? ***X11***: Do you currently have live insurance? ***X12:*** Do you currently have not compulsory car insurance?
Perceived Risks of food production technologies (***C5***)	***X13:*** Please rate irradiation of food in terms of risk to human health. ***X14:*** Please rate artificial colours and flavours in terms of risk to human health. ***X15:*** Please rate artificial preservatives in terms of risk to human health.
Consumer Intentions towards GMF (***C6***)	***X16:*** A 500 gram box of conventional cornflakes is on offer at 2€. How much would you be willing to pay for a 500 gram box of genetically modified cornflakes with health benefits? ***X17:*** A kilo (around two pounds) of conventional loose tomatoes is on offer at 2€. How much would you be willing to pay for a kilo (two pounds) of genetically modified loose tomatoes with health benefits?

Table 2. Spanish public attitudes towards GM products (%)

	Strongly disagree or disagree	Neither agree nor disagree	Agree or strongly agree	DK
Eating GM food might harm my health	13	19	49	19
I wish to have the choice whether to eat GM food or not	4	15	70	11
Growing GM crops will be harmful for the environment	11	28	38	23
GM technologies will lead to healthier foods	21	26	32	21

Table 3. Spanish public attitudes towards organic products (%)

	Strongly disagree or disagree	Neither agree nor disagree	Agree or strongly agree	DK
I am concerned about the harmful effect of chemical residues in food	3	11	82	4
Organic products taste better than conventional ones	11	27	46	16
I am concerned about the effects of agriculture on the environment	5	22	68	5

Table 4. Correlation matrix among indicators.

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
X1	1.00																
X2	0.75	1															
X3	0.52	0.63	1														
X4	0.29	0.29	0.33	1													
X5	0.17	0.15	0.10	0.47	1												
X6	0.13	0.15	0.23	0.52	0.40	1											
X7	0.10	0.12	0.15	0.20	0.13	0.24	1										
X8	-0.06	0.01	0.11	0.00	0.13	0.21	0.53	1									
X9	-0.04	0.05	-0.08	0.00	0.12	0.07	-0.08	-0.13	1								
X10	0.03	-0.10	-0.05	-0.03	-0.15	0.06	-0.05	-0.09	0.02	1							
X11	0.04	-0.13	-0.13	0.07	-0.05	0.14	0.02	-0.06	0.04	0.65	1						
X12	0.11	0.17	0.05	0.16	0.08	0.11	0.01	-0.08	0.14	0.46	0.38	1					
X13	0.28	0.32	0.33	0.40	0.30	0.33	0.27	0.08	-0.01	-0.01	-0.11	0.23	1				
X14	0.15	0.23	0.22	0.24	0.21	0.23	0.33	0.20	0.07	-0.03	-0.05	0.13	0.52	1			
X15	0.04	0.14	0.16	0.13	0.16	0.26	0.29	0.17	0.04	0.00	-0.13	0.08	0.43	0.74	1		
X16	0.07	0.19	0.04	0.04	-0.04	0.00	-0.26	-0.18	0.45	-0.03	-0.05	-0.02	-0.01	-0.03	-0.13	1	
X17	0.04	0.15	0.06	0.06	-0.03	-0.03	-0.30	-0.21	0.39	-0.01	-0.04	0.05	0.04	0.01	-0.08	0.94	1

Table 5. Reliability of the standardized Confirmatory Factor Analysis.

Construct	**Indicators**	**Standardized loadings (*t*-Value)**	**Composite reliability (Variance extracted)**	**Goodness of fit parameters**
C1	***Cronbach's α***	0.73	0.92 (0.79)	χ^2 = 358 df = 104 p = 0.00 *RMSEA* = 0.08 *GFI* = 0.98 *AGFI* = 0.97 *CFI* = 0.98 *NNFI* = 0.97 *NFI* = 0.97
	X1	0.91 (28.64)		
	X2	0.96 (38.46)		
	X3	0.79 (25.62)		
C2	***Cronbach's α***	0.65	0.78 (0.55)	
	X4	0.80 (24.11)		
	X5	0.63 (16.30)		
	X6	0.77 (22.29)		
C3	***Cronbach's α***	0.50	0.73 (.50)	
	X7	0.94 (23.70)		
	X8	0.64 (15.30)		
	X9	-0.45 (9.07)		
C4	***Cronbach's α***	0.60	0.85 (0.65)	
	X10	0.82 (16.96)		
	X11	0.69 (15.46)		
	X12	0.90 (16.24)		
C5	***Cronbach's α***	0.75	0.89 (0.72)	
	X13	0.78 (25.01)		
	X14	0.88 (36.45)		
	X15	0.89 (32.92)		
C6	***Cronbach's α***	0.90	0.96 (0.93)	
	X16	1.00 (71.55)		
	X17	0.95 (64.09)		

Note: REMSEA <=.05-0.08 (Browne & Cudeck, 1992; Kline, 2007) GFI; AGFI; CFI; NFI and NNFI >0.90 (Bollen, 1989; Marcoulides & Schumacker, 1996)

Table 6. Goodness-of-fit for the structural regression model

χ^2_{df}	382	
χ^2_{df} / df	3.4	<3-5 (Carmines & McIver, 1981; Bollen, 1989)
RMSEA	0.08	<0.5-0.8 (Browne & Cudeck, 1992; Kline, 207)
GFI	0.98	>0.90 (Bollen, 1989; Marcoulides & Schumacker, 1996)
AGFI	0.97	>0.90 (Bollen, 1989; Marcoulides & Schumacker, 1996)
CFI	0.98	>0.90 (Bollen, 1989; Marcoulides & Schumacker, 1996)
NFI	0.97	>0.90 (Bollen, 1989; Marcoulides & Schumacker, 1996)
NNFI	0.97	>0.90 (Bollen, 1989; Marcoulides & Schumacker, 1996)

Acknowledgment

This study was financially supported by the European Commission thought the Integrated Project "Co-Extra", contract no 007158, under the 6th Framework Programme, priority 5, food quality and safety. This is gratefully acknowledged.

References

Anderson, J.C., and Gerbing, D.W. (1988). Structural equation modelling in practice: a review and recommended two-step approach. *Psicological Bulletin*, 103: 411-423.

Ajzen, I. (1991). The theory of planned behaviour. *Organizational behaviour and human decision process*, 50: 179-211.

Ajzen, I. (2005) *Attitudes, personality and behaviour*. Berkshire, England: Open University press.

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

Arvola, A., Vassallo, M., Deanc, M., Lampila, P., Saba, A., Lähteenmäki, L., and Shepherd, R. (2008). Predicting intentions to purchase organic food: The role of affective and moral attitudes in the Theory of Planned Behaviour. *Appetite*, 50: 443–454.

Bagozzi, P. and Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16 (1): 74-94.

Baker, G.A., and Burnham, T.A. (2001). Consumer response to genetically modified foods: market segment analysis and implications for producers and policy makers. *Journal of agriculture and resource economics*, 26 (2): 387-403.

Barrio, S. and Luque, T. (2000). *Análisis de ecuaciones estructurales*. En: Técnicas de análisis de datos en investigación de mercados. Madrid.: Pirámide.

Barsky, R., Juster, T., Kimbal, M., and Shapiro, M. (1997). Preference Parameters and Behavioural Heterogeneity: An Experimental Approach in the Health and Retirement Study. *Quarterly Journal of Economics*, 112: 537-579.

Bollen, K.A. (1989). *Structural equations with latent variables.* New York: Wiley.

Bredahl, L. (2001). Determinants Of Consumers Attitudes And Purchase Intentions With Regards To Genetically Modified Foods – Results Of A Cross-National Survey. *Journal of Consumer Policy,* 24: 23-61.

Bukenya, J.O., and Wright, N.R. (2007). Determinants of consumer attitudes and purchase intentions with regards to genetically modified tomatoes. *Agribusiness*, 23 (1): 117-130.

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.

Carmines, E., and McIver, J. (1981). Analyzing models with unobserved variables: analysis of covariance structures. In G.W. Bohrnstedt and E.F. Borgatta (Eds.), *Social measurement – current issues.* Beverly Hills: Sage Publications Inc.

Chen M.-F. and Li H.-L. (2007). The consumer's attitude toward genetically modified foods in Taiwan. *Food Quality and Preference*, 18: 662-674.

Costa-Font, J., and Mossialos, E. (2007). Are perceptions of 2risk" and "benefits" of genetically modified food (in) dependent? *Food Quality and Preference*, 18: 173-182.

Cox, D.N., Evans, G., and Lease, H.J. (2007). The influence of information and believes about technology on the acceptance of novel food technologies: A conjoint study of farmed prawn concepts. *Food quality and preference*, 18: 813-823.

Christoph, I.B., Roosen, J., and Bruhn, M. (2006). Willingness to pay for genetically modified food and non-food products. Selected *paper prepared for presentation at the American Agricultural Economics Association Annual Meeting*, Long Beach, California, July 23-26, 2006.

Devcich, D., Pedersen, I., and Petrie, K. (2007). You eat what you are: Modern health worries and the acceptance of natural and synthetic additives in functional foods. *Appetite*, 48: 333–337.

Dreezens E., Martijn, C., Tenbült, P., Kok, G., and de Vries, N.K. (2005). Food and values: an examination of values underlying attitudes towards genetically modified and organic grown food products. *Appetite*, 44: 115-122.

Eom, Y. (1994). Pesticide residue risk and food safety valuation: a random utility approach. *American Journal of agricultural economics,* 76: 760-771.

Fischoff, B., Bostrom, A., and Quadrel, M. (1993). Risk Perception and Communication. *Annual Review of Public Health*, 14: 183-203.

Fishbein, M. (1963). An investigation of the relationships between beliefs about an object and the attitude toward that object. *Human Relations*, 16: 233-240.

Fishbein, M., and Ajzen, I. (1975). *Belief, Attitude, Intention, and Behaviour: An Introduction to theory and research.* Reading, MA: Addison-Wesley.

Folkes, V. (1988). The Availability Heuristic and Perceived Risk. *Journal of Consumer Research*, 15(1): 13-23.

Frisch, D., and Baron, J. (1988). Ambiguity and rationality. *Journal of Behavioral Decision Making*, 1: 149-157.

Gaskell,G., Bauer, M.W., Durant, J., and Allum,N.C. (2003). Worlds apart? The reception of Genetically Modified foods in Europe and the U.S. *Science*, 285: 384–387.

Gaskell, G., Allum, N., Wagner, W., Kronberger, N., Torgersen, H., Hampel, J. and Bardes, J. (2004). GM foods and the misperception of risk perception. *Risk Analysis* 24: 185-194.

Gaskell G., Allansdottir, A., Allum, N., Corchero, C., Fischler, C., Hampel, J., Jackson, J., Kronberger, N., Mejlgaard, N., Revuelta, G., Schreiner, C., Stares, S., Torgersen, H. and Wagner, W. (2006). *Europeans and Biotechnology in 2005: Patterns and Trends*. Eurobarometer 64.3.Centre for the study of Bioscience BBaSB.

Gianni, C., Giudice, T., and Scarpa, R. (2002). Consumers' perception of quality in organic food: A random utility model under preference heterogeneity and choice correlation from rank-orderings. *British Food Journal*, 104 (3/4/5): 200 – 213.

Grunert, K.G., Lähteenmaki, L., Nielsen, N.A., Poulsen, J.B., Ueland, O., and Åström, A. (2001). Consumers perceptions of food products involving genetic modification - results from a qualitative study in four Nordic countries. *Food Quality and Preferences*, 12: 527-542.

Grunert, K.G., Bredahl, L., and Scholderer, J. (2003). Four questions on european consumers' attitudes toward the use of genetic modification in food production. *Innovative Food Science and Emerging Technologies*, 4: 435-445.

Grunert, K., Sondergaard, H., and Scholderer, J. (2004). How can we know what we like when we don't understand it? Consumer attitude formation towards complex technical issues. Crossenz, QLK1-CT-2002-02208

Hair, J., Anderson, E., Tathan, R., and Black, W. (1999). *Análisis Multivariante*. Prentice Hall.

Hartog, J. Ferrer i Carbonell, A., and Jonker, N. (2002). Linking measured risk aversion to individuals characteristics. Kyklos, 55(1): 3-26.

Hurley, T., and Shogren J. (2005). An Experimental Comparison of Induced and Elicited Beliefs. *The Journal of Risk and Uncertainty*, 30(2): 169-188.

Jöreskog, K. and Sörbom, D. (1996) *Lisrel 8: User's Reference Guide*. Scien-tific Software international.

Kahneman, D., and Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 47(2): 263-92.

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., Kasperson, J. X., and Ratick, S (1988). The social amplification of risk: a conceptual framework. *Risk Analysis*, 8: 177–187.

Kline, R. (2005) *Principles and practice of structural equation modelling*. New York: The Guilford press.

Krishna, V.V., and Qaim, M. (2008). Consumer attitudes towards GM food and pesticide residues in India. *Reiew of agricultural economics*, 30 (2): 233-251.

Lind, R., Arslan, G., Eriksen, H. R., Kahrs, G., Haug, T. T., and Florvaag, E., et al. (2005). Subjective health complaints and modern health worries in patients with subjective food hypersensitivity. *Digestive Diseases and Sciences*, 50: 1245–1251.

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 and labelling and traceability. *Food Policy,* 32: 496-514.

Loureiro, M., and Bugbee, M. (2005). Enhanced GM foods: are consumers ready to pay for the potential benefits of biotechnology? *The Journal of Consumer Affairs,* 39: 52-70.

Marcoulides, G.A., and Schumacker, R.E. (1996). *Advanced structural equationmodelling*. Mahnwah, K.J: Erlbaum.

Martinez, A., Mollá-Bauzá, M.B., Martinez, L.M., and del Campo, F.J. (2004). Imagen percibida de los alimentos transgénicos. un estudio exploratorio. Paper at V Congreso de la Asociación Española de Economía Agraria. 15-17 September, Santiago de Compostela.

Noomene, R., and Gil, J.M. (2004). Grado de conocimiento y actitudes de los consumidores españoles hacia los alimentos con organsimos modificados geneticamente. Paper at V Congreso de la Asociación Española de Economía Agraria. 15-17 September, Santiago de Compostela.

O'Connor, E., Cowan, C., Williams, G., O'Connell, J., and Boland, M.P. (2006). Irish consumer acceptance of a hypothetical second-generation GM yogurt product. *Food Quality and Preference*, 17: 400-411.

Olsen, S. (2003). Understanding the relationship between age and seafood consumption: the mediating role of attitude, health involvement and convenience. *Food Quality and Preference,* 14: 199-209.

Roe, B., and Teisl, M.F. (2004). Consumption externalities, information policies, and multiple equilibria: evidence for genetically engineered food markets. *AAE selectedpaper for the AAEA annual meetings.* Denver.

Rousu, M.C., Huffman, W.E, Shogren, J.F., and Tegene, A. (2004). Estimating the public value of conflicting information: the case of genetically modified foods. *Land Economics*, 80: 125-135.

Saher, M., Lindeman, M., and Koivisto, U. (2006). Attitudes towards genetically modified and organic foods. *Appetite*, 46: 324-331.

Sarin, R., and Weber, M. (1993). Risk value models. *European Journal of Operational Research*, 70:135-149.

Shepherd, R., snd Raats, M.M. (1996). Attitude and beliefs in food habits. In H.L. Meiselman, and H.J.H. MacFie (Eds.), *Food choice, acceptance and consumption,* 346-364. London, UK; Blackie Academic & Professional.

Siegrist, M. (1999). A causal model explaining the perception and acceptance of gene technology. *Journal of applied social psychology,* 22: 2093-2106.

Siegrist, M. (2000). The influence of trust and perceptions of risk and benefit on the acceptance of gene technology. *Risk Analysis*, 20: 195-203.

Slovic, P., and Tversky, A. (1974). Who accepts Savage's axiom?. *Behavioral Science*, 19: 368—373.

Slovic, P., Fischhoff, B., Lichtenstein, S., and Roe, F. (1981). Perceived Risk: Psychological Factors and Social Implications [and Discussion]. Proceedings of the Royal Society of London, Series A, Mathematical and Physical Sciences, 376 (1764): 17-34.

Slovic, P., Finucane, M., Peters, E. and MacGregor D.G. (2004). Risk as analysis and risk as feelings: some thoughts about affect, reason, risk and rationality. *Risk Analysis*, 24(2): 311-22.

Sparks, P., Shepherd, R., and Frewer, L. (1994). Gene technology, food production and public opinion: A UK study. *Agriculture and human values,* Winter: 19-28.

Steptoe, A., Pollard, T., and Wardle, J. (1995). Development of a measure of the motives underlying the selection of food: the food choice questionnaire. *Appetite*, 25: 267-284.

Tanaka, Y. (2004). Major psicological factors affecting acceptance of gene-recombination technology. *Risk Analysis*, 24(6): 1575-1583.

Tversky, A., and Kahneman, D. (1973). Availability: a heuristic for judging frequency and probability. *Cognitive Psychology*, 4: 207-32.

Vilella-Vila, M., Costa-Font, J., and Mossialos, E. (2005). Consumers involvement and acceptance of biotechnology in the European Union: a specific focus on Spain and the U.K. *International Journal of Consumer Studies*, 29:18-118.

Viscusi, W.K. (1992). Fatal Tradeoffs: public and private responsibilities for risk, NewYork: Oxford University Press.

Weber, E.U., and Hsee, C. (1988). Cross-cultural differences in risk perceptions but cross-cultural similarities in attitudes toward perceived risks. *Management Science*, 44 (9): 1205-1217.

Yeung, R.M.W. and Morris, J. (2001). Food safety risk. consumer perceptions and purchase behaviour. *British Food Journal*, 103: 170-186.