CONSUMER WILLINGNESS-TO-PAY FOR GM FOOD PRODUCTS IN ITALY

Stefano Boccaletti and Daniele Moro[1]

This paper evaluates consumer willingness-to-pay (WTP) for food products obtained through the application of biotechnology using data collected from a consumer survey in Italy in 1999. Survey results show that consumers have a low degree of knowledge of the issue, but an overall positive attitude towards genetically modified (GM) foods. Estimation results of an ordered probit model suggest that WTP is mainly affected by income and information.

Key words: biotechnology; willingness-to-pay (WTP); food products; contingent valuation (CV).

The issue of consumer acceptance of biotechnology has been largely debated (see for example Thompson, 1996, 1998). It is commonly believed that European consumers have a negative attitude towards biotechnology; and, indeed, international comparisons of consumer acceptance have shown significant differences between European and North American (Hoban, 1997) countries, with a higher resistance recognized among European consumers. This argument has then been used by public authorities within Europe to justify their stance on GM foods, which has more recently been negative —prohibiting their commercial introduction.

In evaluating consumer acceptance the role of information is crucial. Information plays an even more important role for innovative products, as in the case of GM foods; surveys show that consumer awareness and understanding of biotechnology are still low (Hoban, 1997). Thus, the private and public sectors' provision of educational programs and information is a valuable strategy.

The aim of this paper is to provide further insights to the debate; a consumer survey was conducted in Italy to evaluate the degree of awareness and knowledge, and attitudes towards GM food products; determinants of consumer response were analysed through contingent valuation methods.

Survey Design And Sample

Information was obtained through a phone survey conducted in 1999 on a sample of 384 people, randomly selected from the province of Piacenza in Northern-Italy; the co-operation rate was acceptable, with 200 questionnaires fully completed (52%). The main purpose of the survey was to measure the respondent's awareness and willingness-to-pay for GM foods; and to collect the main explanatory variables, which, from other similar studies, are believed to affect individual purchasing behavior.

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The questionnaire was organized into three sections. The first section was dedicated to understanding the degree of the respondent's knowledge about biotechnology and GM foods. In the second section, we asked for the respondent's WTP for GM foods. Finally, the third section obtained information on the socio-demographic individual characteristics of each respondent. Tables 1, 2, and 3 provide summary statistics about sample characteristics and survey results.

Table 1: Summary of Survey Results: Socio-demographic Characteristics ($N = 200$).

Variable	Percentage (%)	Variable	Percentage (%)
Sex:		**Monthly Household Income (INCOME) in Millions of Lire:**	
Male	42	< 1.5	9
Female	58	1.5 - 2.4	27
		2.5 - 3.4	33
		> 3.4	31
Age (AGE):		**Working Condition:**	
< 20 years old	3.0	Unemployed	2.0
20 - 29	20.0	Student	9.0
30 - 39	24.0	Housewife	18.5
40 - 49	20.0	Retired	12.5
50 - 59	15.5	Blue collar	6.0
60 - 70	12.0	White collar	37.0
> 70	5.5	Other	5.0
Education (EDU):		**Household Size:**	
Up to grade 5	10.0		
Up to grade 8	28.5	1 person	8.0
High school	47.0	2 persons	68.0
University	14.5	3 or more persons	24.0
Place of Residence:		**Usual Shopper:**	
Urban (city centre)	28.5		
Urban (suburbs)	39.5	Yes	66.5
Rural	32.0	No	33.5
Place of Purchase:			
Traditional outlets	12.5		
Multiple retail	87.5		

The degree of knowledge about biotechnology and GM foods in the sample was low: 82.5% of the respondents in the sample rated their degree of knowledge as "insufficient." A previous survey by Pedraglio (1998) indicated that only about 50% of the respondents interviewed knew what

biotechnology was, but 20% of them declared knowledge of biotechnology only after the interviewer read a definition of it. Our results are therefore consistent with this earlier study.

Table 2: Summary of Survey Results: Consumer Awareness (*N* = 200).

Variable	Percentage (%)
Heard about Biotechnology (HEARD):	
Yes	51.0
No	49.0
Aware of Buying GM Foods:	
Yes	24.3
No	47.6
Don't know	28.1
Believe that GM Products are Sold (SOLD):	
Yes	51.5
No	10.5
Don't know	38.0
Knowledge on Biotechnology (KNOW):	
None	38.0
Low	44.5
Sufficient	13.5
Good	4.0

Regarding the degree of awareness about biotechnology and GM foods, 51.5% of the respondents knew that GM food products were already present on the market. Compared with other surveys (Hoban, 1999) our sample showed a significantly higher degree of awareness.

A somewhat surprising result was that 46% of the respondents rated their attitude towards GM foods as positive and only 27.5% rate their attitude as being negative. Over 24% of them were aware of buying GM foods on the market. Nevertheless, information was perceived as an important issue— 94% of the respondents asked for a specific label in order to be able to recognize GM foods. The respondents based their response (either negative or positive) on health and environmental issues. Furthermore, 39.5% showed an indifference towards GM and traditional food products if quality and prices were held the same, and another 22% said they would consume GM foods even if the price was slightly higher (5%).

The rate of acceptance seemed to increase when consumers were confronted with specific products; we proposed 4 alternatives: products with a lower use of pesticides (LP); products with improved nutritional characteristics (N); products with improved organoleptic characteristics (O); and finally products with a longer shelf-life (SL). While 17.5% would not buy "generic" GM foods, this percentage decreased to about 12% on average under the four alternatives.

Table 3: Summary of Survey Results: Consumer Acceptance and WTP (*N* = 200).

Consumer Acceptance of Biotechnology

Attitude:	Percentage (%)
Positive	46.0
Negative	27.5
Indifferent	26.5
Would Like Labeling:	
Yes	94.0
No	5.5
Don't know	0.5
Price Difference with Respect to Regular Products (same quality):	
Don't buy	17.5
< 10%	11.5
< 5%	4.0
Same price	39.5
> 5%	22.0
> 10%	5.5

Willingness-To-Pay (WTP)
(Percentage)

	Lower Use of Pesticides	Improved Nutritional Characteristics	Improved Organoleptic Characteristics	Longer Shelf-Life
Do not buy	11.0	12.0	12.0	12.0
< 5%	30.5	26.0	34.5	52.0
6 - 10%	35.5	35.5	29.0	21.0
11 - 15%	10.5	12.5	13.5	9.0
16 - 20%	4.0	6.5	5.0	3.0
> 20%	8.5	7.5	6.0	3.0

Furthermore, among people that rated their degree of awareness as good, 87.5% were either positive (62.5%) or indifferent (25%) towards GM foods. Some kind of "information bias" could have affected the data for those respondents who indicated a negative attitude toward GM foods, as negativity increased for consumers with "no knowledge" to a "low level of knowledge," but then, when consumers collected more information the rate of acceptance increased.

Model Specification

A contingent valuation (CV) approach was used to evaluate the consumers' response in the absence of a real purchasing situation. The CV approach allows a direct estimation of WTP by means of different (direct) elicitation techniques. Several concerns regarding its reliability have been raised (Buzby, Skees, & Ready, 1995; Fox *et al.*, 1995; Caswell, 1998). For example, consumers may take a theoretical scenario less seriously than a real one and, therefore, they may tend to bias their true WTP (Blumenshein *et al.,* 1998). Nevertheless, the selection of appropriate survey and elicitation methods can reduce and minimize these biases.

We used a payment card elicitation method. First, we asked about the consumer WTP for generic GM products, allowing for negative WTP. Then, for the four specific alternative products, respondents were asked to choose among five classes of WTP: $< 5\%$, $6 - 10\%$, $11 - 15\%$, $16 - 20\%$, and $> 20\%$. This survey method should allow respondents to report their propensity to pay higher prices for unfamiliar products.

The empirical study was based on econometric techniques. The discrete structure of WTP implied the adoption of (multinomial) probit/logit like procedures. Moreover, given the ordinal ranking of the WTP dependent variable, the ordered version of probit estimation was applied (Greene, 1990). The LIMDEP econometric software was used for estimations.

The economic literature indicates that WTP generally depends on socio-demographic factors, such as income, education, demographic characteristics, and place of residence. Moreover, specific studies on the acceptance of agricultural GM food products suggest that knowledge is also crucial (Caswell, Fuglie, & Klotz, 1994). All these factors will have an impact on the probabilities of choosing a particular WTP range.

Five different models were estimated, one for generic GM foods, which admitted negative WTP values, and the four product improvements considered—lower pesticide use, improved nutritional characteristics, longer shelf-life, and improved organoleptic characteristics. The proper set of independent variables for each model was selected by applying a stepwise procedure.

Overall probabilities associated with the different WTP outcomes were calculated at the variables' mean values using estimated intercept and coefficients. Model significance was verified by calculating the chi-square statistics resulting from the restricted and unrestricted log likelihood functions.

Empirical Results

After selection procedures, only three of the five models were statistically significant. Willingness-to-pay for products exhibiting a longer self-life and generic GM food products were not related to any of the available explanatory variables. For products exhibiting a longer shelf-life, a possible explanation could be that shelf-life is individually perceived to be a product characteristic which could be improved without resorting to biotechnology. The explanatory variables introduced in the estimated models are summarized in tables 1, 2, and 3 (abbreviations are showed in parentheses).

The variable INCOME is monthly income; EDU denotes the education level of the respondent; KNOW is the respondent's self evaluation of his or her degree of knowledge; HEARD considered if the respondent had ever heard of various biotechnologies; and SOLD considered if the respondent knew that GM products were currently sold on the market. Table 4 reports the three final models estimated.

Table 4: Regression Results (Ordered Probit Analysis).

Explanatory Variable	Estimated Coefficient	t-ratio	Level of Significance
Dependent Variable: WTP$_{LP}$			
CONSTANT	-1.5595	-3.273	0.0011
INCOME	0.2284	2.589	0.0096***
EDU	0.2369	2.094	0.0362**
AGE	0.1014	1.721	0.0853*
KNOW	0.1789	1.736	0.0826*
Dependent Variable: WTP$_{N}$			
CONSTANT	0.0386	0.100	0.9204
INCOME	0.3376	3.833	0.0001***
HEARD	-0.6566	-3.550	0.0004***
SOLD	0.3127	3.226	0.0013***
Dependent Variable: WTP$_{O}$			
CONSTANT	-1.1908	-2.928	0.0034
INCOME	0.2458	2.702	0.0069***
SOLD	0.2304	2.584	0.0098***
KNOW	0.1957	1.820	0.0688*

Note. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

Interpretation of a qualitative dependent variable model, such as a probit model, is not simple—the estimated coefficients affect the probability that a certain value of the dependent variable occurs. A positive (+) sign means that higher values of the explanatory variable *increase* the probability of higher values of the dependent variable. Likewise, a negative (-) sign indicates that higher values of the explanatory variable *decrease* the probability of higher values of the dependent variable.

INCOME affects consumer behaviour in all models—the positive sign indicates that a higher level of income increases the probability of higher WTP; that is, individuals with higher incomes translate to a greater extent the benefits from GM products into a money equivalent.

Knowledge (KNOW) also plays an important role in purchasing decisions regarding products exhibiting a lower use of pesticides and organoleptic properties. Signs are positive across all models

and, therefore, (proper) information makes individuals more confident regarding GM foods, thereby increasing their WTP.

HEARD is an overall indicator of the degree of diffusion of general information on biotechnology, but probably reflects the negative rumours that have reached European consumers. The negative sign of this variable in the model for products with improved nutritional characteristics indicates that such negative information tends to decrease consumers' overall level of trust in GM foods. This clearly implies that economic agents interested in the production and sale of GM foods should pay particular attention to this aspect, adopting specific reputational strategies.

Knowing that products are actually sold and, therefore, that they have a market, reassures individuals and makes them less suspicious—the SOLD variable is positive and significant for nutritionally enhanced products and products with organoleptic properties. This result could be interpreted as a positive imitation process, which has been found to generally apply to new products. In the particular case of GM food products, however, health safety implications of the technology are likely to make individuals more cautious and, therefore, this variable may not stand alone. If this is the case, the diffusion of these products in retail outlets could be sustained by appropriate complementary strategies, such as product certification and information.

Regarding the weight of the different explanatory variables on consumer's willingness-to-pay we know that for qualitative choice models estimated coefficients affect marginal probabilities; that is, they determine the marginal effect of each explanatory variable on the probability of each outcome of the dependent variable. It is worth noting that in each row of table 5 the sum of marginal probabilities is zero—higher probabilities attached to one or more WTP outcomes mean lower probabilities for the remaining outcomes.

Regarding those products with a lower use of pesticides, income and education seem to be the variables with the strongest impact on the consumer's decision to change from a WTP lower than 5% of the regular price to higher premiums. Individuals show a strong propensity to pay the highest price premium—income increases the probability of paying a premium greater than 20% of the regular price for products with a lower use of pesticides by 0.0347. The second largest marginal effect of income on WTP is on the 11 - 15% WTP class (0.0243). Marginal effects of EDU are comparable to those for INCOME—the probability attached to the maximum premium increases by 0.0359 with higher levels of education of each respondent. Knowledge (KNOW) affects WTP slightly less, with an increase of 0.0271.

Looking at products with enhanced nutritional properties, INCOME is still the most important explanatory variable—higher incomes decrease the probability to pay the lowest premiums (less than 10%) by 0.1138. The same is true for SOLD—the probability of paying a premium higher than 15% increases by 0.1054. Instead, as we anticipated when discussing the signs, HEARD lowers the probabilities of higher premiums; therefore, increasing those attached to the lower two classes (less than 10%) by 0.2214.

The third model, concerning products with organoleptic properties, also shows a strong impact of INCOME, with the probability of the lowest WTP decreasing by 0.0941. The values related to SOLD and KNOW indicate a slightly lower increase in the probabilities of higher WTP classes (more than 5%), 0.0882 and 0.0749, respectively.

Table 5: Marginal Effects.

Variable	WTP = 0 (< 5%)	WTP = 1 (6 - 10%)	WTP = 2 (11 - 15%)	WTP = 3 (16 - 20%)	WTP = 4 (> 20%)
WTP$_{LP}$					
CONSTANT	0.5663	-0.0826	-0.1657	-0.0815	-0.2366
INCOME	-0.0830	0.0121	0.0243	0.0119	0.0347
EDU	-0.0860	0.0125	0.0252	0.0124	0.0359
AGE	-0.0368	0.0054	0.0108	0.0053	0.0154
KNOW	-0.0650	0.0095	0.0190	0.0093	0.0271
WTP$_{N}$					
CONSTANT	-0.0129	-0.0001	0.0047	0.0035	0.0049
INCOME	-0.1127	-0.0011	0.0413	0.0302	0.0424
HEARD	0.2193	0.0021	-0.0802	-0.0587	-0.0825
SOLD	-0.1044	-0.0010	0.0382	0.0280	0.0393
WTP$_{O}$					
CONSTANT	0.4558	-0.0617	-0.1649	-0.0901	-0.1391
INCOME	-0.0941	0.0127	0.0340	0.0186	0.0287
SOLD	-0.0882	0.0119	0.0319	0.0174	0.0269
KNOW	-0.0749	0.0101	0.0271	0.0148	0.0229

<u>Note</u>. Each row represents the marginal probability of each willingness-to-pay outcome, and sums to zero. WTP = 0, WTP = 1, WTP = 2, and so on, represent the amounts by which consumers are willing-to-pay over and above the regular price.

Final Remarks

The empirical analysis developed in this paper supports the idea that one of the main reasons for the low acceptance of GM food products is the "scarce knowledge" that individuals have about this topic—those with a higher knowledge are more likely to buy these products. It is also clear that whenever consumers are given correct information they are more willing to pay higher prices in order to benefit from quality improvements, which may indicate that, regarding the acceptance of GM foods, practical reasons often prevail over ethical considerations. This may be particularly true whenever the use of biotechnology reduces health risks, such as those caused by the use of pesticides. Certification of GM foods may represent a solution to informational problems—many respondents asked for a precise guarantee of no risks for human health. In any case, acceptance of GM food products may not necessarily translate into their consumption. In this context, price plays an important role—the modal WTP class is between 6 and 10% of the regular price for products with a lower use of pesticides and for those products with enhanced nutritional properties, but less than 5%

for organoleptic products. This result indicates that WTP may be differentiated across different degrees of risk type and risk avoidance.

These conclusions should be used with caution, especially if comparisons with other studies are made. In fact, the main limitations of this study, and of other similar studies, are the small sample sizes and the very limited geographical coverage, which make comparisons of WTP quite difficult.

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