85th Annual Conference of the Agricultural Economics Society
Warwick University
18 - 20 April 2011

Demand for improved food safety and quality: a cross-regional comparison *

Edel Doherty† and **Danny Campbell**†

†Gibson Institute for Land, Food and Environment, School of Biological Sciences, Queen's University Belfast.

Abstract

This paper explores the demand for improved safety and quality for meat products among consumers in two regions using a discrete choice experiment methodology. The study takes account of preferences from consumers across Great Britain and the Republic of Ireland. The features explored in the choice experiment include food safety, traceability, animal health and welfare, region of origin and price. The results suggest a large difference between willingness to pay and implicit ranking of attributes across regions. Meat products that come from 'Ireland' are most highly demanded among the features for Irish consumers, whereas consumers based in Great Britain value enhanced testing and animal health and welfare standards highest. Furthermore, a high correlation exists, in both regions, between respondents perception of the risk associated with consuming the meat products and the price premium they are willing to pay for the enhanced features.

***Acknowledgements:** This work was supported by funding from the Department for Employment and Learning (Northern Ireland) under the ASsured, SafE and Traceable (ASSET) food research project.

1 Introduction

The European Union (EU) has shown a strong desire to protect and promote production of food and agriculture from European Countries. This reflects a growing awareness among consumers of the health and environmental implications of purchasing food products. The desire to ensure adequate food safety of European food products has led to the implementation of a number of policies/legislation at EU level under the guise of ensuring food integrity from ‘farm to fork’. Despite these safety initiatives, sporadic food safety scares continue to occur within Europe. Recent high profile examples include the dioxin contamination of livestock feed in the Republic of Ireland and microbiological contamination related to E-Coli in Scotland.

In addition, to the obvious health benefits of ensuring safer foods, there are numerous economic benefits that can be achieved. The most obvious is the aversion of economic losses associated with food scares. A further important economic benefit is the value-added benefit to food products that can be achieved by the addition of credence attributes related to improved food safety and quality (Enneking, 2004; Dickinson and Bailey, 2002, 2005).

In this paper, we investigate preferences for a number of features that better improve the safety and quality of food products than currently exists. We present results from two-case studies based on data collected from representative samples of individuals located in the Republic of Ireland (ROI) and Great Britain (GB). These features are associated with scientific improvements to better ensure the integrity and safety of food products and represent safety measures to combat problems associated with food fraud. Indeed, food fraud appears to be a growing concern as a result of the increasing globalisation of food production. The rising issues of food shortage and increasing food prices mean that food fraud could become an increasingly more prevalent problem. Scientific developments may help combat some of the issues though the use of sophisticated scientific procedures to verify the integrity, safety and origins of food.

To explore preferences for different features associated with the safety and quality of food products we employ the choice experiment (CE) methodology. This approach has been commonly used in the literature to decipher preferences for different credence attributes associated with food products (e.g., Rigby and Burton, 2003; Carlsson et al., 2007; Loureiro and Umberger, 2007). According to Ortega et al. (2011) CEs are advantageous because they closely simulate real-world purchasing decisions where a consumer has to select a product from a set of options. Using this methodology, we further explore whether differences emerge between consumers based in ROI and GB in their preferences for produced originate from their own region. To address these questions the study focused on preferences associated with raw chicken breasts which are widely consumed within both ROI and GB.

Results from the study were analysed using a number of discrete choice models which accounted for random taste heterogeneity for the attributes. The results indicate that large differences between the implicit rankings of attributes existed both between respondents based in ROI and GB. For example, respondents based in the ROI were willing to pay a substantial price premium for chicken products that came from Ireland. On the other hand, respondents based in GB had a higher premium for animal health and welfare whereas the region of origin (including British and Irish) was associated with a lower premium compared to Irish respondents. For both case-studies we find evidence of substitutability between the region and some of the food safety attributes, which suggests that the presence of a local regional certificate diminishes the marginal utility associated with some of the enhanced safety attributes. We also find that there is a significant relationship between respondents' perception of risk and the utility they receive from the safety attributes.

2 Background literature

Determining the economic value of features that enhance the quality and safety of food has become a major area of research in agricultural economics. Indeed, there is numerous studies that have examined preferences for features that are perceived to affect food quality and safety (e.g., Alfnes et al., 2006; Lusk et al., 2007; Rigby and Burton, 2003; Hayes et al., 1995; Lusk, 2003; Olynk, 2010; Ubilava and Foster, 2009; Ortega et al., 2011). For example, Ubilava and Foster (2009) and Loureiro and Umberger (2007) found positive WTP for traceability and quality/safety assurance labelling. However, in the former study traceability commanded a much higher premium than quality assurance, whereas in the latter study a reverse preference ordering was found. A study exploring preferences of Chinese consumers for food safety information, Ortega et al. (2011) found that consumers were willing to pay a positive price premium for safety assurance measures and they found a positive and significant relationship between consumer's perceptions of risk and the price premium they were willing to pay.

Other studies have found that consumers have a strong preference for the region of origin of food products as well as for origin labelling of food products. For example, Alfnes and Rickertsen (2004) found that Norwegian consumers preferred domestically produced beef compared to beef that originated from other developed or developing countries. In a cross-country comparison of consumers in France, Germany and the UK, Roosen and Fox (2003) found that for French and German consumers the origin labelling of beef products was deemed most important whereas consumers in the UK deemed features such as steak colour, price and fat content as more important than the origin label. Loureiro and Umberger (2003) found that US consumers were willing to pay a premium for US certification of origin for steak and hamburgers (where consumers WTP per pound of steak for US certification was almost double the WTP per pound for hamburgers).

In this study we explore preferences for additional measures (beyond current standards) that better assure the safety and quality of food products as well as preferences for region of origin of food. This includes for example exploring preferences for food testing standards that go beyond current testing levels to further reduce the possibility that pathogens or food-borne diseases are present in the foods. These enhanced standards reflect scientific developments to further ensure the safety and quality of food and represent measures that are being developed to reduce the possibility of food fraud which could compromise food safety. Indeed, credence attributes such as traceability or regional verification that add value to food products (through consumer demand for them) could be subjected to incidences of fraud simply because they can command a higher price premium.

3 Case study and data description

To identify the relevant food safety attributes and levels, the study design was informed by expert opinion from food scientists involved in developing methods to verify the safety and authenticity of food. After discussions, three food safety attributes were identified. These included food testing standards, traceability standards and health and welfare standards of the food-producing animals. These attributes were presented at two levels in the choice experiment—a current and enhanced standard. For the 'food safety' attribute, the enhanced standard represented the use of additional testing to ensure safer food. For the 'traceability' attribute, the enhanced standard consisted of the use of technology to verify the exact origins of the meat so that labelling fraud could not occur. For the 'animal health and welfare' attribute, respondents were informed that the enhanced standard tested the animals for the presence of any drugs or diseases, whilst the current standard only tested for the presence of drugs. A 'region of origin' attribute was included to decipher preferences for Irish and British chicken products versus chicken products that came from outside these regions. A final attribute was included to depict the price levels of the chicken products. This attribute represented the price a respondent would have to pay for a tray of two chicken breasts. Although expert opinion ensured the information on the levels was correct and relevant to the scientific developments in these areas, a series of focus group discussions were also held to determine whether the levels were understandable and relevant to the general public. This ensured that consumers could understand and differentiate between the levels as well as the choice alternatives. It also gave an indication of the number of choice sets to present in the choice experiment.

After the feedback from scientific experts and focus groups, experimental designs were generated for consumers based in the Republic of Ireland and Great Britain. This study adopted a Bayesian efficient design, based on the minimisation of the D_b-error criterion (for a general overview of efficient experimental design literature, see e.g., Scarpa and Rose, 2008, and reference cited therein). The design comprised of a panel of up to twelve choice tasks. For each task, respondents were asked to choose between two experimentally designed alternatives and a buy neither option. When making their choices, respondents were asked to consider only the information presented in the choice task and to treat each task separately. Respondents were also reminded that if they thought the alternatives were too expensive or if they did not normally buy chicken they could simply choose the 'buy neither' option.

Market Research companies were contracted to collect data from representative household samples of the populations in both regions based on age, gender, socio class and geographical stratification. In addition to the choice experiment information was also collected on preferences for food shopping, chicken consumption patterns for the household, socio-economic information of the respondent, as well as their perceptions of risk associated with consuming various food products including chicken. In total, this paper uses information from 416 respondents based in the Republic of Ireland and 1162 respondents living in Great Britain.

4 Empirical specification

Standard consumer theory is based on the premise that utility is a function of the quantities of a good. Lancaster (1966) proposed an extension to this which forms the backbone of CEs. His theory states that it is the attributes of a good that determine the utility the good provides and as a result, utility can be expressed as a function of a good's attributes. In the current study, chicken breasts are the good of interest and its attributes include a number of safety, quality and regional information features. The utility derived for each alternative (chicken breasts) is determined by the preferences for the levels of the attributes provided by that alternative.

A second key concept for the analysis of CE data is the random utility model (RUM) as developed by McFadden (1974), which represents the standard economic framework in which we analyse discrete choice data. The basic idea of the RUM model is that when presented with a number of choice alternatives, individuals will choose the alternative that provides them with the hightest utility level on any choice occasion. Under this assumption, utility for individual n is made up of an observable component V_{ni} and a random component ε_{ni}. Therefore the total utility U_{ni} associated with individual n's chosen alternative i is represented by:

$$U_{ni} = V_{ni} + \varepsilon_{ni}, \tag{1}$$

where $V_{ni} = \beta' x_{ni}$. Different discrete models can be obtained depending upon the assumptions made about the random component of utility. The multinomial logit model (MNL) is underpinned by the 'independently and identically distributed' condition of error terms, which implies that the associated variances of the unobserved components of a random utility expression describing each alternative in a choice set are identical. Under the MNL model, the probability of individual n choosing alternative i from the set of j alternatives can be written as:

$$\Pr_{ni} = \frac{\exp(\beta' x_{ni})}{\sum_j \exp(\beta' x_{nj})} \tag{2}$$

The MNL is associated with a number of convenient properties but does have a number of limitations (Louviere et al., 2000; Train, 2003). These limitations include the inability of the model to capture random taste variation as well as correlation in unobserved factors between different choice situations. In recent years, other models have been developed to overcome some of these limitations. In this paper, we employ two alternative model forms that fall under the mixed logit (ML) umbrella.

McFadden and Train (2000) show that ML models provide a flexible and in theory, a computationally practical econometric method for any discrete choice model derived from random utility maximisation. In ML models the probabilities are the integrals of the MNL probabilities over a density of parameters:

$$\Pr_{ni} = \int \frac{\exp(\beta' x_{ni})}{\sum_j \exp(\beta' x_{nj})} f(\beta|\theta) d\beta \tag{3}$$

The ML probability is the weighted average of the logit formulas at different values of β with the weights given by the density $f(\beta)$. In the above equation θ represents the parameters that describe the density function. We can specify different behavioural forms of the ML model depending on the specification of $f(\beta)$. For this paper, we employ a random parameters logit (RPL) model and a latent class (LC) logit model.

In the case of the RPL model, the parameters vary over decision-makers in the population with $f(\beta)$. Therefore, for the RPL models, the unconditional choice probability represents the integral of the logit probabilities over all possible values of β_n. The RPL models reported in this paper are estimated using a panel specification which provides a more realistic representation of the data by accouting for observations drawn from the same respondent. Therefore, when a sequence of choices y_n is observed for a particular respondent defined as $y_n =< y_{nt=1}, ..., y_{nT} >$ for the T choice occasions the choice probability can be represented by a product of logits:

$$\Pr_{yn} = \int \prod_{t=1}^{T} \left(\frac{\exp(\beta' x_{ni})}{\sum_j \exp(\beta' x_{nj})} \right) f(\beta) d(\beta) \tag{4}$$

where T is the number of choices observed for each respondent. The researcher must specify the distribution for the βs and usually estimates the mean and standard deviation of the distribution. A common exploration within the literature is to compare and determine whether random tastes are more suitably accommodated by a RPL or LC specification. For the LC model the mixture of taste intensities takes place over a finite group of latent classes rather than over a continuous distribution under the RPL specification. In the case of the LC specification the mixing distribution $f(\beta)$ is discrete with the vector β taking on a finite set of distinct values. In LC models taste heterogeneity is statistically accounted for by simultaneously assigning individuals into latent classes and estimating the choice model. A primary benefit of this approach is being able to explain the preference variation across individuals conditional on the probability of membership to a latent class.

Suppose β takes C possible values labelled $\beta_1 \cdots, \beta_c$ with probability prob_c in this case the panel LC model becomes:

$$\Pr_{y} n = \sum_{c=1}^{C} \prod_{t=1}^{T} prob_c \left(\frac{exp(\beta_c' x_{nit})}{\sum_j exp(\beta_c' x_{nit})} \right) \tag{5}$$

Therefore, similar to the RPL model the probability is estimated as the product of logit formulas, one for each choice occasion. The expected probability of alternative i being chosen is the expected value (over classes) of the class specific probabilities. The share in the population in class (c) is prob_c which can be estimated in the model along with the β's for each class. For the LC model, respondent n is probabilistically assigned into a particular class c based on their preferences for the good under consideration. The assumption is that respondents in one class have the same preferences but differ in their preferences from respondents probabilistically assigned to another class (Swait and Adamowicz, 2001).

Rather than deriving WTP estimates from a unconditional distribution in which a sample of individuals are randomly assigned along a distribution, in this paper we retrieve the conditional distribution to provide the most likely position of our sample of respondents on the WTP distribution. This approach allows the identification of common-choice specific parameters based on the knowledge of chosen alternatives to derive more behaviourally accurate distributions of WTP estimates (For a full description of the derivation of conditional estimates, see e.g., Train, 2003; Scarpa and Thiene, 2005).

5 Results

In this section we present the results from the RPL and LC models for both regions. We present the responses from the ROI and GB samples separately to enable straightforward comparisons. For both case-studies we include interaction terms between the three enhanced safety attributes (testing, traceability and health and welfare) and the local regional attribute. The purpose of this is to decipher whether respondents perceive their locally produced chicken to be safer compared to chicken that comes from outside their region. We also include an interaction term between respondent's perceptions of risk (of contracting food poisoning) and the safety attributes. This is to determine whether respondents who have indicated that they perceive chicken to be riskier manifests itself into additional utility for these respondents for the attributes.

5.1 ROI Results

In Table 1 we present the results from the RPL and LC models for the ROI residents. For the RPL model we specify the non-cost attributes to take a normal distribution. To ease model estimation and interpretation we specify the coefficients representing the cost attribute, interaction terms and opt-out alternative as fixed. From this model, we can see that the signs conform to *a priori* expectations. Respondents have a positive preference for enhanced testing, traceability, health and welfare as well as chicken products that come from ROI and GB *versus* chicken that comes from outside these regions. As expected, the cost coefficient is negative and significant, implying respondents prefer chicken breasts that have a lower price. Regarding the interaction effects, although independently the coefficients representing enhanced testing, welfare and Ireland are significant and positive, their interaction effects are negative. This implies that respondents may perceive substitutability between the enhanced testing and Ireland attributes as well as between the enhanced welfare and Ireland attributes. This suggests that these respondents perceive 'Irish' chicken products to be associated with better safety features and the presence of an 'Ireland' label diminishes the marginal utility associated with these food safety attributes. On the other hand, the interaction between enhanced traceability and Ireland is positive, albeit only significant at the ten percent level. The interactions effects between risk perception (which is a dummy variable where one represents a very high risk perception associated with chicken) and the enhanced food safety features are all positive. Nevertheless only the interaction between risk and enhanced welfare is significant. This result implies that respondents who have a very high perception of risk from consuming chicken products receive extra utility from enhanced health and welfare for the food-producing birds.

For the LC specification, we present the results obtained from a three class

Table 1: Model results for ROI residents

	RPL		LC Class 1		LC Class 2		LC Class3	
	est.	—t-rat.—	est.	—t-rat.—	est.	—t-rat.—	est.	—t-rat.—
Cost Mean	-0.373	12.82	-0.359	-13.35	-0.693	-5.44	-0.246	5.869
Enhanced Testing Mean	0.49	4.86	0.481	5.12	-0.688	-0.987	0.198	0.993
Enhanced Testing Std Dev	1.021	12.26						
Enhanced Traceability Mean	0.011	0.081	0.249	2.75	-1.394	-2.07	-0.204	0.886
Enhanced Traceability Std Dev	0.985	11.29						
Enhanced Health and Welfare Mean	0.357	2.56	0.479	5.17	0.507	0.979	-0.111	0.532
Enhanced Health and Welfare Std Dev	0.926	11.61						
Ireland Mean	1.943	10.80	1.257	9.02	4.830	11.14	0.503	2.111
Ireland Std Dev	1.897	14.02						
Great Britain Mean	0.265	2.79	0.238	4.41	0.499	1.84	0.558	4.595
Great Britain Std Dev	1.396	13.05						
Ireland* Enhanced Testing	-0.231	1.45.	-0.557	-3.80	1.956	2.87	0.545	1.961
Ireland* Enhanced Traceability	0.296	1.87	0.135	0.97	2.700	4.38	0.123	0.407
Ireland* Enhanced Health and Welfare	-0.747	4.74	-0.743	-5.12	0.408	0.801	-0.357	1.226
Risk * Enhanced Testing	0.203	1.26	0.174	1.96	2.087	2.97	-0.162	0.750
Risk * Enhanced Traceability	0.224	1.40	0.05	0.567	1.585	2.53	-0.197	0.795
Risk * Enhanced Health and Welfare	0.402	2.66	0.263	2.97	0.341	0.797	0.396	1.806
Opt-out	-1.547	15.42	-3.528	-21.83	1.261	3.57	0.597	5.250
Class Membership Probabilities			0.746	5.55	0.146	9.33	0.108	6.65
$\mathcal{L}(\hat{\beta})$	-3871.095				-3513.087			
AIC/N	1.616				1.477			
BIC/N	1.640				1.532			
k	18				41			
$\bar{\rho}^2$	0.267				0.335			

LC model[1] In the LC model, the largest proportion of respondents (almost 75 percent of respondents) are probabilistically assigned to class one. This class is associated with statistically significant coefficient estimates for the attributes. Respondents in this class have a strong preference for chicken that comes from Ireland, which is signified by the large coefficient representing this attribute level. Respondents in this class have similar taste intensities for the enhanced testing and enhanced health and welfare coefficients as well as similar estimates for the enhanced traceability and GB coefficient. Regarding the interaction effects, although independently the coefficients representing enhanced testing, enhanced health and welfare and Ireland are significant and positive, their interaction terms are negative. This suggests that respondents within this class perceive strong substitutability between the coefficients representing the enhanced testing and Ireland coefficients as well as between the enhanced welfare and Ireland coefficients. On the other hand, the interaction between enhanced traceability and Ireland is positive, albeit not significant for this class. The interaction terms between risk perception and enhanced testing and enhanced health and welfare standards are positive and significant. This suggests that respondents who have a very high perception of risk from consuming chicken products receive extra utility from these enhanced standards compared to other consumers.

For class two, which represents approximately fifteen percent of our sample, they have statistically significant coefficients representing the price, enhanced traceability and Ireland attributes. Indeed, the coefficient representing the Ireland attribute is extremely large in relative magnitude which suggests that respondents in this class have a strong preference from chicken that comes from Ireland. The coefficients representing the remaining attributes are not significant at the five percent level (albeit the coefficient for Great Britain is positive and significant at the ten percent level). For this class, the coefficient representing the enhanced traceability standard is negative which would appear behaviourally implausible. However, the interaction between the enhanced traceability and Ireland coefficient is large, positive and significant which could indicate that some of the positive utility associated with the enhanced traceability standard is being captured within this interaction term. The final class, which represent approximately eleven percent of respondents, only has significant coefficients associated with the cost attribute and the levels representing the region of orgin attribute. The coefficient associated with the Great Britain attribute is slightly larger than the Ireland coefficient. For the interaction terms the interaction between enhanced testing standard and Ireland attribute is significant, whereas the remaining interaction terms do not have significant coefficients. For classes two

[1] A three class model was chosen (for both datasets) after evaluating the signs, significance and plausibility of welfare estimates across models with different number of classes. We also tested models were we specified a range of socio-economic information to enter the model as covariates. However, we did not find that the additional covariates added substantially to model performance or the plausibility of resulting welfare estimates.

and three, the coefficient representing the opt-out alternative is positive and significant, which would suggest that respondents probabilistically assigned to either of these classes are more likely to choose the ‘buy neither’ option rather than the chicken alternatives. This may explain the non-significance associated with some of the attribute coefficients in these classes.

For both models, we present a number of different criteria to assess model comparison and performance. This includes the log-likelihood $\mathcal{L}\left(\hat{\beta}\right)$, the AIC and BIC statistics as well as the $\bar{\rho}^2$ statistic [2]. We can see that on the basis of all criteria, the LC model provides a much superior model fit compared to the RPL model.

5.2 GB Results

In Table 2 we present the results from the RPL and LC models for the GB survey. For the RPL model, we specify the random non-cost attributes with a Normal distribution and we specify the coefficients representing the cost, interaction terms and opt-out alternative as fixed. For the RPL model it is evident that the signs reflecting the cost and non-cost attributes conform to *a priori* expectations. In general, the largest coefficient for this sample is associated with the enhanced health and welfare standard followed closely by the enhanced testing standard. For this model, the mean coefficient representing the Ireland attribute is larger than the mean coefficient representing the GB attribute. This result could be indicative of the large degree of taste heterogeneity associated with the GB attribute. The mean coefficient representing the traceability attribute is positive but not significant which may also reflect the large degree of heterogeneity associated with this attribute in this model. As can be seen, there is a negative and significant interaction between the enhanced testing standard and GB attribute. This would suggest that respondents based in GB perceive some substitutability between these attributes. On the other hand, there is a positive and significant interaction between the GB and traceability standard which suggests that GB respondents receive positive utility from chicken products that can be traced using the enhanced standard to a farm based in GB. The only risk interaction term that is significant (at the five or ten percent level) in this model is for the interaction between risk and the enhanced testing standard.

For the LC class model, there is is a more even distribution of respondents probabilistically assigned across the classes compared to the ROI sample. Class

[2] The $\bar{\rho}^2$ is an adjustment of the ρ^2 statistic, penalising for the number of parameters K. It is defined by: $\bar{\rho}^2 = 1 - \left(\left(\mathcal{L}\left(\hat{\beta}\right) - K\right) / \mathcal{L}(0)\right)$, where $\mathcal{L}\left(\hat{\beta}\right)$ and $\mathcal{L}(0)$ are the log-likelihoods for the estimated model and the model in which all parameters are set to zero respectively. The Akaike information criterion (AIC) and Bayesian information criterion (BIC) can be used to discriminate between un-nested models by also placing a penalty on the number of parameters. The AIC is derived by: $\text{AIC} = -2\mathcal{L}\left(\hat{\beta}\right) + 2K$. The BIC is defined as follows: $\text{BIC} = -2\mathcal{L}\left(\hat{\beta}\right) + K\ln(N)$, where N is the number of observations.

Table 2: Model results for GB residents

	RPL		LC Class 1		LC Class 2		LC Class3	
	est.	—t-rat.—	est.	—t-rat.—	est.	—t-rat.—	est.	—t-rat.—
Cost	-0.986	12.67	-0.828	-16.32	-0.500	-15.49	-0.438	-9.68
Enhanced Testing Mean	1.028	3.20	0.591	6.65	0.972	14.28	0.700	5.99
Enhanced Testing Std DEV	1.379							
Enhanced Traceability Mean	0.349	0.941	0.138	1.52	0.326	4.24	0.418	3.44
Enhanced Traceability Std DEV	0.762							
Enhanced Health and Welfare Mean	1.085	2.51	0.579	6.33	0.950	12.82	1.287	11.62
Enhanced Health and Welfare Std DEV	1.312							
Ireland Mean	0.371	11.03	0.049	0.73	0.472	9.26	0.620	6.88
Ireland Std Dev	0.635							
Great Britain Mean	0.21	3.07	0.532	1.98	0.458	2.39	1.239	4.51
Great Britain Std Dev	1.021							
Great Britain* Enhanced Testing	-0.315	2.04	-1.002	-3.25	0.165	0.88	-0.531	-2.48
Great Britain* Enhanced Traceability	0.784	5.79	1.089	5.78	-0.497	-3.17	0.397	2.11
Great Britain Enhanced Health and Welfare	-0.009	0.61	-1.928	-6.74	1.929	11.27	-0.949	-4.50
Risk * Enhanced Testing	0.315	3.01	0.492	4.98	0.018	0.28	0.298	2.68
Risk * Enhanced Traceability	0.119	1.53	0.247	2.97	0.047	0.66	0.169	1.46
Risk * Enhanced Health and Welfare	-0.002	0.029	0.091	0.97	-0.054	-0.83	0.176	1.88
Opt-out	-2.66	15.37	-4.252	-23.86	-2.041	-17.16	1.772	9.63
Class Membership Probabilities	-		0.465	21.24	0.373	23.47	0.162	13.64
$\mathcal{L}(\hat{\beta})$	-7449.099				-7024.326			
AIC/N	1.591				1.505			
BIC/N	1.605				1.537			
k	18				41			
$\bar{\rho}^2$	0.277				0.335			

one has the largest number of respondents probabilistically assigned to it at approximately 47 percent of the sample. For this class, positive and significant coefficients are associated with the enhanced testing standard, enhanced health and welfare standard and Great Britain attributes whereas cost is negative and significant. For this class we find a negative and significant relationship for the interaction terms between GB and enhanced testing and GB and enhanced health and welfare. Similar to the ROI sample, this would suggest that respondents in GB associate British chicken products as safe and the presence of one of these attributes in the chicken product diminishes the marginal utility from the other attribute. Respondents in GB who have a high risk perception also get additional utility compared to other respondents for the enhanced testing and enhanced health and welfare standards.

LC class two contains approximately 37 percent of the sample. For this class significant coefficients are retrieved for all the parameter coefficients. The largest coefficients for this class are associated with the enhanced testing and the enhanced health and welfare standards. This class appear to slightly prefer Irish chicken products with the coefficient value appearing slightly higher for this attribute. This class is associated with significant coefficients for the interaction between GB and enhanced traceability as well as between GB and enhanced health and welfare standards. The other interaction terms, including those between respondents risk perception and the safety features are not significant. Class three also has significant coefficients associated with the attributes. In particular, respondents probabilistically assigned to this class have a large positive coefficient associated with the GB attribute, suggesting respondents assigned to this class strongly prefer British chicken. The interaction terms between GB and the safety features are all significant. It is evident that respondents in this class assume some substitutability between British chicken and the enhanced testing and health and welfare standards as the interactions between these attributes are negative. On the other hand, respondents probabilistically assigned to this class have a positive and significant preference for British chicken that comes with an enhanced traceability standard. For respondents assigned to this class, there are positive and significant interactions between respondent's perception of risk and the enhanced testing standard at the five percent level and their perception of risk and enhanced health standard at the ten percent level.

In terms of comparing results from both the RPL and LC models for the GB sample, similar to the ROI case-study, the LC model outperforms the RPL model by quite a margin based on the different criteria outlined in Table 2.

5.3 WTP Results

In this section of the paper we compare the conditional mean WTP estimates between the two regions for each model. We present the results for each of the attributes separately to enable straightforward comparisons between the rankings of attributes. In general, the RPL and LC model for the ROI respondents produces similar welfare estimates for all the attributes except for Ireland whereby the RPL model produces a substantially larger mean WTP value for this attribute. For ROI respondents, they have a strong and large preference for chicken products that come from Ireland which attains a much larger WTP value compared to the other attributes. The lowest welfare benefit is associated with enhanced traceability, which retrieves a positive but low marginal welfare measure in both models. For the GB respondents more similar estimates are retrieved for all the attributes. Similar estimates are retrieved for the enhanced testing and health and welfare attributes across the RPL and LC models for the GB respondents. The mean WTP estimates for enhanced traceability, Ireland and Great Britain attributes are substantially lower in the RPL model compared to the LC model. This could reflect the fact that under this model a high degree of dispersion were found for these attributes which could impact on the retrieved WTP estimates. In general, GB respondents have a positive preference for chicken products that come from the British Isles but they are WTP substantially less than their Irish counterparts for chicken produced within their own region.

Table 3: Average of the Conditional Mean WTP estimates (£ per breast): ROI and GB estimates

	RPL:ROI	LC:ROI	RPL:GB	LC:GB
Enhanced Testing	0.552	0.403	0.523	0.434
Enhanced Traceability	0.005	0.054	0.178	0.480
Enhanced Welfare	0.418	0.459	0.550	0.510
Ireland	2.32	1.68	0.191	0.413
Great Britain	0.337	0.365	0.107	0.538

6 Conclusions

In this paper we have developed and analysed a CE to examine consumer preferences for features that enhance the quality and safety of food products. For this, we explore preferences from representative samples of the populations based in the Republic of Ireland and Great Britain. Overall our results show that consumers in both regions have strong preferences for features that enhance the safety and quality of food products, where our study focused on chicken products. In the case of ROI consumers, we find some differences between the RPL and LC models. The RPL model results suggest that there is a high degree of dispersion in preferences for the safety and quality features explored in this study.

The LC model also retrieves three distinct preference classes. However, this model would suggest quite a large degree of preference homogeneity with approximately three-quarters of respondents estimated to belong to the same preference class within this model. In terms of welfare measures, both models produce similar estimates of WTP for the attributes under consideration, except for the ‘Ireland’ attribute where substantially higher WTP estimates are retrieved for the ‘Ireland’ attribute under the RPL model. The results suggest that respondents based in ROI have a strong preference for ‘Irish’ chicken products as shown by the substantial price premium for the ‘Ireland’ attribute. This high WTP value could reflect the strong Irish branding of food products in supermarkets in ROI. In addition, ROI residents are willing to pay a premium for chicken products that come from Great Britain, however it is substantially less than for ‘Irish’ chicken. In terms of the other attributes, similar WTP estimates are retrieved for chicken that comes with enhanced testing standards and enhanced welfare standards.

For the GB sample, a high degree of dispersion in preferences is found for the sample. The RPL model produces large and statistically significant standard deviations while the LC model suggests two sizeable latent classes with a smaller retrieved third class. For these respondents, somewhat different WTP estimates are retrieved under the two models. In terms of preferences for the features described in this choice experiment, GB respondents in general have a higher WTP for the enhanced testing, traceability and health and welfare standards compared to ROI residents. On the other hand, GB respondents do not have as strong a preference for chicken products that originate from their own region compared to respondents based in ROI. This could reflect the much larger geographical region of GB compared to ROI whereby consumers are not as strongly motivated in their purchasing decisions by regional identification. On the other hand, in both regions, respondents seem to identify their own region as having better safety or quality, which is indicated by the negative cross-product on the interactions between the region and enhanced testing standards as well as enhanced health and welfare standards. Furthermore, although enhanced traceability by itself may retrieve a lower WTP value, respondents do have a preference for chicken products that come comes from their own region and is traceable using the enhanced standard. Finally, for respondents in both regions, we do find a significant relation between having a high risk perception from consuming chicken products and their preferences for the safety measures explored in this study.

The results presented in this study support the scientific developments to improve the integrity of food products through enhanced safety procedures. Indeed given the increasing globalisation of food production and the economic incentives that can be derived from the false labelling and production of food, it is evident that these improved safety measures are warranted to ensure the safety of food. Importantly, the results from this study confirm that consumers also demand and have positive preferences for these developments.

References

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.

Alfnes, F. and Rickertsen, K. (2004). European consumers' willingness to pay for US beef in experimental auction markets, *American Journal of Agricultural Economics* **31(1)**: 19–37.

Carlsson, F., Frykblom, P. and Lagerkvist, C. J. (2007). Consumer benefits of labels and bans on GM foods—choice experiments with Swedish consumers, *American Journal of Agricultural Economics* **89**: 152–161.

Dickinson, D. and Bailey, D. (2002). Meat traceability: are US consumers willing to pay for it?, *Journal of Agricultural and Resource Economics* **27(2)**: 348–364.

Dickinson, D. and Bailey, D. (2005). Experimental evidence on willingness to pay for red meat traceability in the United States, Canada, the United Kingdom, and Japan, *Journal of Agricultural and Applied Economics* **37(3)**: 537–548.

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.

Hayes, D., Shogren, J., Shin, S. and Kliebenstein, J. (1995). Valuing food safety in experimental auction markets, *American Journal of Agricultural Economics* **77**: 40–53.

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

Loureiro, M. and Umberger, W. (2003). Estimating consumer willingness to pay for country-of-origin labeling, *Journal of Agricultural and Applied Economics* **37(1)**: 309–320.

Loureiro, M. and Umberger, W. (2007). A choice experiment model for beef: what us consumers responses tell us about relative preferences for food safety, country-of-origin labeling and traceability, *Food Policy* **32**: 496–514.

Louviere, J. J., Hensher, D. A. and Swait, J. D. (2000). *Stated choice methods: analysis and application*, Press Syndicate of the University of Cambridge, Cambridge.

Lusk, J., Nilsson, T. and Foster, K. (2007). Public preferences and private choices: effect of altruism and free riding on the demand for environmentally certified pork, *Environmental and Resource Economics* **36**: 499–521.

Lusk, J.L., R. J. F. J. (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**: 16–29.

McFadden, D. L. (1974). *Conditional logit analysis of qualitative choice behavior*, Frontiers in econometrics, Academic Press, New York.

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

Olynk, N., T. G. W. C. (2010). Consumer willingness to pay for livestock credence attribute claim verification, *Journal of Agricultural and Resource Economics* **35(2)**: 261–280.

Ortega, D., Wang, H., Laping, W. and Olynk, N. (2011). Modelling heterogeneity in consumer preferences for select food safety attributes in China, *Food Policy* **36**: 318–324.

Rigby, D. and Burton, M. (2003). Capturing preference heterogeneity in stated choice models: a random parameters logit model of the demand for GM food, *The University of Manchester School of Economic Studies Discussion Paper Series No. 0319* .

Roosen, J., L. J. and Fox, J. A. (2003). Consumer demand for and attitudes toward alternative beef labeling strategies in France, Germany and the UK, *Agribusiness: An International Journal* **19**: 77–90.

Scarpa, R. and Rose, J. (2008). Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why, *The Australian Journal of Agricultural Economics* **52**: 253–282.

Scarpa, R. and Thiene, M. (2005). Destination choice models for rock climbing in the Northeastern Alps: a latent-class approach based on the intensity of preferences, *Land Economics* **81**: 426–444.

Swait, J. D. and Adamowicz, W. L. (2001). The influence of task complexity on consumer choice: a latent class model of decision strategy switching, *Journal of Consumer Research* **28**: 135–148.

Train, K. E. (2003). *Discrete choice methods with simulation*, Press Syndicate of the University of Cambridge, Cambridge.

Ubilava, D. and Foster, K. (2009). Quality certification vs. product traceability: consumer preferences for informational attributes of pork in Georgia, *Food Policy* **34(3)**: 305–310.