Bez čvrstih stavova, ali s mnogo zahtjeva: čvrstoća uvjerenja i želja za označavanjem genetski modificirane hrane

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Abstract:
There are two opposing viewpoints regarding consumers' acceptance of genetically modified (GM) foods and their desire for the labeling of these foods. Some suggest consumers are unconcerned and do not desire any GM labeling while others indicate the opposite. The mixed results may be because consumers are capable of making finer distinctions than surveys have called for, and appear to have evaluation schemes that are quite sensitive to information about the potential benefits and risks associated with GM foods. Using a mix of statistical approaches, we find consumers are quite different and nuanced in terms of their preferences for GM labeling policy. Consumers with less-defined views require mandatory labeling of the most stringent type and require the most amount of information to be placed on labels. In contrast, consumers with stronger viewpoints (either pro- or con-GM) are more relaxed in their labeling and information requirements.

Keywords: labeling policy, cluster analysis
JEL classification: Q18, M31

Bez čvrstih stavova, ali s mnogo zahtjeva: čvrstoća uvjerenja i želja za označavanjem genetski modificirane hrane

Sažetak:
Postoje dva oprečna stajališta u odnosu na prihvaćanje genetski modificirane hrane (GM) i želje potrošača za označavanjem tih proizvoda. S jedne strane, postoji mišljenje kako potrošači nisu zainteresirani i kako stoga ne postoji želja za označavanjem GM proizvoda. Drugi se protive tom stavu. Podvojena mišljenja možda nastaju kao posljedica činjenice da u svakodnevnom životu potrošači mogu razlikovati više mogućnosti nego što se to u istraživanjima razmatra. Istodobno, potrošači mogu na različite načine procjenjivati informacije o mogućim koristima i rizicima povezanim s GM proizvodima. Pomoću različitih statističkih pristupa, u ovom se radu pokazuje kako potrošači imaju prilično različite preferencije prema uvođenju označavanja GM proizvoda. Potrošači koji nemaju čvrsto izražene stavove često zahtijevaju obvezno označavanje proizvoda najstrože vrste te traže da oznake sadrže najviše informacija. Upravo suprotno, potrošači s jasnije izraženim stavovima (ili za ili protiv GM proizvoda) u pravilu postavljaju manje zahtjeva prema politici označavanja GM proizvoda.

Ključne riječi: označavanja proizvoda, klaster analiza
JEL klasifikacija: Q18, M31

1 Introduction

There are two opposing viewpoints regarding consumers' acceptance of genetically modified (GM) foods and their desire for the labeling of these foods. Industry leaders believe consumers accept these foods because the public shows a willingness to consume them. For example, most milk in the U.S. is produced with the use of bST hormone, even though bST-free milk is available, clearly labeled and advertised. In fact, initial sales for bST-free milk were so weak it almost disappeared from the market (Webb 2006).[1] In addition, some national surveys indicate that consumer concerns toward GM foods are low and few individuals desire any GM labeling (IFIC 2006). In contrast, most of the scientific literature indicates that people are concerned about the GM technology (e.g., Huffman et al. 2002), are willing to pay to avoid GM foods (e.g., McClusky et al. 2001) and would like to see GM foods labeled (e.g., Teisl et al. 2003a).

A problem with many of these studies is that they often refer to the GM technology in imprecise terms so it is hard to interpret the attitudes levels being reported (Fischhoff and Fischhoff 2001). For example, willingness to pay studies commonly assume the genetic modification only provides benefits to consumers by lowering prices; i.e., the studies do not look at situations where individuals may derive non-price benefits (e.g., improved nutritional characteristics). In turn, it is not surprising that survey respondents would respond negatively to GM content because new technologies are often viewed as having long-term risks.[2] Further, consumers appear to be capable of making finer distinctions than surveys have called for, and appear to have complex evaluation schemes that are quite sensitive to information about the potential benefits and risks associated with GM foods (and possibly to the framing of survey questions). Because consumers are heterogeneous in how they weigh these costs and benefits, recent authors have focused on segmenting consumers by how they evaluate GM foods (e.g. Vermeulen 2004; O'Connor et al. 2005; Roosen, Thiele, and Hansen 2005; Kontoleon 2003; Verdurme, Gellynk and Viaene 2001; Ganiere, Chern and Hahn 2004). However, none of these studies examine whether respondents' views on GM labeling policy differ across segments; here we extend this literature by examining this very point.

2 Methods

During the summer of 2002, we administered a mail survey to a sample of 6,172 U.S. residents. The sample design consisted of a nationally representative group of adults (5,462 individuals) with an additional over-sample of Maine (710 individuals) residents.[3] The survey was administered with multiple mailings and with an incentive paid for

[1] Recently bST-free milk has gained market share - up to 25 percent - in some markets (Webb 2006).

[2] Studies including a GM-related benefit often find consumers are indeed willing to buy these foods (e.g., Boccaletti and Moro 2000; Verdurme, Gellynk and Viaene 2001; Teisl et al 2003a).

[3] For all analyses, the data are weighted to adjust for any over-sampling.

returned surveys; in total 370 Maine residents and 1,915 U.S (non-Maine) residents responded to the mail survey for a response rate of 52 and 35 percent, respectively.[4] The mail survey instrument consisted of questions used to elicit respondents' perceptions of various food technologies, knowledge of the prevalence of GM foods, perceptions of the potential benefits and risks of GM foods, reactions to alternative GM labeling programs, and willingness to pay for, or avoid GM foods.

Consumer Segmentation

In the survey we provided respondents with a list of 16 potential benefits and 16 potential costs of GM foods and asked them to rate each one on importance; we used factor analysis to find the set of underlying factors influencing consumers' perceptions. Next, we used a hierarchical cluster analysis[5] on the revealed factors to segment respondents and then examined each of the clusters in relation to their mean scores on benefit and cost variables.

In order to better understand the three consumer segments, we examined their relationship with other variables in the survey. In addition to respondent characteristics (children in the household, respondent's gender, age, education, income, allergies to foods, level of vegetarianism), we used variables measuring the respondent's concern with food production. The survey contained several questions to measure respondent's concerns[6] with food production in general, and related to particular food technologies (use of antibiotics, pesticides, artificial growth hormones, GM ingredients, irradiation, artificial colors/flavors, pasteurization and preservatives). Because concerns are highly correlated (Cronbach alpha of 0.91) we used these variables to construct a *concern with food technology index*. Then we used multinomial logit regression with the segment classification as a dependent variable and the above as independent variables to identify the predictors of cluster membership. Respondents were asked about their preferences[7] regarding various pieces of information that could be displayed on a GM label.

3 Results

The factor analysis on the benefits and risks indicates that, as expected, two factors (Table 1) explain respondent reactions to the benefits (Factor 1 is called *Own benefits* (OB) because these relate to the consumer; Factor 2 is called *Producer benefits* (PB) because these relate to the producer) and two (Table 2) explain respondent reactions to the costs (Factor

[4] Our survey respondents are relatively representative of the characteristics of the U.S. adult population.

[5] We used Ward's method with squared Euclidian distances.

[6] Concerns are rated on a scale from 1 (not at all concerned) to 5 (very concerned).

[7] Importance is on a scale from 1 (not at all important) to 5 (very important).

1 is *Own cost* (OC) as it relates to health costs that consumers would bear; Factor 2 is *Producer cost* (PC) as it describes the cost born by the producer).

Table 1 **Respondents' Importance Ratings of Various Benefits Potentially Associated with GM Foods, with Rotated Factor Loadings**

	Importance[a]	Factor 1	Factor 2
Decreased use of pesticides	4.12		0.67
Increased food production in LDC's	3.92		0.64
Lower food prices	3.84	0.68	
Decreased use of antibiotics	3.82		0.70
Increased vitamins/minerals	3.82	0.55	
Decreased total fat/saturated fat	3.76	0.68	
Increased disease resistance in crops	3.69		0.72
Increased anti-oxidant levels	3.63	0.57	
Increased protein in foods	3.58	0.73	
Longer shelf life	3.53	0.69	
Removal of allergens	3.46	0.69	
Decreased need for irrigation	3.45		0.71
Increased flavor	3.43	0.78	
Increased frost resistance	3.25		0.67
Foods modified to contain vaccines	3.09	0.74	
Increased size of fruits/vegetables	2.79	0.78	

[a] *where 1 = not at all important, 3 = somewhat important, and 5 = very important*

Table 2 **Respondents' Importance Ratings of Various Risks Potentially Associated with GM Foods, with Rotated Factor Loadings**

	Importance[a]	Factor 1	Factor 2
Unknown long-term health effects	4.42	0.82	
Increased risk of antibiotic resistant bacteria	4.38	0.76	
Increased use of pesticides	4.21		0.60
Unknown toxins produced	4.19	0.83	
Unknown long-term environmental effects	4.18	0.75	
Genetic contamination of the environment	4.13	0.69	
Increased use of herbicides	4.11		0.63
Risks to wildlife & insects	4.08	0.58	
Damage to topsoil	3.93		0.60
Unknown allergens introduced	3.92	0.77	
Spread of disease resistance to weeds	3.87		0.87
Spread of pest resistance to weeds	3.86		0.87
Spread of herbicide tolerance to weeds	3.85		0.88
Control of agriculture by biotech. firms	3.8	0.53	
Risks to species diversity	3.74		0.63
Ethical issues	3.57		0.56

[a] *where 1 = not at all important, 3 = somewhat important, and 5 = very important*

After inspecting the hierarchical tree from the cluster analysis (Figure 1) we conclude there are 3 clusters and perform k-means segmentation (k=3). By examining the clusters in relation to their mean scores on the benefit and cost variables (Figure 2) we find the segments can be described in the following way:

- Cost avoiders: are not interested in potential benefits; they are very worried about their own risks associated with GM foods.
- Benefit seekers: rate their own and producer benefits higher than costs and are not worried about the potential health risks associated with GM foods. It seems these consumers believe the technology can bring benefits at a low personal cost.
- Balanced but interested: find both benefits and costs important; unlike the other segments, these consumers are not committed to any of the above points of view.

In order to better understand the three consumer segments, we examine their relationship with demographic variables, and variables related to the concern with food production and technologies. The data show there are no differences among the segments regarding the presence of children in the household and income. However, we find that the segments differ on age, education and gender. The segment *Balanced but interested* tends to be least educated while *Cost avoiders* are likely to be most educated. *Cost avoiders* also tend to be younger than the other two segments. *Cost avoiders* and *Balanced but interested* are more likely to be female, while *Benefit seekers* are more likely to be male. There are no significant differences among the segments regarding food allergies.

Figure 1 **Hierarchical Cluster Segmentation**

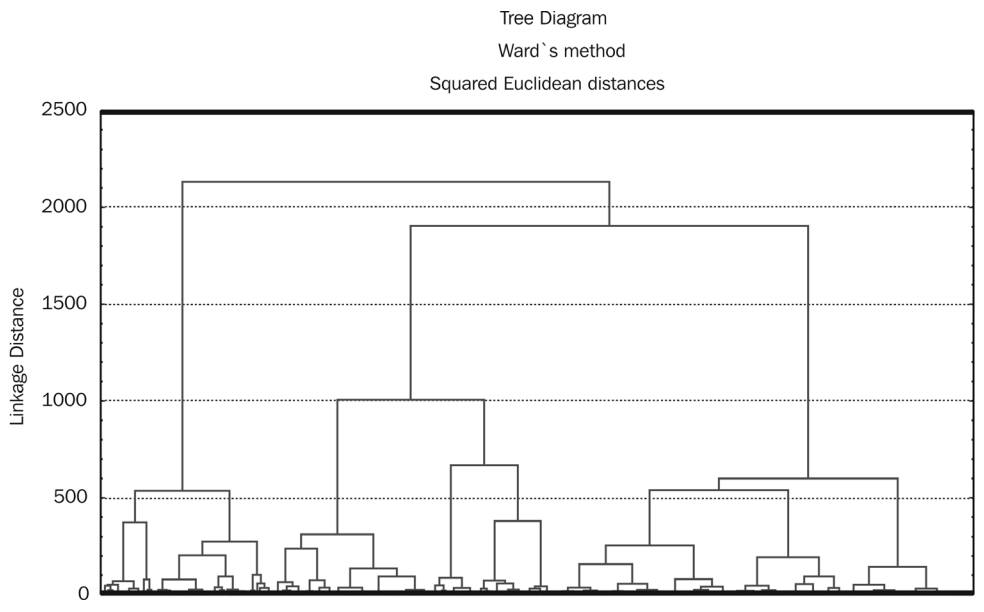

Figure 2 **Plot of Means for Each Segment**

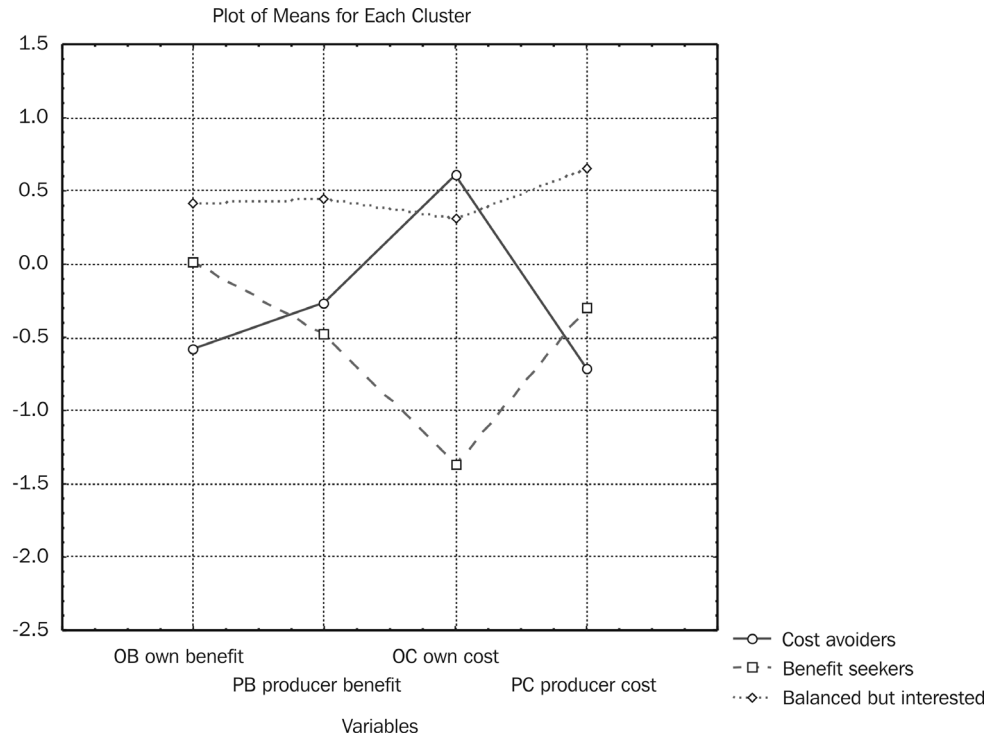

Table 3 **Regression Coefficients: Equation to Predict of Segment Membership**[a]

Variables	**Cost avoiders**	**Benefit seekers**
Intercept	0.934	4.694**[b]
Overall concern	-0.064	-0.326**
Concern with food technologies	-0.638**	-1.327**
Gender	0.173	-0.331**
Age	-0.018**	0.002
Education	0.130	0.071**
Children in household	0.061	0.026
Food allergies	0.053	-0.707
Income	0.000	0.000

[a] *Reference category is membership in the segment* Balanced but interested
[b] *** denotes significance to 0.01, *** denotes significance to 0.05*
Likelihood score = 498.3926, N=1501

Regarding variables addressing the concern about food, we find significant differences among the segments. *Benefit seekers* express less overall concern than the other two segments that do not differ significantly on that issue. When it comes to the concern about food technologies, *Benefit seekers* are least worried, followed by *Cost avoiders*, while *Balanced but interested* are most worried.

Table 4 **Respondents' Experience with, and Desires for, GM Food Labeling**			
	Cost avoiders	**Benefit seekers**	**Balanced but interested**
Percent seeing a GMO-free label[a]			
No	68	75	74
Yes	17	13	10
Don't know	15	12	16
Percent wanting food labels to indicate whether the product contains GM ingredients[b]			
No	10	32	7
Yes	90	68	93
Percent wanting different labeling approaches[c]			
mandatory labeling	86	80	92
voluntary labeling	14	20	8

[a] *Pearson* $\chi_{(2)} = 15.036$, $p=0.005$
[b] *Pearson* $\chi_{(2)} = 156.086$, $p<0.000$
[c] *Pearson* $\chi_{(2)} = 22.94$, $p<0.000$

We find that the segments behave differently when asked about GMO labeling.[8] For example, if we look at their attention to labels,[9] we find that *Cost avoiders* and *Balanced but interested* both read nutrition labels relatively more often compared to *Benefit seekers* (means: 3.69, 3.79, and 3.33 respectively, ANOVA $F_{(2,1775)}= 29.8$, p=0.000). Most people in each segment have heard about GM foods (81 percent of *Cost avoiders*, 69.8 percent of *Benefit seekers* and 64.61 percent of *Balanced but interested*); however, a majority of each segment have not seen a GM-free food label (Table 4). *Cost avoiders* are more familiar with GM-free labels since they are possibly more sensitized to the issue.

When asked whether they would like to see the labels on foods, most consumers answered positively, although a significantly larger percentage of *Benefit seekers* said no. Among the respondents who are in favor of labeling, we find there is a significant difference among clusters in terms of their preferences for mandatory vs. voluntary labeling; *Balanced but interested* are more in favor of mandatory labeling, while *Benefit seekers* are least in favor. Interestingly, *Cost avoiders* also show more inclination to allow for voluntary labeling.

When we investigate this issue more deeply we find that the segments do indeed exhibit differences in their choice of labeling and testing programs (Table 5). *Balanced but interested* want mandatory testing and labeling of all foods, *Cost avoiders* want mandatory testing but are willing to have looser labeling policy, while *Benefit seekers* are in favor of voluntary testing and labeling policy.[10] It is interesting that despite pronounced concerns *Cost avoiders* are comparatively more inclined toward the option that only foods containing GM ingredients display a label. This may be because they are already more familiar with GM labels, and more educated. Thus, they may be more likely to search for

[8] In the US, GM labels are voluntary and appear only on foods not containing GM ingredients.

[9] Reading nutrition labels is rated on a scale from 1 (never) to 5 (always).

[10] This is the current US approach.

information and more adept in interpreting it; they may not need the most detailed level of information.[11] Another possibility is that the *Cost avoiders* understand that if only GM foods need to be tested and carry a label, then the GM-labels are likely to act as a warning label. Thus, their policy preference may be a way to punish the producers of GM products.

Table 5 **Respondent Preferences for GM Testing and Labeling Policies; Observed Minus Expected Frequencies**

	Cost avoiders	Benefit seekers	Balanced but interested
Testing is mandatory and all foods must display a label	-39.35	-16.56	55.91
Testing is mandatory and only foods containing GM ingredients display a label	31.26	-1.74	-29.53
Testing is mandatory and only foods **not** containing GM ingredients display a label	9.86	-1.96	-7.89
Testing is voluntary and only foods **not** containing GM ingredients display a label	0.80	17.16	-17.96
Testing and labeling are unnecessary	-2.57	3.1	-0.53

Pearson $\chi_{(8)} = 64.65$; $p<0.000$

When examining respondents' preferences regarding the importance of various pieces of information that could be displayed on a GM label (Table 6), we find that *Benefit seekers* assign least importance to all of these, with the exception of information about any benefits associated with modification where they do not significantly differ from *Cost avoiders*. *Balanced but interested* consistently ascribe higher importance to each piece of information relative to *Cost avoiders*.

Table 6 **Preferences for Information Pieces to Be on a GM Label; Importance by Segment**

	Cost avoiders	Benefit seekers	Balanced but interested	ANOVA
Which ingredients in a product are GM	4.07	3.71	4.48	$F_{(2, 1418)}=63.47$; $p< 0.00$
How the ingredients are genetically modified	3.22	2.98	3.81	$F_{(2, 1414)}=57.94$; $p< 0.00$
Who is certifying the information	3.18	2.92	3.83	$F_{(2, 1409)}=62.77$; $p< 0.00$
Warnings associated with modification	4.15	3.61	4.44	$F_{(2, 1410)}=64.88$; $p< 0.00$
Benefits associated with modification	4.65	4.11	4.78	$F_{(2, 1414)}=86.58$; $p< 0.00$
Web site or phone number where one could obtain more information	3.62	3.48	4.26	$F_{(2, 1405)}=66.72$; $p< 0.00$

[11] *Cost avoiders* also buy more organic food than the other segments, and are more likely to be vegetarian, which suggests they are savvy shoppers when it comes to choosing food.

Altogether we can conclude that out of the three segments, *Balanced but interested* is the strictest regarding labeling. These consumers require mandatory labeling of all foods, and would like the most amount of information. That information is significantly more important for them can be explained by the fact that these consumers have not made up their mind regarding GM foods, unlike the other two consumer segments that hold strong views. *Balanced but interested* are strongly worried about risks, but they also find possible benefits very important.

4 Conclusion

By using factor and cluster analysis we uncover three consumer segments with different attitudes to the costs and benefits of GM foods. One segment is very worried about potential health risks, and does not consider potential benefits as important (*Cost avoiders*). *Benefit seekers* are almost a mirror image as they are relatively positive about benefits and rate costs as much less important. The last segment (*Balanced but interested*) finds both potential benefits and costs important and, unlike the other two segments, does not seem to hold strong opinions for or against GM foods.

We find these consumer segments are quite different and nuanced in terms of their preferences for GM testing and labeling policy. Having formed no definite preference, *Balanced but interested* respondents require mandatory labeling of the most stringent type, while *Cost avoiders* are more relaxed (while still rather strict) in their requirements. In contrast, *Benefit seekers* have a slight preference for a voluntary testing policy where only foods not containing GM content would display a label. In terms of preferences for what types of information would be important to place on a GM label, the *Balanced but interested* consumer places a great interest in having both the benefit and risk information. Surprisingly, *Benefit seekers* have the weakest desire for GM labels to display information about the benefits associated with the genetic modification while *Cost avoiders* have a similar non-interest in the risk information. These consumers already hold strong opinions about GM foods which appear to dampen their need for additional information. The *Balanced but interested* consumer, being relatively more open-minded, has a heightened interest in both types of information.

Finally, the analysis supports Fischhoff and Fischhoff's (2001) contention that attitudes toward new technologies are likely to be nuanced, and that earlier studies used measures too vague or general to be useful for interpretation. In addition, we find these nuanced attitudes may translate into differences in the desired form of information policy. This information can help policy makers, consumer scientists and marketing professionals develop better information policies and programs.

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