Marketing GM-Labeled Food Products in the United Kingdom: Can American Agribusinesses Do It Profitably?

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MARKETING GM-LABELED FOOD PRODUCTS IN THE UNITED KINGDOM: CAN AMERICAN AGRIBUSINESSES DO IT PROFITABLY?

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MARKETING GM-LABELED FOOD PRODUCTS IN THE
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Nathan S. Hill and DeeVon Bailey*

ABSTRACT

American food companies selling products in the European Union are faced with the
dilemma of either segregating non-GM components as inputs in food products or labeling their
products as containing genetically modified material. This paper presents an analysis of whether
or not GM-labeled food products could be sold profitably in the United Kingdom. The results
suggest that GM-labeled foods would likely appeal principally to a low-income segment of the
market in the EU, but that selling GM food products might still be profitable.

JEL Classifications: Q13, Q17

Key words: GM food products, profitability, consumer indifference
MARKETING GM-LABELED FOOD PRODUCTS IN THE UNITED KINGDOM: CAN AMERICAN AGRIBUSINESSES DO IT PROFITABLY?*

Introduction

Perhaps as early as the 1960s, large U.S. companies, both agribusiness and non-agribusiness alike, facing mature domestic markets looked offshore for future sales and earnings growth. Much to the delight of Wall Street investors, many food companies, now multinationals, were quite successful using both export and foreign direct investment strategies. So much so that these firms have come to rely on foreign markets for the majority of their sales and profits. Such long-term, now-irreversible strategies are not without risk.\(^1\) In fact, the lure of untapped consumer markets abroad is steeped in risk; political instability, cultural differences, exchange rate risk and an ever-changing regulatory environment are just few of the pitfalls encountered by Big Food in their quest for market growth. The focus of this paper is on the changing regulatory environment for genetically modified (GM) foods.\(^2\)

Marketing GM foods has become a major issue in international trade. Although many GM foods have been declared safe by different government agencies and institutions, including in the U.S. Department of Agriculture (USDA) and U.S. Food and Drug Administration (FDA), many other organizations and individuals believe that GM foods should be segregated and

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* We would like to thank Steve Vickner for his insights on GM food marketing. Any remaining errors are the responsibility of the authors.

\(^1\) The commitment to the offshore strategy is by definition irreversible as it is not a credible strategy for a firm to abandon the majority of its sales and profits.

\(^2\) Given the irreversible offshore strategy, the changing regulatory environment is a special case of the classic hold-up problem in game theory.
labeled as containing GM material in order to give the consumer information to make an informed purchase decision.

In the United States, segregation and labeling of GM food products is not mandatory. However, if American producers and processors of GM foods wish to market these products in Europe, they must comply with the standards and protocols existing in the importing countries where the products are sold. The anticipated expense of segregating and labeling genetically modified foods has deterred many agribusiness firms from promoting GM food products in some foreign countries, especially in the member states of the European Union (EU).

This paper explores the potential impact EU standards and regulations for GM food labeling might have on the market for American GM food products labeled as being GM and sold in the EU, and specifically the United Kingdom (UK). To conduct this study, data are gathered from an attitudinal survey conducted in England and analyzed to determine the effect of consumer demographics on stated preferences for buying GM food products. A case study of a hypothetical American firm's estimated profit margins for both GM-labeled food products and conventionally produced food products is also used to provide suggestions regarding the possible profitability of marketing GM-labeled food products in the EU. The results suggest that GM-labeled foods would likely appeal principally to a low-income segment of the market in the EU, but that selling GM food products might still be profitable. In interpreting our results we emphasize that additional research would need to be conducted to achieve definitive results concerning the question of GM-labeled food products and their acceptability and profitability in

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3 Nearly all GM foods and food products in the U.K. require labeling under GM Food and Feed Regulation (EC) No. 1829/2003. The exceptions to this rule (i.e., foods not required to be labeled as GM products nor as containing GM material) include products created from animals that were fed GM feeds, foods produced using GM enzymes, animal feed products produced using GM or genetically modified micro-organism fermentation processes, and foods made from fermentation products that do not leave GM substrate in the final product (FSA, 2004b).
the EU. However, our results suggest that the requirement to label GM food may not necessarily mean the absence of a profitable market for these products in the EU.

**Background**

Many studies have examined consumer attitudes and willingness to pay (WTP) for GM food products (e.g., Lusk et al.; Lusk and Fox; Baker and Burnham). These studies generally support the notion that people want information about whether or not their food contains GM material. In order to satisfy consumer food safety concerns and other possible risks associated with GM foods, as well as address the potential benefits provided by this new technology, government policymakers are confronted with difficult questions regarding whether or not labeling and/or other legislative remedies should be imposed on GM food products. Numerous countries, particularly in the EU, require GM foods to be labeled. Labeling GM food products in the UK has been mandatory since 1998 (FSA). Because of existing concerns in international markets such as the EU and growing concerns in the domestic market, U.S. agribusiness firms must address the concerns about GM foods appropriately since consumer perception of and acceptance of GM foods are vital to the successful marketing of GM products and their trade in international markets (Chen and Chern).

Food labeling can be an effective tool for communicating information to consumers about nutrition, possible food allergens, food safety, where additional information can be acquired, and other characteristics that may increase the value of the product to consumers at the point of sale. A few examples of labeling that may address these issues include “USDA approved,” “dolphin-free,” “organic,” “reduced-fat,” “low in sodium,” and nutritional information. Though labeling
is mandatory in some countries, the matter of whether or not to label GM foods is an ongoing debate (FAO).

From a regulatory perspective, mandatory labeling of GM foods provides the advantage of giving consumers information to make informed decisions (Caswell). Conversely, if there are no significant differences between products that use GM and those that do not, then false warnings may cause people to forego consumption of a GM product for no good reason. Current FDA policy does not require food products containing GM material to be labeled since the foods have been reviewed and analyzed for safety prior to entering the market (Unnevehr and Hasler). On the other hand, if GM labels are not utilized it may suggest that there are safety issues needing to be concealed from consumers in order sell the products (Caswell).

Past research shows that consumers prefer additional labeling such as logos to clearly identify the use of GM ingredients in food products (FSA; Teisl et al.). Many countries besides the EU have mandatory labeling requirement for GM foods including Australia, New Zealand, and Japan. The EU’s labeling requirements, in terms of the threshold for GM ingredients (0.9%), is the most stringent of these countries (Carter and Gruere). The U.S. government has strenuously resisted EU labeling requirements, even threatening to take the issue before the World Trade Organization (WTO) as a non-tariff trade barrier (Carter and Gruere). However, excepting a softening of the EU’s position or an eventual favorable ruling by the WTO, American agribusiness firms marketing GM food products within the EU will be required to label them.

The requirement to label GM food products sold in the EU raises the question of consumer acceptance and pricing (profitability) for these products. A preliminary analysis is offered here which examines some of the demographic characteristics of consumers in the EU
(specifically the UK) who would be indifferent between purchasing GM or non-GM foods. A measure of the potential profitability of selling GM foods in the EU based on an indirect measure is also calculated.

Methodology

This research gathered data from an attitudinal survey of British consumers about their perceptions of GM foods, their stated willingness to pay for such products, and the perceived usefulness of GM food labels.\(^4\) In May 2004, 65 individuals were selected opportunistically in a mall-intercept type survey in two British cities, Cirencester and Bibury, both of which have populations of approximately 16,000.

Many hypothetical market survey and experimental auction studies have been completed to determine consumer acceptance and WTP for GM and non-GM food items (Lusk et al.; Lusk and Fox; Baker and Burnham; and for a thorough review of this literature see Marks, Kalaitzandonakes, and Vickner, 2003). The uniqueness of this study is that it identifies the characteristics of persons who are indifferent between GM and non-GM food products. This is important in the respect that it identifies the market characteristics of persons that would be willing to purchase GM-labeled food products in the UK at the same price as non-GM food, an important consideration for American and other agribusiness firms wishing to sell GM food products in the EU. While the results provide a new perspective on the issue of GM food products, they must nonetheless be considered cautiously because they are based on a small sample size, and may vary from the opinions and perceptions of the UK and EU populations as a whole.

\(^4\) The survey and full summary of results are available upon request from the authors.
The economic concept of indifference suggests that, assuming constant levels for income and prices, a consumer is equally satisfied consuming a bundle of goods containing GM food products as he/she would be consuming a bundle of goods containing non-GM food products (Figure 1). For this study, consumer indifference between GM and non-GM food products was determined by a positive response to the survey question, "Would you pay the same price for a GM food item as a non-GM food item?"

In cases where only action or inaction is observable, an index function model may be the best method to describe the probability of an action being carried out or not. In this case the action or inaction is the state of the survey respondent being indifferent or not regarding the purchase of GM-labeled and non-GM food products. Greene (2003) suggests that survey participants will base their response, in this case acceptance of GM foods, on "a marginal benefit-marginal cost calculation" which evaluates the perceived benefit from purchasing the non-GM food products and by not purchasing them (i.e., consuming GM foods), thus spending the money on other items. Greene (2003) demonstrates the difference between cost and benefit as an unobservable index variable, \( y^* \), in the following model:

\[
(1) \quad y^* = x'\beta + \epsilon
\]

where the error term, \( \epsilon \), is described as an "innocent normalization" since its actual variance is not known. However, if the actual variance were known, a normalization of the observed data (\( y \) and \( x \)) would not be changed (Greene). The explanatory variables and parameter estimates are represented in this model by \( x \) and \( \beta \), respectively. The model presented by Greene (2003)
shows that because the survey measures only whether participants are indifferent or not toward GM foods, then the observed choice is demonstrated by

\[ y = 1 \text{ if } y^* > 0 \text{ and } y = 0 \text{ if } y^* \leq 0. \]

Greene (2003) states that a constant term must be included in the latent regression if the threshold for \( y^* \) is zero. This is because the marginal cost and benefits are being evaluated indirectly through participants’ choice to be indifferent regarding GM and non-GM food at the same price \((y = 1)\) or to prefer non-GM food if its price is the same as GM food \((y = 0)\). The following equation shows a model for probability if the distribution of the error term is symmetric:

\[
\text{Prob}(y^* > 0 \mid x) = \text{Prob}(\varepsilon < x'\beta \mid x) = F(x'\beta).
\]

For normally distributed disturbances, either a logit or probit model may be used to estimate the probabilities according to Greene (2003).

The variables explaining indifference between GM and non-GM foods for the British survey participants are given by \( \text{FAMGM}, \text{PURCHASE}, \text{CHILDREN}, \text{YOUNG}, \text{FEMALE}, \text{MARRIED}, \) and \( \text{INCOME} \) (Table 1 catalogues the survey questions used to obtain responses, frequency of responses, mean responses for the explanatory variables). Survey participants’ stated familiarity with GM foods and related risks, benefits, and alternative food products is represented by \( \text{FAMGM} \). The parameter estimate on \( \text{FAMGM} \) is expected to have a negative sign because familiarity of GM food could raise more questions of concern in the minds of consumers about GM products which will reduce the probability of consumer acceptance especially in the EU where GM-food has received a tremendous amount of negative press coverage. Survey participants were asked if they knew whether or not they had previously purchased GM foods \( \text{(PURCHASE)} \). The parameter estimate on \( \text{PURCHASE} \) should have a positive sign because, if
the respondent knew he/she had consumed GM food before, one would think that he/she would be likely willing to purchase GM food items again due to habit formation.

The parameter estimate on the variable representing the number of children in the household \((CHILDREN)\) would likely be negative given that many people in the EU view GM food products as being connected with a food safety issue and this issue is likely heightened for families with children. It is anticipated the parameter estimate on the age variable \((YOUNG)\), indicating that participants under 25 years of age, would be negative assuming that young people are less likely to be indifferent between GM and non-GM food than older people. We expect younger consumers would likely have received more information about GM foods through educational programs relative to older consumers. The \(a\ priori\) expected sign for the parameter estimate on the \(FEMALE\) and \(MARRIED\) variables are uncertain and will be determined by the underlying data generation process. \(INCOME\) was annual household income based on categorical responses to a survey question about annual income stated in £s. It is anticipated that the parameter estimate on the \(INCOME\) variable would have a negative sign because the demand for “cause” foods such as non-GM is expected to increase with income.

Table 1 suggests that the average respondent had a moderate understanding about the risks and benefits of GM food products (i.e., the average response was 2.54 for \(FAMGM\)). Eighty percent of the respondents either had not purchased GM-food products or were uncertain whether they had or not \((PURCHASE)\). Thirteen percent of the respondents were 25 years old or younger \((YOUNG)\). Sixty-four percent of the respondents were female \((FEMALE)\) and fifty percent of the respondents were married \((MARRIED)\). Fifty percent of the respondents had an annual household income of £39,999 or less.
Several respondents did not reply to survey questions, especially about income and the number of children in their home. These non-responses can be incorporated into the data set by including a dummy variable for variables with non responses, in this case CHILDREN and INCOME, to the set of explanatory variables. This technique was used in a different setting by Aadland and Caplan. The dummy variable is set to one if the observation contains a response for that regressor, and zero otherwise. Variable non-responses are then coded as zero. Using this technique allows one to distinguish between a response of zero (in which case the corresponding dummy variable would be one) and a non-response (in which case both the variable and the dummy are zero). For example, if a respondent did not reply to the CHILDREN variable, then CHILDREN is set to zero, and the CHILDREN dummy is also set to zero. If the person responded that he has no children, CHILDREN is set to zero, but the CHILDREN dummy is set to one.5

Results for Test of Indifference

Both logit and probit analyses were used to identify respondent characteristics that influenced the probability of their being indifferent between GM and non-GM food products. The logit model had slightly better predictions than the probit, although the value of parameter estimates and their p-values was similar for both models. For brevity, the logit parameter estimates and the marginal effects for the logit model are presented in Table 2. All a priori expectations for signs were met. The two parameters without a priori expectations on signs were for the variables FEMALE and MARRIED, both of which have insignificant parameter

5 Eight observations had non responses for CHILDREN and there were 15 non responses for INCOME. To preserve degrees of freedom, two observations were set at the mean for YOUNG and one non response for FEMALE was set as being female (rounded average response), and one non response for MARRIED was set as 0 (unmarried) based on average responses.
estimates. The results reported in Table 2 suggest that three characteristics, of those considered, can explain indifference between GM and non-GM food products; the level of familiarity with issues about GM-food products (FAMGM), whether or not the respondent knew they had purchased GM-food products before (PURCHASE), and the respondent’s income level (INCOME).

Respondents who considered themselves to be uninformed about perceived benefits and risks related to consuming GM food products were more likely to be indifferent about buying GM food products. For example, the marginal effect reported in Table 2 suggests that, all other things being equal, a respondent with a “Very Good” knowledge of benefits and costs of GM food products would be 27.5% less likely to be indifferent about consuming GM food than a person with only a “Good” knowledge of these costs and benefits. This is not a good result for companies considering marketing GM-labeled food products in the UK. If one assumes that negative information about the potential costs and benefits of GM foods will continue to be proliferated to European consumers, it will have a detrimental impact on the demand for GM food products. In other words, given the negative slant of most of this information in Europe, this represents a negative trend in terms of the market for GM-labeled foods. However, respondents who knew they had purchased GM food products before were 57.7% more likely to be indifferent about purchase GM food than respondents who indicated they had not purchased GM food before or were uncertain whether they had or not (PURCHASE in Table 2). This suggests that enticing consumers to try GM food items is a method to help them have a increased positive attitude about these products. This may be related to consumer satisfaction with the

Even though these variables have insignificant parameter estimates, the negative sign for FEMALE would be consistent with a higher level of sensitivity about food safety for the person in the household most likely to be responsible for food purchase decisions. The positive sign on the coefficient for MARRIED would also be consistent with added pressures to keep food expenditures in line and, hence, perhaps more price sensitivity that might result in a willingness to purchase GM-food products if they are less expensive than non-GM food products.
quality of these products (or perhaps their price) when they are consumed which may override some or all of the marginal concerns they may have about potential risks.

Higher incomes (*INCOME*) tended to make respondents less indifferent about purchasing GM food products compared to non-GM food products. For example, a respondent in income category 4 (£40,000-£49,999) would be 11.5% less likely to be indifferent about GM food products than a person in income category 3 (£30,000-£39,999) (Table 2 marginal effect for *INCOME*).

Taken as a whole, the results offer both negative and positive indications to American companies considering marketing GM food products in the UK and the EU. On the positive side, over half of the respondents (35 out of 65) indicated that they were indifferent about purchasing GM food products or non-GM food products (Table 1 *INDIFFERENCE*). This suggests a sizeable share of the market doesn’t care whether food products are GM or not. Persons who know they have consumed GM food products before would likely be willing to purchase them again. On the negative side, persons who consider themselves to be educated about the benefits and risks associated with GM food products and/or who have high incomes are less likely to be willing to purchase GM food products compared to non-GM food products.

Based on results obtained from this small sample, a market appears to exist for GM-labeled food products exists in the UK. However, this market might be considered a “low-end” market given that people considering themselves knowledgeable about GM food and who have high incomes would likely not purchase GM-labeled food products, at least at the same price as non-GM food products. This suggests, however, that a strategy using different product lines, some that are GM and some that are not, might be the appropriate strategy for marketing food
products in the UK and the EU. Again, this result would need to be confirmed by broader market analysis than the small sample used here.

**Profitability Analysis**

Entrenched American food processors in the European market have no choice but to absorb the additional expenses associated with mandatory segregation of the supply chain and additional costs for the GM labeling. The additional expenses by definition reduce the gross profit margins of American processors and hence make these markets less attractive. A profit analysis would offer help explain the financial economic consequences of these additional costs.

Microeconomic theory can be used to estimate profitability for a product if its price or marginal cost is known and if its price elasticity of demand is known. For example, the well-known result in equation (4) can be used to estimate profit margins.

\[
\frac{P - C'}{P} = \frac{1}{|\eta|}
\]

Allow \( P \) to represent product price, \( C' \) to represent marginal cost (MC), and \( \eta \) to characterize the price elasticity of demand. Product prices may be obtained at the point-of-purchase using retail scanner data. With the appropriate demand system model, \( \eta \) may be estimated using the scanner data as well. Typically, data for MC is not observable. However, MC may be imputed with average \( P \) and estimated \( \eta \). With some algebra, equation (4) can be rearranged and used to obtain an estimate of MC.

\[
\left[ \frac{P - |\eta|P}{-|\eta|} \right] = C' = MC.
\]

Assuming profit maximizing behavior, marginal revenue (MR) is represented by the expression on the left-hand side of the equation, while the right-hand side represents MC.
Assuming that constant returns-to-scale (CRTS) in production exist in the industry and that a firm’s average fixed costs are nearly zero, MC is equal to average cost (AC) (Varian). For many food companies, the CRTS assumption is quite reasonable; doubling inputs leads to doubling outputs. The firm’s percentage markup may be re-expressed as

\[
\text{Markup} = \left[ \frac{P - AC}{P} \right]
\]

where \(AC=MC\).

Markups, often called gross profit margins, measured similarly to (6) are commonly found in annual (10K) and quarterly (10Q) consolidated financial statements for publicly-held food companies.\(^7\) Gross profit margins are the average markup across all the firms products, however, but they still provide an interesting point of comparison for estimated markups obtained using equation 6. In a previous study using data for an agribusiness marketing GM foods in the Netherlands, mean prices and estimated price elasticities are available and can be used to determine the markups as defined by equation 6 by product category (Marks, Kalitzandonakes, and Vickner, 2004).

Table 3 summarizes estimated demand elasticities, average prices, imputed marginal costs and estimated product markups. Estimated demand elasticities and average prices were obtained from Marks, Kalaitzandonakes and Vickner (2004). The price sensitivity of GM food is driven by the fact that there are more substitutes for GM food items. Methodology used to obtain the demand elasticities is not addressed here, however, it is worth noting the elasticities are a function of not only the actual underlying transactions data observed in the marketplace (i.e., the prices and quantities) but also the functional form of demand imposed on the data

\(^7\) Gross profit margins are defined specifically as (Sales−Cost of Goods Sold)/Sales. Factoring ‘quantity’ out of the numerator and denominator results in the expression \((P - AC)/P\).
generation process by the econometrician. Estimated markups range from 19.32% to 36.84%. Since these are simply estimates based on some standard microeconomic principles, it is of interest to compare these results to average markups for firms marketing similar products.

Hill (2005) used a financial economic methodology to calculate gross profit margins from annual report information for large U.S.-based food firms including ConAgra, General Mills, Kellogg, Kroger, Procter & Gamble, Sara Lee, and Tyson and found margins ranged between 6.73% (Tyson) and 42.55% (Kellogg) (Table 4). Markups for the GM products are quite consistent with actual average markups of these behemoth multinational agribusinesses. Individual firms would need to determine if the estimated profit margin for GM food products in the EU would be high enough to bear the additional expenses, or at least the added costs of segregation and labeling that could not be immediately passed on to consumers. Although the current research compares the estimated percentage markups from various American processors to only one set of GM food products, the results indicate that American processors selling GM foods in the European food market, there may be an opportunity to sell GM food items and receive a return similar to that of the company-wide gross profit margins.

Among the obstacles encountered by American agribusiness firms from marketing GM foods in European countries, such as the UK, is the added expense of segregation and labeling that is required in the EU. Specifically, the initial set up costs for segregation between the farm and the consumer would require additional direct and hidden costs. Such set up expenses might include cleansing of equipment or separate equipment for producing and processing each GM food product. Additionally, buffer zones on farms (strips of land planted around the circumference of each field with GM crops) would be required in order to prevent drift pollen from spreading to non-GM crops, as well as, to provide an area for pests to target so that
resistance to GM crops will be avoided or delayed. This increase in production costs, while borne by the farmer, could also transmit to higher input costs to the processor. Finally, testing and analysis for GM content levels, and specific labeling protocols that would be printed on GM food packaging that comply with current EU labeling standards would be required.

Studies such as those conducted by Buckwell et al. (cited by Burton et al., p. 9) and the individual studies combined in the research of Wilson et al. suggest both farmers and processors would incur additional cost if segregation and labeling were implemented into their procedures. However, if compared to the overall return which could be anticipated for GM foods marketed by American firms in the UK or other European countries, it may still be a lucrative proposition for American producers and processors. Clearly, each processor would have to evaluate the added expenses their specific firm would incur in order to segregate GM from non-GM products. Additionally, the added costs producers would encounter would also have to be considered.

Conclusions

This research suggests that there are arguments both for and against American producers and processors of marketing GM foods in European markets. Although some factors may be dissuading, producers and processors may still be able to obtain a sufficient return on investment to look beyond such matters. Each set of producers and processors would need to evaluate their own circumstances to determine if potential benefits would exceed the anticipated costs and risks that might be encountered by marketing GM foods in the U.K. and other E.U. American producers and processors must first be willing to incur any segregation and labeling expenses that would accompany such foods in order to comply with the standards of EU legislation.
There are significant differences between segregation and labeling requirements in the United States and the European Union, which raise the question of why GM food labeling is necessary. American producers and processors have argued that labeling GM foods is unjustified since these products have been tested and deemed to be as safe as their non-GM counterparts, according to Lupien (cited by Kalaitzandonakes and Phillips). Furthermore, “... any labeling regime for GM foods has immediate practical impact on trade” (Kalaitzandonakes and Phillips, p. 182). In the case of mandatory GM labeling in the EU, it is implied that labeling regimes for GM food products in the EU restrict or impede American agribusinesses from selling GM food products because at present most American segregation and labeling efforts regarding GM and non-GM foods do not meet EU standards. Moreover, GM labeling may send a mixed message that there is reason for alarm regarding GM foods, even though they have been tested and deemed as safe, thus causing consumers to refrain from purchasing such goods (Runge and Jackson). The results of this analysis suggest that GM-labeled food products can be marketed profitably to some segments of the EU market. However, if one considers that brand equity may be hurt as a result of GM-labeling, it is understandable why American food companies are concerned about mandatory labeling requirements.

From a consumer’s perspective, specifically in the EU, the “right to know” what is in the food one is consuming is strongly upheld (Huffman). This concern for “knowing” what is in consumable goods may be derived from the minimal confidence that many European consumers have in their governments (Christensen et al.). The research conducted by Christensen et al. suggests that British consumers prefer private certification regarding the safety of food products, while Americans place higher confidence in food safety certifications made by government agencies.
This lack of confidence from European consumers pertaining to government safety certifications, outbreaks of BSE, or Mad-Cow Disease, and other food contamination outbreaks over the past decade have contributed to the need for mandatory traceability and labeling of food products (Bailey and Slade), including segregation and labeling of GM foods. Findings from various past studies indicate that consumers highly favor mandatory labeling of GM foods in the EU (Wolf and Domegan; FSA).

High entry-level expenses to segregate and label GM food products have been a deterrent for some American agribusinesses who have considered expanding into foreign markets that require such standards (Caswell), such as the case with the EU. The majority of American producers and processors has not dealt with crop segregation, and may perceive the costs and risks associated with segregating and labeling GM products as being unprofitable. This may be true for some food products, but a careful cost/benefit analysis conducted by each agribusiness firm may reveal that UK or other EU markets may return profits equally as favorable as domestic market returns.
References


Table 1. Survey Questions, Frequencies, and Mean Responses to British Survey

<table>
<thead>
<tr>
<th>Question</th>
<th>Code</th>
<th>Frequencies</th>
<th>Mean</th>
<th>Variable and Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>How would you describe your understanding of GM foods with respect to risks and alternative foods?</td>
<td>Very Good=1</td>
<td>6</td>
<td>2.54</td>
<td>FAMGM=Code</td>
</tr>
<tr>
<td></td>
<td>Good=2</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor=3</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very Poor=4</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever purchased GM foods or products?</td>
<td>Yes=1</td>
<td>13</td>
<td>2.34</td>
<td>PURCHASE=1 if</td>
</tr>
<tr>
<td></td>
<td>No=2</td>
<td>17</td>
<td></td>
<td>Yes, 0 otherwise</td>
</tr>
<tr>
<td></td>
<td>Uncertain=3</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Would you pay the same price for a GM food item as a non-GM food item?</td>
<td>Yes=1</td>
<td>35</td>
<td></td>
<td>INDIFFERENCE=Code</td>
</tr>
<tr>
<td></td>
<td>No=0</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please select the age group that best fits you.</td>
<td>Under 18=1</td>
<td>5</td>
<td>3.41</td>
<td>YOUNG=1 if code ≤ 2, 0 otherwise</td>
</tr>
<tr>
<td></td>
<td>18-25=2</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>25-35=3</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>36-55=4</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>56+=5</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Male=0</td>
<td>23</td>
<td>1.64</td>
<td>FEMALE=Code</td>
</tr>
<tr>
<td></td>
<td>Female=1</td>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td>Married=1</td>
<td>32</td>
<td>1.88</td>
<td>MARRIED=1 if Code = 1, 0 otherwise</td>
</tr>
<tr>
<td></td>
<td>Single=2</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Divorced=3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Partner=4</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of children</td>
<td>Continuous variable</td>
<td>1.25</td>
<td>CHILDREN</td>
<td></td>
</tr>
<tr>
<td>Annual household income</td>
<td>Under £20,000=1</td>
<td>11</td>
<td>3.22</td>
<td>INCOME=Code</td>
</tr>
<tr>
<td></td>
<td>£20,000-£29,999=2</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>£30,000-£39,999=3</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>£40,000-£49,999=4</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>£50,000-£64,000=5</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>£65,000+=6</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a Frequencies may not add to 65 for each question due to nonresponses.
Table 2. Parameter Estimates for Logit Model Together with Marginal Effects

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Parameter Estimate</th>
<th>Marginal Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-2.497</td>
<td>-0.614</td>
</tr>
<tr>
<td></td>
<td>(1.697)</td>
<td>(0.422)</td>
</tr>
<tr>
<td>$FAMGM$</td>
<td>1.119</td>
<td>0.275</td>
</tr>
<tr>
<td></td>
<td>(0.466)**</td>
<td>(0.115)**</td>
</tr>
<tr>
<td>$PURCHASE$</td>
<td>2.347</td>
<td>0.577</td>
</tr>
<tr>
<td></td>
<td>(0.996)**</td>
<td>(0.241)**</td>
</tr>
<tr>
<td>$YOUNG$</td>
<td>-0.883</td>
<td>-0.217</td>
</tr>
<tr>
<td></td>
<td>(0.943)</td>
<td>(0.231)</td>
</tr>
<tr>
<td>$FEMALE$</td>
<td>-0.437</td>
<td>-0.107</td>
</tr>
<tr>
<td></td>
<td>(0.712)</td>
<td>(0.175)</td>
</tr>
<tr>
<td>$MARRIED$</td>
<td>0.668</td>
<td>0.164</td>
</tr>
<tr>
<td></td>
<td>(0.952)</td>
<td>(0.234)</td>
</tr>
<tr>
<td>$CHILDREN$</td>
<td>-0.117</td>
<td>-0.029</td>
</tr>
<tr>
<td></td>
<td>(0.391)</td>
<td>(0.096)</td>
</tr>
<tr>
<td>$INCOME$</td>
<td>-0.468</td>
<td>-0.115</td>
</tr>
<tr>
<td></td>
<td>(0.275)*</td>
<td>(0.067)*</td>
</tr>
<tr>
<td>$CHILDREN DUMMY$</td>
<td>-1.286</td>
<td>-0.316</td>
</tr>
<tr>
<td></td>
<td>(1.80)</td>
<td>(0.265)</td>
</tr>
<tr>
<td>$INCOME DUMMY$</td>
<td>2.591</td>
<td>0.636</td>
</tr>
<tr>
<td></td>
<td>(1.326)**</td>
<td>(0.324)**</td>
</tr>
</tbody>
</table>

Predictions:

<table>
<thead>
<tr>
<th>Actual</th>
<th>Predicted</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>65</td>
</tr>
</tbody>
</table>

$^a$ Standard errors are in parentheses.

*Denotes statistically different than zero at the 10% level of confidence.

**Denotes statistically different than zero at the 5% level of confidence.
Table 3. Estimated Profit Margins for Selected GM Foods in the Netherlands

<table>
<thead>
<tr>
<th>Product</th>
<th>Demand Elasticity ((\eta))</th>
<th>Average Price</th>
<th>Imputed Marginal Cost</th>
<th>Estimated Markup</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM Soup</td>
<td>-3.6315</td>
<td>3.8530</td>
<td>2.8093</td>
<td>27.09%</td>
</tr>
<tr>
<td>GM Meat</td>
<td>-2.7146</td>
<td>10.8219</td>
<td>6.8353</td>
<td>36.84%</td>
</tr>
<tr>
<td>GM Pizza</td>
<td>-2.7675</td>
<td>14.9805</td>
<td>9.5675</td>
<td>36.13%</td>
</tr>
<tr>
<td>GM Fish</td>
<td>-5.1773</td>
<td>12.9019</td>
<td>10.4099</td>
<td>19.32%</td>
</tr>
</tbody>
</table>

Data source: Marks, Kalaitzandonakes and Vickner, 2004. Prices and costs in Dutch gilders.
Table 4. Gross Profitability for Selected American Food Companies

<table>
<thead>
<tr>
<th>Food Company</th>
<th>Revenue (ttm)</th>
<th>Gross Profit (ttm)</th>
<th>Gross Profit Margin</th>
<th>ttm as of</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConAgra</td>
<td>$14.52 B</td>
<td>$3.82 B</td>
<td>26.31%</td>
<td>31-May-04</td>
</tr>
<tr>
<td>General Mills</td>
<td>$11.07 B</td>
<td>$4.40 B</td>
<td>39.75%</td>
<td>31-May-04</td>
</tr>
<tr>
<td>Kellogg</td>
<td>$9.19 B</td>
<td>$3.91 B</td>
<td>42.55%</td>
<td>30-Jun-04</td>
</tr>
<tr>
<td>Kroger</td>
<td>$54.43 B</td>
<td>$14.15 B</td>
<td>26.00%</td>
<td>31-May-04</td>
</tr>
<tr>
<td>Procter &amp; Gamble</td>
<td>$51.41 B</td>
<td>$21.24 B</td>
<td>41.32%</td>
<td>30-Jun-04</td>
</tr>
<tr>
<td>Sara Lee</td>
<td>$19.57 B</td>
<td>$7.24 B</td>
<td>37.00%</td>
<td>30-Jun-04</td>
</tr>
<tr>
<td>Tyson</td>
<td>$25.86 B</td>
<td>$1.74 B</td>
<td>6.73%</td>
<td>30-Jun-04</td>
</tr>
</tbody>
</table>

ttm = trailing twelve months.
Data source: 10Ks and 10Qs from the U.S. Securities and Exchange Commission (SEC) EDGAR database and Yahoo! Finance.
The consumer utility function is the same for GM and non-GM food products.

Figure 1. Indifference Curve for GM and Non-GM Food Products