Consumer Demand For and Attitudes Toward

Alternative Beef Labeling Strategies in France, Germany, and the UK

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ABSTRACT

A wide array of food safety scares and breakdowns have led to loss of consumer confidence in the quality and safety of beef products. To counteract such concerns, firms and regulators have the ability to utilize brands or labels to signal quality. Utilizing a mail survey in France, Germany, and the United Kingdom, we analyzed consumer preferences for alternative beef labeling strategies. Using an ordered probit model and a double bounded logit model, we estimate consumer preferences for alternative beef labeling programs. In general, results suggest that consumers have more confidence in government mandated labels as opposed to private brands. French and German consumers place a higher level of importance on brands and labels than do UK consumers. Results also suggest that more than 90% of surveyed consumers desire a mandatory labeling program for beef produced from cattle fed genetically modified crops.

Keywords: beef, double bounded logit, genetically modified feed, labels, ordered probit.

JEL subject codes: D120, L660.

1. INTRODUCTION

A wide array of food safety scares and breakdowns in the European Union (EU) have led to a loss of consumer confidence in the safety and quality of meat products. Decline in beef demand has been drastic and has had a marked effect on EU cattle producers. EU beef consumption dropped from 21.5 kg per person in 1990 to 19.7 kg per person in 1998. During this time, consumption reached a low of 18.6 kg per person in 1996 when the United Kingdom (UK) government suggested a possible link between bovine spongiform encephalopathy (BSE) and a new variant of Jakob Creutzfeld disease. The reduction in beef consumption has been more pronounced in some EU countries than others. For instance, in Italy and Germany beef consumption has reportedly declined by as much as 30 to 50% during that period (Verbeke & Viaene, 1999). The more recent BSE crisis, which occurred in late 2000, is thought to have led to an additional 27% reduction in EU beef consumption (The Economist, 2001).

In addition to BSE, a large number of food safety incidences have shattered consumers' confidence in meat products. These include illegal use of growth hormones, residues from antibiotic use, and dioxin contamination of feedstuffs. One additional issue that may potentially lead to a future reduction in beef demand is the use of genetically modified (GM) feed in cattle production. Past studies have shown that European consumers are reluctant to accept the use of GM organisms in food production. According to Hoban (1997), 91, 55 and 57 percent of consumers were aware of biotechnology, while 30, 60, and 63 percent were willing to buy GM foods in Germany, France and the UK, respectively. However, 57, 38, and 39 percent of consumers in the three respective countries viewed biotechnology as a health risk. In a more recent study, the Angus Reid Group/The Economists concluded that 64%, 60% and 47% of surveyed consumers are less likely to purchase products that contain GMOs in France, Germany and the UK.

The "novel food directive" (Directive 1139/98/EC) demands labeling of products that contain more than 1% of genetically modified (GM) foods; however, this requirement has not been extended to meat products. A wide range of actions has drawn consumer attention towards products directly containing GM ingredients and effective labeling policies have been put into place to make these identifiable. However, currently consumers cannot discern whether meat products are from animals fed GM crops. To avoid such meat products the consumer must rely on very restrictive, for example "organic", labels that reject in addition to the non-desired feed component numerous "traditional" production practices. The widespread use of GM crops in animal feed has drawn attention of environmental and consumer groups and many are promoting a labeling initiative to identify such meat.

Recent food safety scares demand new actions on the part of beef producers and regulators in order to maintain and restore consumer confidence. The EU has recently enacted mandatory labeling of place of slaughtering (2001) and production (2003) in the EU in order to ensure the tracability of beef products. Furthermore, several firms are beginning to promote brand names to attract consumers. In the UK, the BSE crisis has encouraged the creation of grocery-store specific beef labels and the cooperation of actors along the production chain (Loader & Hobbs, 1999). To counteract the drastic demand decline, the beef industry is in need of information regarding the ability of branding and labeling to enhance consumer awareness about the products they consume. The effectiveness of previous labeling and branding strategies and the potential of the proposed GM fed beef labeling strategy are currently unknown. Whether labeling of beef from cattle fed GM crops should be carried out through government regulations or through private branding is a function of the effectiveness of each program.

In this context, the objective of this paper is to analyze the effectiveness of two existing labeling approaches, private branding and government imposed mandatory labeling. In addition, our goal is to estimate the demand for a proposed labeling program – mandatory labeling of beef

from cattle fed GM crops. In this study, we employ a mail survey to examine consumer attitudes towards labeling and branding of beef in three EU countries: France, Germany, and the UK. In the next section, problems associated with quality signaling when meat attributes are unobservable and the opportunities of private brands and government labels to mitigate this problem are discussed. A brief review of the relevant literature is included in this section. Research methods are outlined in the following section and the results of a mail survey are presented. The paper concludes with a discussion of the implications of our research for policy and further investigation.

2. LABELING STRATEGIES

Consumers often face difficulties in judging the quality and safety attributes of meat products (Caswell & Padberg, 1992). Consumers have such a problem when they attempt to determine whether beef is from an animal that was fed GM grains. The consumer cannot assess the true quality of the meat, even after consumption. As such, the consumer must rely on other information sources, either private or government, to assess the quality of the product consumed. The study of such food products often falls in the context of the analysis of credence goods. Typically, with credence goods, no amount of search costs can remedy the problem of quality identification. It is often assumed that private firms cannot signal quality through brands because consumers do not trust private firms to be truthful. In the typical analysis of credence goods, quality signaling must be done through labeling by the government or by independent third parties. However, such assumptions do not explain the proliferation of private brands that have entered the market in the EU. For example, “label rouge” chicken in France (Westgren) and “Blanc-Bleu fermier” beef in Belgium (Burny, 1997) are private brands that have been successful at signaling quality attributes associated with particular production practices, among

other quality factors. It appears that private brands have the potential to mitigate some of the quality signaling problems associated with credence-like goods.

The failure of the market to "signal" the quality of such food safety attributes in meat has long been recognized and private and government responses have focused on product labeling (Verbeke & Viaene, 1999). Firms can choose to develop a brand associated with particular production systems and/or quality characteristics and governments can choose to mandate labeling of quality assurance, production processes, contents of ingredients, or nutritional values. If consumers place a high level of importance and trust on private brands, government intervention in the market may be unnecessary. Through private brands and prices reflecting quality signals, the market may be able to provide consumers with the level of information they desire. However, government may need to intervene and enforce mandatory labels if consumers do not trust or place any importance on private labels. As previously stated, the goal of this study is to determine the relative level of importance that consumers place on private versus government labels.

Approaches to mandatory labeling have been quite diverse across countries and sectors. In the US, labeling is primarily limited to private efforts; however, European regulators have invested heavily in the creation and protection of government labels. European labels include ingredient information and origin of products. There also exists mandatory labeling requirements for irradiated foods and for food products that contain either protein or DNA from GM organisms. Mandatory labels also exist for the protection of geographic origin as established in EC regulation 2081/92 and 2082/92. They distinguish protected designation of origin (PDO), protected geographical indications (PGI), and certificate of specific character (CSC) (Luz Loureiro & McCluskey, 2000). Regional labels establish and protect a collective reputation of firms. Consumers use the information they have about the collective of firms to assess the quality of the individual firm (Tirole, 1996). Former studies have shown that regional

labels can be important in consumer choices (Landon & Smith, 1998; Luz Loureiro & McCluskey, 2000).

Firms may also directly respond to consumer concerns by developing recognizable brands that are associated with particular quality characteristics. For example, in response to consumer concern about the health impacts of pesticide residues on infants, Hipp baby foods in Germany only uses "organic" ingredients in their production process. It has to be recognized, however, that research suggests that such sought protection from adverse consequence of food safety scares may lead to socially excessive investment into product protection (Henson & Traill, 1993; Swinbank, 1993).

3. METHODS

To analyze consumer attitudes towards private and government labeling, a mail survey was developed and sent to consumers in German, France, and the UK. The survey instrument included questions on demographic characteristics, meat consumption habits, beef attributes considered in purchasing decisions, and concern about different food safety issues and food production technologies. The first section of the survey was designed to estimate the relative importance of previous private and government labeling strategies. In this section consumers were asked to indicate the importance of several factors in their beef steak purchasing decision. Factors included in the analysis were steak marbling (intramuscular fat content), color, external fat, price, brand, and country of origin label. An information sheet was included with the survey that displayed pictures of steaks with various degrees of marbling. Consumers were asked to indicate how important each factor was in their purchasing decision on a Likert scale, where one was not important and 5 was very important.

In this context, an ordered probit model can be used to determine the influence of several consumer characteristics in explaining the level of importance consumers place on brands or country of origin labeling. Because the dependent variable ranges on a scale from one to five and is cardinal in nature, an ordered probit model is the appropriate modeling choice. The ordered probit model can be motivated by a latent variable approach (Greene, 2000, pp. 875-879). Let y_i^* denote the true unknown preference of consumer *i* for the respective label and denote the observed variables with y_i. Then the relationship between true and observed preferences can be described as

$$y_i = 1 \text{ if } y_i^* \le 0, \tag{1.1}$$

$$y_i = 2 \text{ if } 0 < y_i^* \le \mu_1, \tag{1.2}$$

$$y_i = 3 \text{ if } \mu_1 < y_i^* \le \mu_2, \ldots, \tag{1.3}$$

$$y_i = 5 \text{ if } \mu_3 < y_i^*. \tag{1.4}$$

Assuming that $y_i^* = \beta' x_i + \varepsilon_i$ and that $\varepsilon_i \sim N(0,1)$, the probabilities of observing y_i are

$$P(y_i = 1) = 1 - \Phi(\beta' x_i) \tag{2.1}$$

$$P(y_i = 2) = \Phi(\mu_1 - \beta' x_i) - \Phi(-\beta' x_i) \tag{2.2}$$

$$P(y_i = 3) = \Phi(\mu_2 - \beta' x_i) - \Phi(\mu_1 - \beta' x_i), \ldots, \tag{2.3}$$

$$P(y_i = 5) = 1 - \Phi(\mu_3 \beta' x_i), \tag{2.4}$$

where $\Phi(\cdot)$ denotes the standard normal cumulative distribution function. Introducing the dummy variables

$$d_{ij} = \begin{cases} 1 & if \ \ y_i = j \\ 0 & otherwise \end{cases}, \ j = 1,2,...,5,$$

the log-likelihood function is given by

$$\ln L = \sum_i \sum_j d_{ij} P(y_i = j) . \quad (3)$$

As explanatory variables, we incorporate dummy variables designating the nationality of the consumer, demographic variables, and two indicators of food safety concern. Inclusion of nationality dummy variables is important. While previous research has mainly focused on the wide disparity of attitudes between EU and US consumers, the same studies have also shown that consumer attitudes towards GM foods and responses to food safety crises are quite variable across European countries. Cultural, political, and economic differences make it likely that consumers across countries react differently to food safety information and it is our goal to account for such differences while trying to assess consumer demand for beef labels in the EU.

The explanatory variables dealing with food safety concern are constructed from responses to questions about the relative concern for several food safety issues. Consumers were asked to indicate, on a scale from one to five, how concerned they were for the following food safety issues: bacterial contamination, food spoilage, pesticides, additives, antibiotics, irradiation, hormones, and biotechnology/genetic engineering. One indicator is constructed to represent concern for food spoilage and bacterial contamination and is formed as the simple average of these two variables, defined as BIOL. Secondly, we formed an indicator of concern about food production methods as the mean of the pesticides, additives, antibiotics, irradiation, hormones, and biotechnology variables and name it TECH. Such concerns for food safety are likely to influence the manner in which consumers view the importance of brands or country of origin labels. Those consumers that have a greater concern for food safety issues are likely to place a greater importance on brands and labels. Segregating food safety concerns into two

components permits greater insight into the motivations explaining why consumers may or may not perceive brands or labels as important.[1]

The following section of the survey was designed to determine consumer demand for mandatory labeling of beef from cattle that were fed GM crops. In this section of the survey, we asked consumers if they would prefer a mandatory label on beef from cattle that were fed GM crops utilizing a referendum design with follow up. In the questions, consumers were initially asked to indicate their demand for a mandatory label at no price increase. However, mandatory labels will likely come at cost because product has to be segregated throughout the production chain and input costs may increase. Therefore, a second question was posed that asked consumers to indicate their preference for the mandatory labeling program if it resulted in a 2% increase in beef prices.

To provide a deeper understanding of consumers' preferences for the mandatory labeling program, we econometrically estimate the determinants of demand for mandatory labels of beef produced with GM crops. Hannemean, Loomis, & Kanninen (1991) showed that utilizing data from referendum questions in a double bounded logit framework increases the precision of estimated coefficients. The consumer responses to the double bounded question allow placing bounds on intervals that contain true willingness to pay. The first question asked survey participants if they would prefer a mandatory labeling policy at no cost. The second question asks the same at a cost of 2% of beef prices. We define dummy variables and the resulting bounds as shown in table 1. Denote the price increase due to mandatory labeling of zero and 2% as B^L and B^H, respectively. The log-likelihood function is formulated as

[1] Including all variables individually in the regression was not possible because indicators aggregated to BIOL and TECH, respectively, are highly correlated.

$$\ln L^D(\alpha,\gamma,\beta) = \sum_{i=1}^{N}\left\{(1-d_i^{y})\pi^{n}(B^L) + d_i^{yn}\pi^{yn}(B^L,B^H) + d_i^{yy}\pi^{yy}(B^L,B^H)\right\} \qquad (4)$$

The function $\pi(\cdot)$ is the likelihood of observing WTP_i and takes the form

$$\begin{Bmatrix}\pi^{n}\\ \pi^{yn}\\ \pi^{yy}\end{Bmatrix} = \begin{Bmatrix} G(B^L;\alpha,\gamma,\beta) \\ G(B^H;\alpha,\gamma,\beta) - G(B^L;\alpha,\gamma,\beta) \\ 1-G(B_i^H;\alpha,\gamma,\beta)\end{Bmatrix} \qquad (5)$$

We use a logistic specification of the likelihood function so that each

$G(B^j;\alpha,\gamma,\beta) = \left[1+e^{\alpha+\gamma'\mathbf{X}-\beta B^j}\right]^{-1}$, $j = L,\ H$. Here $\mathbf{X}$ is a vector of individual characteristics that enters the estimation and $\alpha,\gamma,$ and β are the parameter to be estimated. As in the previous model, dummy variables designating the nationality of the consumer, demographic variables, and two indicators of food safety concern are incorporated as explanatory variables. The marginal effects of changes in price due to the mandatory labeling program on the probability that the consumer indicates her preference for such a program can be calculated as

$$\frac{\partial \pi^{n}}{\partial B^L} = -\frac{\partial \pi^{yn}}{\partial B^L} = \frac{\beta\ e^{-\left(\alpha_0+\gamma'\mathbf{X}-\beta B^L\right)}}{\left[1+e^{-\left(\alpha_0+\gamma'\mathbf{X}-\beta B^L\right)}\right]^2} \qquad (6.1)$$

and

$$\frac{\partial \pi^{yn}}{\partial B^H} = -\frac{\partial \pi^{yy}}{\partial B^H} = \frac{\beta\ e^{-\left(\alpha_0+\gamma'\mathbf{X}-\beta B^H\right)}}{\left[1+e^{-\left(\alpha_0+\gamma'\mathbf{X}-\beta B^H\right)}\right]^2}. \qquad (6.2)$$

Given $\beta > 0$, an increase in B^L increases the probability that a consumer rejects a mandatory labeling program and at the same time decreases the probability that she will favor it. Equivalently, an increase in B^H decreases (increases) the probability of a yes (no) response in the follow-up question.

4. RESULTS

The survey was sent to random samples of 1000 consumers in each of the three EU countries: France, Germany, and the UK. The questionnaire was translated into the respective languages and monetary units were adjusted to the national currencies. After adjusting for return surveys due to incorrect addresses, response rates were 12.0%, 6.8%, and 15% for France, Germany, and the UK, respectively. Some of the questionnaires were incomplete; therefore, we base our analysis on 76, 43, and 105 observations, respectively. The summary statistics describing the demographic characteristics of our sample are given in Table 2.

The sample included slightly more women than men, which is consistent with the fact that we asked the person responsible for the food shopping to fill out the questionnaire. The mean age varied around 45 years in the three countries. Consumers in Germany and the UK consumed more ground beef than French consumers; however, consumers in France consumed more steak than German and UK consumers. In general, a large preference was exhibited for poultry in the UK and for fish in France.

4.1 Consumer Concern for Food Safety Issues

Table 3 shows summary statistics of ranking of consumer concern for different food safety issues. Concern for food safety was high among consumers in the three surveyed countries; however, there were also considerable differences across countries when one considers specific food safety issues separately. Bacterial contamination ranked highest among all issues in the UK followed by concern about the use of biotechnology. Bacterial contamination was also of much concern to consumers in France, but much less so in Germany. Although food irradiation was not of particularly high concern in Germany and in the UK, it was of concern to consumers in

France. Lastly, use of hormones and biotechnology triggered a high degree of consumer concern, particularly so in France.

4.2 Importance of Brands and Country of Origin Labels

A series of questions were asked to determine the role of several beef attributes in consumers' purchasing decision. Table 4 presents the summary statistics for these results. Marbling was more important for consumers in Germany whereas color played a more important role for consumers in France and in the UK. Price was most important steak attribute in the UK. Variables of particular interest are BRAND and ORIGIN. Interestingly, ORIGIN received the highest rating of all steak attributes in France and Germany. Thus, when purchasing beef steaks, consumers in France and Germany are likely to be more responsive to government imposed country of origin labels than they are to factors such as price, marbling, fat, etc. French, German, and UK consumers found beef brands to be of lesser importance than country of origin labels. This finding suggests that consumers place more importance on government mandated and controlled labels than on private brands. The relative importance of BRAND versus ORIGIN varied by country. For example, BRAND was the second most important purchasing factor behind ORIGIN in France, but in the UK, BRAND received the lowest importance of all purchasing factors.

The results of the estimation of equation 3 are shown in table 5. Results suggest that concern about biological food safety hazards does not influence the level of importance consumers place on brands; however, biological concerns positively influence the level of importance consumers place on country of origin labeling. Concern for production technologies were positively associated with consumers viewing branding and country of origin labeling with high importance. Estimates suggest that a marginal increase in concern for production technology has a large impact on the perceived level of importance of country of origin labels, as

compared to branding. Results also indicate that German and French consumers are considerably more interested in brands and the origin of the beef product than UK consumers.

4.3 Mandatory Labeling of Beef from Cattle Fed GM Crops

Results of the referendum questions regarding consumer demand for beef from cattle fed GM crops are shown in table 6. In France and in Germany, demand for mandatory labeling was higher (95% and 93%, respectively) than in the UK (83 %). Under the scenario that mandatory labeling leads to a 2 % price increase, German consumers were least price sensitive and demand decreased by only 2 %, whereas demand declined by 9 % and 8 % in France and in the UK, respectively.

The results of the estimation of equation 4 are shown in table 7. Concern for production technology was an important explanatory variable affecting the demand for mandatory labeling of beef from cattle fed GM crops. Also, mandatory labeling was desired by more consumers in Germany than in France and in the UK. The only other significant demographic variable in the model was age. As age increased, respondents were less likely to demand a mandatory labeling of beef coming from cattle fed GM crops. Lastly, as expected, the parameter β is positive and a price increase, due to mandatory labeling, decreases the preference for the labeling program. The marginal effects of price are 0.027 when evaluated at B^L and 0.039 when evaluated B^H. This implies that a marginal increase of the cost of mandatory labeling decreases the probability of demand for such a program by 0.027 (0.039) respectively.

5. CONCLUSION

Consumer demand for beef in the European Union has fallen dramatically in recent years. To counteract falling consumer confidence, beef producers and retailers are attempting to "signal" the quality of their product. There are currently two avenues in which beef producers can indicate the level of safety of their product to consumers: private brands and government mandated labels.

In this study, we estimated the relative importance that consumers place on private brands and mandatory "country-of-origin" labels in France, Germany, and the United Kingdom (UK). Results suggest that consumers place a higher level of importance on government mandated labels than on private brands. In France and Germany, mandatory country of origin labels were rated as the most important factor in consumers' beef steak purchasing decision. However, in the UK, country of origin labeling was less important, on average, than steak color, price, and fat content. In France, private brands were rated with high levels of importance; however, brands were of little relative importance in Germany and the UK. In general French and German consumers placed a higher level of importance on both brands and mandatory country of origin labels than did UK consumers.

Results of the study also suggest that a large percentage of consumers demand a mandatory labeling policy for beef from cattle being fed GM crops. This underlines the fact that consumers are not only concerned about direct consumption of GM crops but also about indirect consumption. Over 90 percent of consumers in France and Germany and over 80 percent of consumers in the UK desired mandatory labeling of beef from cattle fed GM crops; however, demand for the labeling program was found to be sensitive to increased beef prices associated with increased labeling and production costs.

Results from the analysis have several interesting implications. First, it appears that private brands are not likely to mitigate consumer concern for beef safety. Although private

brands are perceived with some level of importance, mandatory labels, such as country of origin labels, are viewed as being more important. Private brands and country of origin labels differ not only by their control and enforcement mechanism, be it private or public, but also by the collective of firms on whose behalf they signal. Because consumers cannot directly observe the safety attributes of beef, even after consumption, they are more likely to trust government labels than private brands. The may also prefer origin labels if they consider the product of a particular country/origin to be of superior quality. Our results show that government should play a role in identifying safe beef products if consumer demand is to recover.

Finally, results suggest that concern for GM foods in the EU is high. Research by Gaskell et al. (1999) has indicated that European consumers place little confidence in national institutions to regulate biotechnology. Our results suggest that consumers await a mandatory labeling program. Notwithstanding consumers' demand for a mandatory program, beef industry officials should perhaps take a proactive approach and label beef from animals that have been fed GM ingredients. If the beef industry waits until the public becomes aware of such production practices, another loss in consumer confidence may transpire.

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Table 1. Definition of dummy variables for double bounded logit model

$d_i^{y} = \begin{cases} 1 \\ 0 \end{cases}$	Consumer i demands mandatory labeling at zero costs otherwise
$d_i^{yn} = \begin{cases} 1 \\ 0 \end{cases}$	Consumer i demands mandatory labeling at zero costs but not at a cost of 2% otherwise
$d^{yy} = \begin{cases} 1 \\ 0 \end{cases}$	Consumer i demands mandatory labeling at zero costs and at a cost of 2% otherwise

Table 2. Sample characteristics [a]

Variable	Definition	France	Germany	UK
SEX	0 = female; 1 = male	0.500 (0.503)	0.488 (0.506)	0.410 (0.494)
AGE	Age in years	50.658 (13.869)	45.302 (14.349)	41.695 (12.219)
HHSIZE	Household size	2.842 (1.276)	2.767 (1.172)	2.962 (1.192)
CHILDREN	1 = children in the household; 0 otherwise	0.263 (0.443)	0.302 (0.465)	0.371 (0.486)
SCHOOL [b]	Number of years of education	14.340 (1.734)	12.893 (3.187)	13.196 (2.058)
INCOME	Household income level: 1 = less than $10,000; 2 = $10,000 to 19,999 . . . 19 = $180,000 to $189,999; 20 = more than $190,000	4.237 (2.780)	4.744 (3.935)	5.010 (3.356)
GRBEEF	Number of times per month respondent consumes groundbeef	1.914 (2.288)	3.442 (2.363)	3.448 (3.038)
STEAK	Number of times per month respondent consumes steak	5.507 (4.956)	1.674 (1.739)	2.057 (2.201)
POULTRY	Number of times per month respondent consumes poultry	5.362 (3.337)	3.640 (2.947)	7.381 (4.809)
PORK	Number of times per month respondent consumes pork	4.849 (4.321)	4.814 (3.948)	2.981 (2.808)
LAMB	Number of times per month respondent consumes lamb	2.717 (3.567)	0.572 (1.002)	2.152 (2.018)
FISH	Number of times per month respondent consumes fish	6.796 (5.388)	3.105 (2.040)	4.657 (2.967)
No. Obs.		76	43	105

[a] Number in parentheses are standard errors.

[b] Missing values were filled in for SCHOOL were filled in using a linear regression. Details are given in the appendix.

Table 3. Concern about food safety issues

Variable	Definition	France	Germany	UK
BACT	1 = not concerned; …; 5 = very concerned	4.474 (0.973)	3.209 (1.355)	4.438 (1.009)
SPOIL	1 = not concerned; …; 5 = very concerned	4.474 (0.986)	2.884 (1.295)	4.190 (0.952)
PEST	1 = not concerned; …; 5 = very concerned	4.224 (1.196)	3.744 (1.236)	4.119 (1.041)
ADD	1 = not concerned; …; 5 = very concerned	4.197 (1.166)	3.535 (1.297)	4.029 (1.014)
ANTIBIO	1 = not concerned; …; 5 = very concerned	4.382 (1.166)	4.349 (1.193)	4.171 (1.078)
IRR	1 = not concerned; …; 5 = very concerned	4.395 (1.096)	3.744 (1.513)	3.895 (1.100)
HORM	1 = not concerned; …; 5 = very concerned	4.711 (0.830)	4.395 (1.116)	4.257 (1.000)
BIOTECH	1 = not concerned; …; 5 = very concerned	4.566 (0.984)	4.302 (1.225)	4.267 (1.003)

[a] Number in parentheses are standard errors.

Table 4. Importance of factors in the beef purchasing decision[a]

Variable	Definition	France	Germany	UK
MARBLING	1 = not important; …; 5 = very important	3.408 (1.277)	4.047 (0.899)	3.629 (1.187)
COLOR	1 = not important; …; 5 = very important	4.053 (1.094)	3.860 (0.990)	4.086 (0.867)
FAT	1 = not important; …; 5 = very important	3.263 (1.418)	3.837 (1.022)	3.686 (1.155)
PRICE	1 = not important; …; 5 = very important	3.197 (1.143)	3.349 (1.343)	3.829 (1.113
BRAND	1 = not important; …; 5 = very important	3.711 (1.403)	3.651 (1.361)	2.638 (1.374)
ORIGIN	1 = not important; …; 5 = very important	4.316 (1.235)	4.349 (1.213)	3.590 (1.261)

[a] Number in parentheses are standard errors.

Table 5. Ordered Probit model to estimate the importance of BRAND and ORIGIN in the purchasing decision [a]

Variable	BRAND	ORIGIN
CONST	-1.211**	-2.055***
	(0.576)	(0.634)
Dummy France	0.773***	0.620***
	(0.177)	(0.189)
Dummy Germany	1.125***	1.292***
	(0.226)	(0.255)
BIOL	0.113	0.152*
	(0.083)	(0.090)
TECH	0.469***	0.575***
	(0.093)	(0.098)
SEX	-0.328**	0.134
	(0.148)	(0.159)
AGE	0.001	0.001
	(0.006)	(0.006)
SCHOOL	-0.032	0.038
	(0.035)	(0.037)
INCOME	-0.022	-0.032
	(-0.025)	(0.026)
μ_3	0.394***	0.504***
	(0.072)	(0.108)
μ_4	1.225***	1.109***
	(0.111)	(0.135)
μ_5	1.760***	1.758***
	(0.129)	(0.150)
Scaled R^2	0.317	0.342
Log Likelihood	-333.252	-273.349
No. of Observations	243	243

[a] Number in parentheses are standard errors.

Table 6. Preferences for mandatory labeling [a]

Variable	Definition	France	Germany	UK
GMLABEL	1 = in favor of mandatory labeling of beef from cattle fed GM crops with no price increase; 0 otherwise	0.947 (0.225)	0.930 (0.258)	0.829 (0.379)
GMLABEL2	1 = in favor of mandatory labeling of beef from cattle fed GM crops with a 2% price increase; 0 otherwise	0.855 (0.354)	0.907 (0.294)	0.752 (0.434)

[a] Number in parentheses are standard errors.

Table 7. Double bounded logit model. Demand for mandatory labeling [a]

Variable	Parameter
Constant	-2.492 (1.570)
Dummy France	0.988* (0.542)
Dummy Germany	2.121*** (0.657)
BIOL	-0.004 (0.267)
TECH	1.396*** (0.273)
SEX	0.023 (0.422)
AGE	-0.050*** (0.017)
SCHOOL	0.059 (0.102)
INCOME	0.037 (0.096)
β	0.368*** (0.096)
Log-Likelihood	-109.933
(1 - ln L/ln L0)	0.233
No. of observations	243

[a] Number in parentheses are standard errors.

Appendix A

Missing values for the variable SCHOOL have been filled in using a linear regression, estimated separately for each country:

$$SCHOOL_i = \beta_0 + \beta_1 SEX_i + \beta_2 AGE_i + \beta_3 INCOME_i + \varepsilon_i$$

Table A1. Regression on SCHOOL

Variable	France	Germany	UK
CONST	12.309***	12.301***	13.304***
	(1.687)	(1.501)	(0.777)
SEX	0.886	1.218	-0.248
	(0.732)	(0.933)	(0.420)
AGE	-0.004	-0.010	-0.026
	(0.032)	(0.032)	(0.017)
INCOME	0.409***	0.164	0.223***
	(0.132)	(0.111)	(0.063)
R^2	0.214	0.082	0.124
No. of observation	41	54	111