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Consumers' Preferences for GM Food and Voluntary Information Acquisition: A Simultaneous Choice Analysis

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Abstract
Previous research studies directed at the influence of information on consumers' preferences and choices of food in the context of genetically modified (GM) food assume that information is exogenous, in that this is provided to consumers from external sources. Information made available to consumers is also typically treated as being received and processed. Other literature and observation suggests that these two features tend not to apply in practice. Using data from a choice experiment on consumers' choices for genetically modified food in which respondents were able to voluntarily access information, this study allows information to be endogenous; consumers' product choices and information access decisions are examined within a simultaneous choice framework. We find that these two types of decisions are related, but not entirely as might be expected from the existing agricultural economics literature since those with more negative attitudes toward GM food were most likely to access information made available. Our results are consistent with research findings in the social psychology literature. There is heterogeneity across consumers in the relationship between information access and consumer choices which may reflect differentiation in attitudes to GM food.
Keywords: Genetically modified food; information search; multinomial logit models; simultaneous modeling.
JEL Codes: Q13, Q18; C8

Introduction

Genetically modified (GM) foods pose uncertainties to consumers from possible implications of modern agricultural biotechnology for human health, the environment, or for associated ethical or social concerns. With uncertainty, the influence of information on consumer behaviour and markets becomes of interest. Amongst many recent studies of genetically modified food, relatively few focus explicitly on the role of information (Lusk et al, 2005). Studies that assess the impact of information on consumer choices in the context of GM food typically assign respondents to different information treatments and compare product choice behaviour in stated choice or auction experiments (for example, Rousu et al, 2002; Onyango et al, 2004). These studies found information to have impacts on consumers' choices, with positive information (citing potential benefits of GM technology) tending to reduce adverse product reactions, and negative information (citing risks of the technology) tending to reinforce negative responses.

Generally it has been assumed that consumers receive and process information that is provided. If this assumption does not hold, conclusions about consequent consumer and market behaviour may be misleading. In fact, some individuals may choose not to seek for, access or process information. Stigler (1961) recognized that consumers search for information only when the marginal benefits of search exceed marginal costs. Indeed, survey participants do not always process (GM) information even if this is singled out from the product label and presented directly and separately (Noussair et al, 2002).

In contrast to previous studies of information access relative to GM food we did not directly give information to respondents, but provided those surveyed with opportunities to voluntarily access information. This was implemented through hyperlinks in the course of a computer-based experiment on consumers' stated choices for food. We believe that this approach better represents processes of information search than directly presenting information to respondents. Providing for voluntary information access allows us to model explicitly the choice of the types of information that are accessed as a function of consumers' characteristics, in addition to modeling impacts on an individual's stated purchase intentions. In this situation, decisions on product choices and whether/what type of information to access are likely to be made simultaneously, raising issues of endogeneity and the possibility of bias if the two processes are modeled separately. The approach used in this study models the two decisions jointly through a simultaneous choice model. These estimates are compared with initial results from modeling the two processes separately.

Modelling the Simultaneous Process

Many of the widely used models of simultaneous discrete / continuous decision processes are derived from studies originally developed to account for self-selection bias by Amemiya (1978) and Heckman (1979). The theoretical framework for self-selection bias treats decision processes as two implicit simultaneous stages: the decision of whether to participate (e.g., to work or consume) and the quantity decision (e.g., how many hours to work or how much food to purchase). The first decision has a discrete outcome (yes or no) and the second has a continuous outcome (number of units). The approach used in this study differs from these models. Rather than two implicit decision processes, behavior involved in product choices relative to GM food and whether/what product information to access are two distinct (yet correlated) choices. Secondly, both decisions are discrete. This introduces different challenges. Schmidt and Strauss (1975) proposed a simultaneous discrete choice model by allowing for interactions between two decision processes, but maintaining the basic structure of each individual model. This is the approach from which our method is derived.

In this study, the choice of product is observed over the distribution of product-specific attributes while the choice of the type of information to access is explained by individual respondent characteristics. Following Schmidt and Strauss (1975), the outcome of one decision process will affect choices made in the other decision. This allows explicit definition of separate models for each of these two decisions. Thus, in a random utility framework, the indirect utility of individual *n*'s choice of product alternative *i* and information access *j* can be written as:

$$U_{ni}^{1} = \mathbf{X_{ni}}\boldsymbol{\beta} + \mathbf{D^2}\boldsymbol{\alpha} + e_{ni}^{1} \tag{1.1}$$

$$U_{nj}^{2} = \mathbf{Y_n}\boldsymbol{\gamma}_\mathbf{j} + \mathbf{D^1}\boldsymbol{\lambda}_\mathbf{j} + e_{nj}^{2} \tag{1.2}$$

where subscript *i* indexes products and *j* indexes information; **X** is a vector of variables that explains choice behavior in the *i*-th decision; Y denotes individuals characteristics, the *e's* are unknown disturbance terms with the assumption that $Cov\left[e_{ni}^{1}, e_{ni}^{2}\right] = 0$; and $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are vectors of parameters to be estimated. D^1 and D^2 are specific values of $\mathbf{D^{-d}}$, which is a vector of dummy variables measuring the outcome of choice, taking the following form:

$$\begin{cases} \text{if } d = 1 \quad \mathbf{D^{-d}} = D_j^2 = 1 \text{ if } j = 2,3,\ldots,J^{d=2} \text{ is chosen} \\ \qquad\qquad\qquad \text{otherwise } 0 \\ \text{if } d = 2 \quad \mathbf{D^{-d}} = D_i^1 = 1 \text{ if } i = 2,3,\ldots,I^{d=1} \text{ is chosen} \\ \qquad\qquad\qquad \text{otherwise } 0 \end{cases}$$

Thus product choices and information access are specified by the superscript (*d* = 1 or 2) and J^d and I^d are the total numbers of alternatives available in the respective *d*-th decisions. Note that the alternative index *i* and *j* in each decision starts from the second alternative, since including the entire set of outcome dummy variables would cause perfect collinearity. Therefore, an arbitrary "1st alternative" in both decisions is normalized.

If respondent n makes utility-maximizing product choices and information access decisions, and if the two error terms in the two models are assumed to be independent and distributed as iid type I largest extreme value distributions, the conditional probabilities of choosing the i-th and j-th alternatives in the two decisions respectively can be written as:

$$\left(P_{ni}^{1}\left(D_{i}^{1}=1\right)\middle|\mathbf{D^{2}}\right)=\frac{\exp\left(\mathbf{X_{ni}}\boldsymbol{\beta}+\mathbf{D^{2}}\boldsymbol{\alpha}\right)}{\sum_{k}^{I}\exp\left(\mathbf{X_{nk}}\boldsymbol{\beta}+\mathbf{D^{2}}\boldsymbol{\alpha}\right)} \tag{2.1}$$

$$\left(P_{nj}^{2}\left(D_{j}^{2}=1\right)\middle|\mathbf{D^{1}}\right)=\frac{\exp\left(\mathbf{Y_{n}}\boldsymbol{\gamma}_{\mathbf{j}}+\mathbf{D^{1}}\boldsymbol{\lambda}_{\mathbf{j}}\right)}{\sum_{k}^{J}\exp\left(\mathbf{Y_{n}}\boldsymbol{\gamma}_{\mathbf{k}}+\mathbf{D^{1}}\boldsymbol{\lambda}_{\mathbf{k}}\right)} \tag{2.2}$$

Note that the joint probabilities $P\left(D_{i}^{1}=1,\, D_{j}^{2}=1\right)=P\left(D_{j}^{2}=1,\, D_{i}^{1}=1\right)$. With I and J alternatives in the two decision processes, there are a total of $I*J$ joint probabilities. Recognizing the property that $\sum_{i}\sum_{j}P\left(D_{i}^{1},D_{j}^{2}\right)=1$, the expression of each individual joint probability can be derived:

$$\begin{aligned}
&P\left(D_{1}^{1}=1,\, D_{1}^{2}=1\right)=A \\
&P\left(D_{i}^{1}=1,\, D_{1}^{2}=1\right)=\exp\left(\mathbf{X_{ni}}\boldsymbol{\beta}\right)A && i=2,3,\ldots,I \\
&P\left(D_{1}^{1}=1,\, D_{j}^{2}=1\right)=\exp\left(\mathbf{Y_{n}}\boldsymbol{\gamma}_{\mathbf{j}}\right)A && j=2,3,\ldots,J \\
&\qquad i,\, j=2,3,\ldots,I(J)
\end{aligned} \tag{3}$$

where A is:

$$A=1\Big/1+\sum_{i=2}^{I}\exp\left(\mathbf{X_{ni}}\boldsymbol{\beta}\right)+\sum_{j=2}^{J}\exp\left(\mathbf{Y_{n}}\boldsymbol{\gamma}_{\mathbf{j}}\right)+\sum_{i=2}^{I}\sum_{j=2}^{J}\exp\left(\mathbf{X_{ni}}\boldsymbol{\beta}+\mathbf{Y_{n}}\boldsymbol{\gamma}_{\mathbf{j}}+\boldsymbol{\alpha}+\boldsymbol{\lambda}_{\mathbf{j}}\right)$$

$$i,\, j=2,3,\ldots,I(J)$$

and parameters α and λ reflect linkages between the two decision processes. It is expected that there may be unobservable factors associated with the respondents or the survey that determine the direction and magnitude of these parameters. In this case, a random parameter structure may be assumed. For notational convenience, define $\theta=(\alpha,\lambda)$ as the combination of α and λ. If the density of θ is given by $f(\theta)$, the overall likelihood function can be derived:

$$L = \prod_{n}^{N} \prod_{i=1}^{I} \prod_{j=1}^{J} \int P\left(D_{ni}^{1} = 1, D_{nj}^{2} = 1\right) f(\theta) d\theta \qquad (4)$$

Data

The data are from a 2003 Canada-wide internet-based survey focused on pre-packaged sliced bread. The 445 respondents to this survey were drawn from a large representative panel maintained by a research firm. Demographic characteristics of the sample are reasonably representative of the Canadian population. On beginning the survey, respondents chose, from lists of bread attributes, the features of their normally purchased bread, including the types of bread, brand-name, flour and loaf price. Subsequently, stated choice tasks were presented in which each respondent chose one of: their normally purchased bread (based on their earlier responses); a bread product in which the first alternative was modified, at different prices, and with one or more new attributes; or a third alternative of not making any bread purchase. These alternatives are termed Options A, B and C, respectively. Additional attributes in the second product alternative were determined by a fractional factorial design based on four design variables with main and first-order interaction effects. Design variables are: the product could contain health benefits ("contains healthy vitamins"); it could have environmental benefits ("produced environmentally friendly"); it could contain GM ingredients; finally, price varied, with four levels. Each respondent was randomly assigned eight choice tasks.

Whenever health and environmental attributes appeared in product descriptions, a hyperlink to an information statement also appeared. When the health attribute appeared this stated "To find out more about the vitamins in this bread, please click here" or "To learn why vitamins are important, please click here." Respondents who clicked either are classified as accessing health information. For the environmental attribute, the statement was "To find out why this product is environmentally friendly, please click here" or "Why is reducing herbicides in agriculture important? Please click here." Respondents who clicked either were assumed to have accessed environmental information.

Whenever the GM attribute appeared, a standard definition of genetic modification was given. Information scenarios in the study included a "no GM information" control. Thus, when the GM attribute appeared in the alternative product description, additional information might or might not be offered through hyperlinks.[1] Respondents assigned to the scenario that did not provide any further links for the GM attribute are excluded, leaving effective sample size at 384 respondents. Whenever the GM attribute appeared, options to access GM information were: “To find out whether genetically modified foods are safe to eat, please click here” or “To find about information on environmental effects of genetically modified crops, please click here.” Respondents who clicked either were considered to have accessed information about the GM attribute. Only about 50% of respondents chose to access any information.

Estimation of Single Equation and Simultaneous Models of Choice and Access

The simultaneous logit models introduced earlier are simplified based on features of the choice experiment. Respondents chose one of three alternatives: options A (base case), B (includes new attributes) and C (no purchase), based on product attributes. The conditional logit model is appropriate for this. However, information access decisions applied to the choice of any combination of the three types of information (health, environment, GM) involving eight different situations, which ranged from accessing none of the information links, to any one of these, any two, and so on, to all of them. Since these choices are not directly based on the characteristics of the offered information (are not known before access), but on respondents’ characteristics, a multinomial logit model is appropriate for this process.

Relative to a conditional logit model of product choice, assuming the choice of A is the base case, with zero coefficients associated with the attributes, based on equation (2.1) it can be seen that:

$$\ln\left[\frac{P(B|D^2)}{P(A|D^2)}\right] = \mathbf{X_{ni}\beta} + \alpha_h^B D_h B + \alpha_e^B D_e B + \alpha_g^B D_g B \tag{5.1}$$

$$\ln\left[\frac{P(C|D^2)}{P(A|D^2)}\right] = \mathbf{X_{ni}\beta} + \alpha_h^C D_h C + \alpha_e^C D_e C + \alpha_g^C D_g C \tag{5.2}$$

[1] Different information scenarios applied to information offered on the GM attribute. These varied across information types (positive, negative or both) and source.

where vector $\mathbf{X_{ni}}$ in this study is composed of [B, C, Price, GMO, HE, EN, GMOHE, GMOEN]. B and C are alternative specific constants for product choice alternatives B and C; GMO, HE and EN are dummy variables indicating whether the GM, health or environmental attributes appear in an alternative; GMOHE and GMOEN are interaction terms between variables GMO and HE and between GMO and EN; D_h, D_e and D_g are dummy variables indicating whether individual *n* accessed any of the three types of information. The interactions between these access variables and alternative specific constants are represented by variables HEB, ENB, GMB, HEC, ENC and GMC respectively; α 's and $\boldsymbol{\beta}$ are parameters to be estimated.

Similarly, relative to a multinomial logit model of information access, the decision of accessing no information can be assumed as the base case, with zero coefficients associated with all explanatory variables. Denoting N, H, E and G as dummy variables indicating whether a respondent accessed no information, health information only, environmental information only and GM information only, respectively, the multinomial logit model for choosing only health-related information suggested in (2.2) can be further decomposed into:

$$\ln\left[\frac{P\left(H \middle| D^1\right)}{P\left(N \middle| D^1\right)}\right] = \mathbf{Y_n}\boldsymbol{\gamma}_\mathbf{h} + \lambda_h^B B + \lambda_h^C C \tag{6}$$

where vector $\mathbf{Y_n}$ is a series of demographic variables: [constant (CONST), male (MALE), employed (EMP), consumer group member/donator (CGP), Quebec resident (QUB), rural resident (RURAL), age (AGE), number of children (CHILD), respondent's years of education (EDU), household income (INC)]; λ 's and vector $\boldsymbol{\gamma}$ are parameters to be estimated. As noted earlier, joint probabilities for any one of the $I*J$ = 24 situations will be the same, ie, $P(B,H) = P(H,B)$. Based on equations (5) and (6), a natural structural property of this relationship is that $\alpha_h^B = \lambda_h^B$ and $\alpha_h^B = \lambda_h^C$. This result is generalized to:

$$\alpha_2^1 = \gamma_2^1, \quad \text{where } 1 = B, C \text{ and } 2 = H, E, G \tag{7}$$

Given this property, the multinomial logit models can be rewritten, replacing parameter γ 's by α 's.

$$\ln\left[\frac{P(D \mid D^1)}{P(N \mid D^1)}\right] = \mathbf{Y_n}\boldsymbol{\gamma}_\mathbf{h}^D + \alpha_D^B B + \alpha_D^C C \qquad (8.1)$$

where $D = H, E, G$

$$\ln\left[\frac{P(D \mid D^1)}{P(N \mid D^1)}\right] = \mathbf{Y_n}\boldsymbol{\gamma}_\mathbf{h}^D + \sum_D \alpha_D^B B + \sum_D \alpha_D^C C \qquad (8.2)$$

where D is any combination of two or three types of information.

Another issue in simultaneous estimation is that the information access multinomial logit model does not need to (and indeed cannot) take the panel nature of the data set, since respondents' demographic characteristics are fixed for the course of the survey. However, in product choices, each respondent was assigned to eight choice situations and this format allows a panel conditional logit model. As a preliminary approach to simultaneous estimation, this discrepancy between the requirements to jointly estimate the two models is reconciled by removing the panel nature of the conditional logit model. A procedure was developed to pick randomly one choice situation from each respondent to a total of 384 (the sample size) observations. Comparing estimated parameters of the conditional logit in the simultaneous model and estimates of the conditional logit for all choice situations suggests this data loss does not lead to serious bias in coefficient estimates.[2] Finally, the α coefficients are specified as random coefficients with normal distributions to capture unobserved heterogeneity in the links between the two choice processes. A simulated version of the likelihood given in (4) was maximized based on 100 randomized Halton draws.

Results of Separate and Simultaneous Models

Space precludes tabular presentation of initial separately estimated results of conditional and multinomial logit models explaining, respectively, product choices and decisions of whether/what combinations of information to access. Both include variables linking the two decision processes. Regarding significant explanators of the initial conditional logit model of bread choice, price is significantly negative (the higher the price, the lower the probability of purchase). A significant positive value for the

[2] However, in a future revision of this paper we propose to repeatedly select a sample from the set of choice tasks (bootstrap) and will present averages of these estimates.

alternative specific constant (ASC) denoting choice of Option B indicates that, holding bread attributes constant, consumers favourably viewed new bread products, which contrasts with the significantly negative ASC for Option C. The other highly significant variables in this model denote the presence of the GM attribute (significantly negative), health attribute (significantly positive), and interacted environment-GM effect (significantly positive)[3]. However, no information variable (interaction terms between information access and variables denoting three types of information) is significant. Based on the initial model, significant impacts of information access on product choices were not observed.

Regarding significant explanators in the initial multinomial logit model of bread choice[4]: the top panel of Figure 1 summarizes the signs of these marginal effects; (zero indicates insignificant effects). Relative to females, males were less likely to access information, except on health and environment attributes. Negative effects of CHILD influence most categories of information access: the more children in the household, the less likely were respondents to access information, suggesting time constraints for respondents in households with young children. The link dummy variable indicating choice of Option B was not significant. However, compared with accessing no information, respondents who chose Option C ("no purchase") were more likely to access the environmental attribute information alone or to choose information on both the health and environmental attributes, while being less likely to access GM information when this was the only information offered or to access GM and health information when both were offered.

Estimation results for the simultaneous model are in Table 1. As with the initial model of bread choices, Option B is preferred to A while C is least preferred; increased price has a strong negative impact on utility and the probability of purchase, which is also

[3] Marginal values are derived from total differentiation of the underlying utility function for the model and calculated as the ratio of the coefficient in question and the opposite of the coefficient of the price variable.
[4] Marginal effects for continuous variables (AGE, CHILD, EDE and INC) were calculated by taking the derivatives of the probabilities with respect to the variable for each individual in the sample and averaging these. Marginal effects for dummy variables (MALE, EMP, CGP, QUB, RURAL, and link variables showing product choice of options B and C) are calculated by taking the difference of the probabilities when the dummy variable is assumed to be zero or one, valued for each individual, and averaging the individual measures. Standard errors associated with all marginal effects are calculated by 3000 simulation repetitions. These estimates are available on request.

the case for the GM attribute, while the health attribute has a significant positive impact. The environmental attribute is not significant but its interaction with the GM attribute is significant and positive. Marginal values of these factors differ very slightly from the single equation approach. The lower panel of Figure 1 summarizes the directions of the marginal effects reported in the lower section of Table 1. Relative to the relationship between household factors and information access, those who accessed all the types of information that were offered tended to be older, have fewer children, were not employed and had lower income. Children in the household tended to have a consistent negative influence on decisions to access information, which may indicate that respondents in these households experience shortage of time available for information search. Respondents belonging or donating to consumer groups were consistently more likely to access information than those who were not, perhaps indicating a higher level of "consumer interest" for these individuals.

Turning to the impacts of information access on choices in the simultaneous model: compared to those who chose Option A (the normally purchased product), respondents choosing Option B (products with new attributes) generally did not access information; marginal effects are negative for choice of environmental information only; for health and GM information presented together, and for environment and GM information presented together (none of these variables were significant in the initial multinomial logit information access model). The behaviour of those who chose new products presented in Option B choices suggests relatively little motivation to access attribute information. Information access behaviour of those who chose Option C over their regular bread product is somewhat different. These respondents tended to access the combination of information on the environment and GM attributes, but not to access these information topics when they were presented individually.

Table 1 also reports estimation of the six link variables with a random parameter specification. These help to interpret the impact of information access on bread choices. Variables HEB and ENB are significantly negative, indicating that those who accessed any information on the health- or environmental-related topics were less likely to choose Option B than Option A as their desired product choice alternative. Accessing information about the GM attribute did not seem to affect product choice. Since the mean estimates of variables HEC, ENC, and GMC are all insignificant, the choice of Option C over Option A is not well explained by any of the three types of information access dummy variables. However, the analysis does indicate that bread choice behavior is associated with information access decisions.

We note that the standard deviations of variables HEB and GMC are both strongly significant and that the standard deviation of HEC is marginally significant. These significant standard deviations indicate the existence of heterogeneity among the sampled consumers in terms of their individual links between these two decisions. For coefficient HEB, although the mean estimate is negative, its associated standard deviation implies that about 33.4% of respondents would be more likely to choose Option B if they accessed health-related information. Since the mean estimate of coefficient GMC is not significant, its significant standard deviation indicates that about equal numbers of respondents chose, as did not choose, Option C when they clicked GM-related information. A similar interpretation exists for the coefficient HEC and its standard deviation.

Further Discussion and Conclusions

The results of our study indicate that information offered, even on issues that are widely considered to be contentious, like GM food, is not always accessed or processed. This may occur because of time constraints and/or because the issue or topic is not considered to be of interest by some individuals. Some previous studies in the agricultural economics literature have provided different types of information to surveyed respondents and have found that these influenced choice behaviour. This is not evident from our study where information was offered rather than provided. Although those who chose Option B might be viewed as variety-seeking consumers, and those who chose Option A as habit-preferring consumers who were relatively more inclined to seek information, interpretation of our findings seems more complex than this. There does appear to be an interaction between the decision to access information and the product choices made by respondents. Further, there is evidently much heterogeneity in the relationship between those who accessed information and the nature of their product choices. A plausible explanation of our results relates to our finding that those who tended to access information also tended to hold more strongly adverse opinions about

GM food than those who did not. Further, research reported in the social psychology literature on information and GM food (Scholderer and Frewer, 2003) suggests that where negative attitudes to GM food are well-entrenched, these are unlikely to be changed by information strategies. It appears that this may be the case for numbers of respondents to our survey.

Table 1. Estimation Results of the Simultaneous Model

Variables	Coefficients	Std. Error	Random Variables	Coefficients	Std. Error
B	1.323***	0.3379	HEB	-0.653***	0.224
C	-3.487***	0.253	SDHEB	1.493***	0.389
PRICE	-0.443***	0.168	ENB	-0.545***	0.194
GMO	-2.310***	0.372	SDENB	0.277	0.287
HE	0.723**	0.319	GMB	0.105	0.219
EN	0.070	0.303	SDGMB	-0.428	0.267
GMOHE	0.486	0.337	HEC	-1.107	0.923
GMOEN	0.841***	0.325	SDHEC	-0.798*	0.474
			ENC	0.024	0.557
			SDENC	-0.840	0.587
			GMC	-1.670	1.131
			SDGMC	0.844**	0.432

Variables	Marginal Effects	Std. Error	Variables	Marginal Effects	Std. Error
CONST1	-0.159***	0.052	CONST2	-0.148***	0.037
MALE1	-0.027***	0.007	MALE2	-0.017**	0.009
AGE1	-0.043**	0.022	AGE2	0.037**	0.019
CHILD1	-0.017	0.011	CHILD2	0.009	0.013
EDU1	0.104***	0.037	EDU2	0.036**	0.016
EMP1	-0.002	0.006	EMP2	-0.019	0.014
INC1	-0.007	0.005	INC2	0.027	0.018
CGP1	0.063***	0.019	CGP2	0.093***	0.024
QUB1	0.028**	0.010	QUB2	-0.018**	0.008
RURAL1	-0.089**	0.033	RURAL2	0.054***	0.015
B1	-0.003	0.006	B2	0.272***	0.043
C1	0.001	0.002	C2	0.037**	0.015
CONST3	0.073**	0.042	CONST4	-0.148***	0.036
MALE3	0.001	0.012	MALE4	0.027**	0.016
AGE3	-0.311***	0.092	AGE4	-0.048**	0.022
CHILD3	0.004	0.015	CHILD4	-0.025**	0.017
EDU3	-0.074***	0.026	EDU4	0.086***	0.024
EMP3	-0.006	0.019	EMP4	0.000	0.022
INC3	0.074***	0.023	INC4	0.005	0.016
CGP3	0.093**	0.033	CGP4	0.095***	0.026
QUB3	-0.022**	0.008	QUB4	0.012	0.020
RURAL3	-0.043**	0.017	RURAL4	-0.017	0.011
B3	-0.002	0.001	B4	0.017	0.013
C3	0.000	0.000	C4	-0.011	0.007
CONST5	-0.077**	0.030	CONST6	-0.060***	0.020
MALE5	-0.011**	0.004	MALE6	-0.034***	0.010
AGE5	0.074***	0.026	AGE6	-0.083***	0.022
CHILD5	-0.023**	0.009	CHILD6	-0.022**	0.008
EDU5	-0.067***	0.020	EDU6	0.020	0.016
EMP5	0.071***	0.022	EMP6	0.026**	0.011
INC5	0.009	0.008	INC6	-0.004	0.009
CGP5	-0.093***	0.029	CGP6	-0.102***	0.033
QUB5	0.056***	0.017	QUB6	0.033	0.014
RURAL5	0.021**	0.010	RURAL6	-0.038**	0.017
B5	0.005**	0.002	B6	0.063***	0.019
C5	0.001	0.002	C6	-0.021**	0.009
CONST7	0.131**	0.052	adj. pseudo-R^2		
MALE7	-0.072**	0.032	LL		-746.781
AGE7	0.437***	0.062			
CHILD7	-0.076**	0.038			
EDU7	-0.054	0.040			
EMP7	-0.126***	0.035			
INC7	-0.072**	0.032			
CGP7	0.149**	0.065			
QUB7	-0.067**	0.026			
RURAL7	0.048**	0.023			
B7	-0.001	0.001			
C7	0.000	0.000			

*, **, and *** indicates significant at the 10%, 5%, and 1% significance level respectively.

Note: Labels 1 through 7 identify, respectively, those accessing information related to health only, environmental only, GM only, health and environment only, health and GM only, environment and GM only, and all three types of information.

Figure 1. Summary of Marginal Effects in the Single and Simultaneous Multinomial Models

Single Model

Consumer Characteristics	Information Access Probabilities by Category (Compare to No Access)						
	Health Only	Env. Only	GM Only	Health and Env.	Health and GM	Env. and GM	All
Male	-	-	0	+	-	-	-
Older	-	0	-	0	+	-	+
More children	-	0	0	-	-	-	-
High education	+	+	-	+	-	0	-
Employed	0	-	0	0	+	+	-
High income	-	+	+	0	0	0	-
Member of consumer group	+	-	+	0	0	0	-
Quebec resident	+	0	-	0	+	+	-
Rural resident	-	+	-	0	+	-	0
Chose Alt. B	0	0	0	0	0	0	0
Chose Alt. C	0	+	-	+	-	0	0

Simultaneous model

Consumer Characteristics	Information Access Probabilities by Category (Compare to No Access)						
	Health Only	Env. Only	GM Only	Health and Env.	Health and GM	Env. and GM	All
Male	-	0	+	0	0	0	0
Older	-	+	-	-	+	-	+
More children	0	0	0	0	-	-	-
High education	+	+	-	+	-	0	0
Employed	-	+	+	0	0	-	-
High income	-	0	+	0	0	0	-
Member of consumer group	+	+	+	+	-	-	+
Quebec resident	-	-	+	0	-	0	+
Rural resident	-	0	+	0	0	-	0
Chose Alt. B	0	-	0	0	-	-	0
Chose Alt. C	0	-	-	0	0	+	0

References

Amemiya, T. 1978. “The Estimation of a Simultaneous Equation Generalized Probit Model” *Econometrica* 46: 1193-1205.

Heckman, J. 1978. “Dummy Endogenous Variable in a Simultaneous Equation System” *Econometrica* 46: 931-939.

Lusk, J.L., M. Jamal, L. Kurlander, M. Loucan, L. Traulman. 2005. A Meta-analysis of GM Food Valuation Studies” *Journal of Agricultural and Resource Economics*, 30 (1): 28-44.

Noussair, Charles, Stephane Robin, Bernard Ruffieux. 2002. “Do consumers not care about GM foods or do they just not read the labels?” *Economics Letters*, 75: 47-53.

Onyango, Benjamin, Rodolfo M. Nayga Jr, Brian Schilling. 2005. “Role of product benefits and potential risks in consumer acceptance of genetically modified foods” *AgBioForum*, 7 (4): 202-211 (http://www.agbioforum.org/v7n4/v7n4a06-onyango.htm)

Rousu, Mathew, Wallace Huffman, Jason F. Shogren, Abebayehu Tegene. 2002. “The value of verifiable information in controversial market: Evidence from lab auctions of genetically modified food” Iowa State University, Department of Economics Working Paper # 02003: 52 pp.

Schmidt, P. and R. P. Strauss. 1975. “Estimation of Models with Jointly Dependent Qualitative Variables: A Simultaneous Logit Approach” *Econometrica* 43: 745-755.

Scholderer, Joachim and Lynne Frewer. 2003. “The biotechnology communication paradox: Experimental evidence and the need for a new strategy“ *Journal of Consumer Policy*, 26: 125-157.

Stigler, G.J. 1961. “The economics of information” *Journal of Political Economy*. 69: 213-225.