

## **On Consumer Opposition to GMOs in Europe: The Importance of Trust**

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**2èmes journées de recherches en sciences sociales**

**INRA SFER CIRAD**

11 & 12 décembre 2008 – LILLE, France

## ***Abstract***

The emergence of genetically modified plants, in Europe, led to important debates and particularly about the consumption of genetically modified foods. In this context, many researches try to explain consumer's opposition to GMO in Europe. Different authors puts forward the notion of trust as determining to define the position of individuals in a context of incertitude, in the debate about the GMOs use in agriculture. Because as in the present case we could fear the simultaneity of decisions (trust and different types of opposition), we have to take into account this endogeneity risks. With data from a European Survey (the Eurobarometer), multivariate probit was used to specify the importance of trust in the various organizations involved in the public debate on the acceptance of (and the resistance to) genetically modified foods on behalf of the "ordinary citizens".

## ***Key words***

Biotechnology; Consumer Attitudes Towards Technology; European Survey Data; Genetically Modified Foods; Multivariate Probit; Trust

## 1. INTRODUCTION

The introduction of biotechnologies in production processes is widespread today in a number of sectors, such as pharmacy, agriculture, food-processing, chemistry, environment, the cosmetics industry, energy, etc. Moreover, since their emergence, agricultural biotechnologies have triggered off an intense debate concerning their innocuousness or lack of, in government circles of several industrialized countries, leading to a multiplicity of official initiatives on evaluation of this new technology. In Europe, the reference to traceability is one of the major innovations of the current review of rules concerning deliberate dissemination of GMOs, and appears as a partial answer to the important opposition of associations, which justify their action as intermediary for the “public opinion” opposed to GMOs. It implies rules of labeling as a guarantee for the free choice of the consumer which for ethical or health reasons can refuse to buy biotechnological products (See Sheldon (2002) for a survey.). These labeling laws are largely a response to the important mobilization of public opinion associations (consumers’ associations, environmental and animal protection associations). Contrary to the environmental protection associations, which were leaders in the emergence of the debate about GMOs in Europe, consumers’ associations can be considered as followers as they got involved quite late in the debate. The initial positioning of environmental protection associations such as Greenpeace France, one of the most important actors in the structuring of the debate in France, allowed them to gain credibility in the eyes of the public opinion (Bonny 2003; Todt 2003; Toke 2004). Similarly, whereas the opposition of the environmental protection associations appears as an opposition about principles, consumers’ associations seem first to strike for the defense of consumers’ interests, *i.e.* for the right of information.

More broadly, this clearly fits in the frame of what Godard (1998) calls a *controversial universe*. Faced with these disagreements, it is crucial to answer the question about the formation of individual and collective preferences. In this frame, several surveys in experimental economics (Cook *et al.*, 2002; Frewer *et al.* 2003; Heslop 2006; Huffman *et al.*, 2004a, 2004b; Lang *et al.*, 2003; Lusk *et al.* 2004; Noussair *et al.*, 2004) or based in transnational survey (including Eurobarometers) (Bredahl, 2001; Gaskell *et al.*, 2004; Priest *et al.*, 2003; Pardo *et al.*, 2002) show the diversity of consumers' approvals or refusals of biotechnological food-products. The determinants of the opposition to the GMOs seem largely linked to individual attitudes and values (Pardo *et al.*, 2002; Bredahl, 2001), whereas the level of scientific knowledge about biotechnologies is of relative little importance for the formation of individual preferences (Priest *et al.* 2003; Sturgis *et al.* 2005; Gaskell *et al.*, 2004). On this last point, according to Marris (2001) and Gaskell *et al.* (2004), the usual argument which holds that the augmentation of knowledge would lead to a better acceptance of biotechnological implementations, is due to a wrong understanding of the consumers' decision making. Different authors puts forward *the notion of trust* (Todt, 2003; Priest *et al.*, 2003; Cook *et al.*, 2002; Huffman *et al.*, 2004a, 2004b; Munnichs 2004) as determining to define the position of individuals in a context of incertitude, in the debate about the GMOs use in agriculture: according to Todt (2003: 248) the controversy about the use of certain technologies is first and foremost symptomatic of the difference of trust in the actors.

The objective of this article is hence to study, in the domain of agricultural biotechnologies, the impact of trust in the information given by the different actors and in their actions, on the level of consumption of GMOs based products. This work aims to characterize the position of "ordinary citizens" who are legitimized neither by a specific expertise nor by a representative function (Joly and Marris, 2003) and is based on their

opinion about the information work of the different actors involved in this public and controversial debate about GMOs in Europe.

## 2. PRESENTATION OF THE SURVEY DATA

The data used are taken from the special European survey “Eurobarometer 58.0” dealing with the services of general interest, biotechnologies and the environment. The special Eurobarometer reports are based on advanced thematic study carried out for the account of the services of the European Commission or other European institutions, and integrated into the waves of the survey of the standard Eurobarometer. Carried out in September and October 2002, Eurobarometer 58 covers the population—having the nationality of one of the member countries of the EU—15 years and older, residing in each member state of the European Union. 17076 individuals from 16 countries were thus questioned.

In our analysis, we have retained different variables: socio-demographic ones (age, age at the end of formal education, income, professional status, place of residence), individual values (political stance, interest in science, politics and the quality of food, agreement with certain social proposals) and concerning the debate on biotechnology (trust, knowledge, information). For “Trust”, the question posed is “do you trust the information on modern biotechnology coming from the following sources”. Each time we thus obtain a qualitative dichotomous variable with the modalities “trust” (mentioned) and “no trust” (not mentioned). The list of variables obtained is relative to the confidence in some organizations<sup>1</sup>. A possibility to answer “do not know” is thus offered as well as the possibility to spontaneously answer “none of these”.

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<sup>1</sup> “consumer organizations”, «environmental organizations”, “animal welfare organizations”, “the medical profession”, “farmer organizations”, “religious organizations”, “national government bodies”, “international institutions (not companies)”, “a particular industry”, “universities”, “political parties”, “television and newspapers”.

We also created variables concerning the opposition to the food use of GMOs and knowledge of biotechnologies. We thus established a scale of opposition to the food use of GMOs and a dichotomous variable “opposition to all food use of GMOs”. Six questions were asked about the use of GMOs to nutritive ends (with three possible modes of response: “yes”, “no”, “do not know”)<sup>2</sup>. Based on the negative responses to these six questions we thus constructed a scale of opposition going from 0 (“non opposition”) to 6 (“total opposition”). Cronbach’s Alpha for this scale is 0.877, which allows us to suppose a greater reliability. By isolating the last modality, we thus obtain a new variable “opposition to total food usage of GMOs” taking two modalities: total opposition/ total non-opposition. According (Gaskell *et al.*, 2004), this division is one that discriminates most between the two groups thus created. A variable was created concerning knowledge of biotechnologies. Questions concerning the use of biotechnologies had the goal of measuring the real knowledge of individuals. In order to aid the comparability of results with the use of the precedent Eurobarometer reports, a scale taking up the 9 questions asked in the different sessions of the Eurobarometer can thus be constituted<sup>3</sup>. We thus obtain a reliable scale (Cronbach’s alpha = 0.740) providing the number of right answers.

### 3. RESULTS OF THE ECONOMETRIC MODEL

To study the relationship between trust and opposition, we concentrated on five categories of actions that are the most important in this debate on GMOs: trust in the

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<sup>2</sup> “If food I was eating in a restaurant contained genetically modified ingredients, I would not mind”, “I would buy genetically modified food if it contained less fat than ordinary food”, “I would buy genetically modified food if it were cheaper than ordinary food”, “I would buy genetically modified food if it contained less pesticide residues than ordinary food”, “I would buy genetically modified food if it were grown in a more environmentally friendly way than ordinary food”, “I would buy genetically modified foods if it tasted better than ordinary food”.

<sup>3</sup> This choice has also been done so as to compare the results with Gaskell’s. The nine questions are : “There are bacteria which live from waste water”, “Ordinary tomatoes do not contain genes, while genetically modified tomatoes do”, “The cloning of living things produces genetically identical copies”, “By eating a genetically modified fruit, a person’s genes could also become modified”, “It is the mother’s genes that determine whether a child is a girl”, “Yeast for brewing beer consists of living organisms”, “It is possible to find out in the first few months of pregnancy whether a child will have Trisomy”, “Genetically modified animals are always bigger than ordinary ones”, “More than half of human genes are identical to those of a chimpanzee”, “It is not possible to transfer animal genes into plants”. The question 5 is thus eliminated: “It is the mother’s genes that determine whether a child is a girl”.

information on biotechnologies furnished by environmental protection agencies, by consumer groups, by the agbiotech industry, by the scientists, and finally by public authorities. As showing by a hierarchical cluster analysis, scientific and medical professions have a tendency to converge. National government and international institutions follow the same tendency. There is eventually a small convergence of industrial and farmers' organizations. This grouping allows us to have more reliable results, as each category is larger. We have hence grouped together under the label of 'scientists', both academic scientists and medical professionals. Similarly, national government and institutional institutions have been gathered under the label 'public authorities'. The group 'industry' entails farmers' organizations and agbiotech business.

To analyze further these data, different methods of logistic regression could be used. However, there is a risk here to get biased coefficients, as in the present case we could fear the simultaneity of decisions (trust and different types of opposition); the responses to the different questions are not independent to one another. The determining factors, both observable and unobservable, of a trust type are variables that could potentially explain the other types of trust. To take into account this *simultaneity*, which induces *endogeneity* risks that lead to biased coefficients (Wooldridge, 2002), we estimate a multivariate probit model with six independent variables (rather than six independent probit models) (Cappellari and Jenkins, 2003). Furthermore, this correlative model gives us an indication, the coefficient *rho* of correlation between residuals, of the force of association of the different variables (once controlled by a set of other variables).

We thus select the six latent variables  $y_1$  (opposition – labeled OPP),  $y_2$  (trust in the information on biotechnologies given by environmental protection agencies – labeled TRUSTENVI),  $y_3$  (trust in the information given by consumers' associations – labeled TRUSTCONSO),  $y_4$  (trust in the information on biotechnologies given by the agbiotech

business – labeled TRUSTINDUSTR),  $y_5$  (trust in the information on biotechnologies given by scientists – labeled TRUSTSCIENCE) and  $y_6$  (trust in the information on biotechnologies given by public authorities – labeled TRUSTPUBLIC).

Let the following hold for the given six latent variables  $y_1^*, y_2^*, y_3^*, y_4^*, y_5^*, y_6^*$  (i.e.  $y_j = 1$  si  $y_j^* > 0$ ; 0 otherwise), the system of equations to estimate is then given by:

$$\begin{cases} y_1^* = \alpha_1 + X\beta_1 + \varepsilon_1 \\ y_2^* = \alpha_2 + X\beta_2 + \varepsilon_2 \\ y_3^* = \alpha_3 + X\beta_3 + \varepsilon_3 \\ y_4^* = \alpha_4 + X\beta_4 + \varepsilon_4 \\ y_5^* = \alpha_5 + X\beta_5 + \varepsilon_5 \\ y_6^* = \alpha_6 + X\beta_6 + \varepsilon_6 \end{cases}$$

with

$X$  a vector of variables, identical in each equation. According to our previous precisions, it entails sociodemographic variables, as well as variables of values and participation in the debate on biotechnologies

$\alpha_i, \beta_i$  with  $i = 1, \dots, 6$ , the parameters to be estimated,  $\varepsilon_1, \varepsilon_2, \varepsilon_3, \varepsilon_4, \varepsilon_5, \varepsilon_6$  six error terms distributed according to law of multivariate normal distribution, with mean equal to 0 for each variable and a variance-covariance matrix  $V$ , such that  $V$  has the value 1 on the principal diagonal and the correlation terms  $\rho_{jk} = \rho_{kj}$  as the off-diagonal terms.

The log-maximum likelihood function to maximize then becomes:

$$L = \sum_{i=1}^n \log \varphi_3(\mu_i; \Omega), \text{ with } \varphi_3(\mu_i; \Omega) \text{ the cumulative multivariate normal distribution.}$$

This system of six simultaneous equations is estimated according to the method of simulation of maximum likelihood (as the estimation implies the calculation of a triple integral with the likelihood function). The GHK simulator (Geweke-Hajivassiliou-Keane) can

be used (Hajivassiliou 2000). It corresponds to the *mvprobit* procedure of *Stata* developed by Cappellari and Jenkins (2003). The use of the GHK simulator implies that results depend on a number of random draws used to calculate the simulated likelihood function. Cappellari and Jenkins (2003) recommend choosing a number of draws equal to at least the square root the sample size. Consequently, the choice of 150 draws allows us to be relatively confident in the estimated parameters. In the system of equations, we keep as independent variables: the different sociodemographic variables (age, gender, education, income, previous and current socioprofessional status, residence location), variables of values (political scale, approval of propositions linked to social values, variables in relation to GMO debate), as well as dichotomous variables of countries as a control on country effect.

The LR test of  $p$  (positive) allows us to justify the estimation of this multivariable probit and not of six independent probits: the hypothesis  $H_0$  of conjoined nullity of 15  $p_y$  can be rejected (p-value <0.0001). Moreover, the coefficients  $p_y$  (the correlation between the terms of errors in each one of the equations) are significant in almost every case: the unobserved variables influencing the opposition to GMOs are positively correlated to the characteristics not mentioned influencing the trust in each kind of actor. The only case where  $p$  is not significant is the one linking the opposition to trust in consumer associations. There this seems to be a relative independence between these two variables. The Wald  $\chi_2$  test allows us to reject the  $H_0$  hypothesis of conjoint nullity of variable coefficients included in the estimation. From the explication of these results, we can particularly highlight the fact that it is not exactly the same variables that significantly influence the different dependant variables.

Concerning socio-demographics variables, the opposition is positively influenced by age: this relation can be modeled in the form of a quadratic equation. The opposition rises strongly in relation to age but in a successively slower way (the tipping point is approximately at 70). Being a man lowers the marginal propensity to trust the information provided by

environmental defense associations, consumer and agbiotech associations, scientists and public authorities, while it has no influence on the opposition. The place of residence is important for the opposition against GMOs and the confidence in the information provided by environmental defense agencies, but in an inverted way. As the urban concentration rises, the opposition to GMOs falls, while the confidence in environmental protection agencies rises. In contrast with the rural zone, the individuals in the most comfortable urban zones are more confident in the consumer groups. The educational level has no impact on the level of opposition. On the other hand, it influences the level of confidence in environmental protection agencies and consumer groups positively, and only amongst students, in the trust shown towards scientists. The level of knowledge has no significant influence on the opposition to GMOs, whereas it influences the confidence in information furnished by environmental protection agencies, the agbiotech industry and scientists in a positive manner. The variables concerning the political scale influence the different dependant variables in the same way. Indeed, in relation to the people situated to left, those more to the right or not situated on the political scale at all, tend to oppose GMOs less. They tend to be less confident in the information provided by environmental protection agencies or consumer groups, but more confident in the information provided by industrialists and scientists. Beyond a "left" opposition, another type of opposition to GMOs can be identified. The people who oppose while they do not trust any of the diverse organizations are people who do not feel themselves concerned. In other words, there is a form of opposition based on the absence of looking for information: Not participating in a discussion on biotechnologies increases the opposition to GMOs, but lessens the trust in environmental protection agencies, consumer groups, industry groups and public powers. The same pattern of influence occurs for people who do not inform themselves on the subject, with the difference that these people have a tendency to trust scientists less.

*Table 1: Results of the multivariate probit model*

	<b>OPP</b>	<b>TRUSTENVI</b>	<b>TRUSTCONSO</b>	<b>TRUSTINDUSTR</b>	<b>TRUSTSCIENCE</b>	<b>TRUSTPUBLIC</b>
AGE	0.020 (0.005)***	-0.003 (0.004)	0.007 (0.004)*	-0.012 (0.005)**	-0.008 (0.004)*	-0.009 (0.005)*
AGE2	-0.014 (0.005)***	0.003 (0.004)	-0.007 (0.004)	0.011 (0.005)**	0.008 (0.005)*	0.009 (0.005)*
MALE	-0.014 (0.024)	-0.094 (0.023)***	-0.051 (0.024)**	-0.084 (0.028)***	-0.058 (0.024)**	0.045 (0.025)*
EDUC16-19	-0.011 (0.032)	0.106 (0.031)***	0.090 (0.031)***	-0.019 (0.036)	0.041 (0.032)	0.040 (0.034)
EDUC20+	-0.019 (0.038)	0.142 (0.036)***	0.126 (0.037)***	-0.043 (0.043)	0.115 (0.038)***	0.124 (0.039)***
EDUCSTILL	0.047 (0.144)	0.031 (0.135)	-0.015 (0.131)	-0.100 (0.155)	0.360 (0.145)**	0.206 (0.137)
INCOME-	-0.025 (0.038)	0.021 (0.037)	0.053 (0.037)	0.029 (0.042)	0.053 (0.038)	0.063 (0.040)
INCOME+	-0.020 (0.042)	0.059 (0.040)	0.087 (0.040)**	-0.062 (0.047)	0.070 (0.041)*	0.144 (0.043)***
INCOME++	-0.114 (0.044)***	0.003 (0.041)	0.100 (0.042)**	-0.058 (0.049)	0.125 (0.043)***	0.154 (0.044)***
INCOMEDK	0.020 (0.036)	-0.017 (0.034)	0.041 (0.035)	-0.084 (0.040)**	-0.045 (0.035)	-0.020 (0.038)
SMTOWN	-0.095 (0.026)***	0.067 (0.025)***	0.078 (0.026)***	-0.027 (0.030)	-0.021 (0.026)	0.034 (0.027)
LARGETOWN	-0.086 (0.029)***	0.075 (0.028)***	0.066 (0.028)**	-0.052 (0.033)	0.001 (0.029)	0.095 (0.030)***
SCALEKNOWLEDGE	-0.039 (0.051)	0.174 (0.053)***	0.064 (0.052)	0.128 (0.063)**	0.112 (0.050)**	0.072 (0.057)
SCALEKNOWLEDGE2	0.008 (0.013)	-0.023 (0.013)*	-0.006 (0.013)	-0.020 (0.016)	-0.016 (0.013)	-0.010 (0.014)
PUBBIOTECHDIS	0.059 (0.026)**	-0.075 (0.025)***	-0.054 (0.025)**	-0.090 (0.029)***	-0.018 (0.027)	-0.086 (0.027)***
PUBBIOTECHDK	-0.101 (0.040)**	-0.014 (0.038)	-0.038 (0.038)	-0.068 (0.045)	-0.058 (0.038)	-0.102 (0.040)**
TVBIOTECHDIS	0.081 (0.029)***	-0.164 (0.028)***	-0.246 (0.029)***	-0.033 (0.034)	-0.241 (0.029)***	-0.184 (0.031)***
TVBIOTECHDK	-0.303 (0.048)***	-0.220 (0.044)***	-0.122 (0.044)***	-0.088 (0.053)*	-0.237 (0.043)***	-0.091 (0.048)*
FREQTALKBIO	0.094 (0.049)*	0.055 (0.047)	-0.025 (0.047)	0.096 (0.053)*	-0.005 (0.049)	0.092 (0.049)*
OCCASTALKBIO	0.113 (0.029)***	0.087 (0.028)***	0.131 (0.028)***	-0.060 (0.033)*	0.045 (0.029)	0.100 (0.030)***
ONCETALKBIO	0.080 (0.032)**	0.034 (0.031)	0.046 (0.031)	-0.115 (0.037)***	0.079 (0.032)**	0.071 (0.033)**
SOMEINTSTPOL	-0.047 (0.028)*	-0.040 (0.026)	-0.079 (0.026)***	-0.033 (0.031)	-0.008 (0.028)	-0.088 (0.028)***
HARDLYINTSPOL	-0.031 (0.033)	-0.100 (0.032)***	-0.171 (0.032)***	-0.020 (0.038)	-0.022 (0.033)	-0.121 (0.034)***
SOMEINTSCIENCE	0.114 (0.028)***	0.026 (0.026)	0.006 (0.027)	-0.074 (0.031)**	-0.133 (0.028)***	-0.057 (0.028)**
HARDLYINTSCIENCE	0.226 (0.034)***	-0.017 (0.032)	-0.072 (0.033)**	-0.097 (0.038)**	-0.204 (0.034)***	-0.179 (0.035)***
SOMEINTFOOD	-0.145 (0.025)***	-0.145 (0.024)***	-0.089 (0.025)***	-0.049 (0.029)*	-0.024 (0.025)	0.108 (0.026)***
HARDLYINTFOOD	-0.352 (0.034)***	-0.295 (0.032)***	-0.116 (0.033)***	0.054 (0.037)	0.053 (0.033)	0.192 (0.034)***
GROWTHDIS	0.191 (0.025)***	0.014 (0.024)	-0.090 (0.024)***	-0.071 (0.028)**	-0.167 (0.025)***	-0.204 (0.026)***
GROWTHDK	-0.018 (0.041)	-0.150 (0.039)***	-0.126 (0.040)***	-0.221 (0.048)***	-0.182 (0.039)***	-0.195 (0.043)***

	<b>OPP</b>	<b>TRUSTENVI</b>	<b>TRUSTCONSO</b>	<b>TRUSTINDUSTR</b>	<b>TRUSTSCIENCE</b>	<b>TRUSTPUBLIC</b>
EXPNATUDIS	0.307 (0.024)***	0.089 (0.023)***	0.079 (0.023)***	-0.161 (0.027)***	-0.105 (0.024)***	-0.095 (0.025)***
EXPNATDK	0.054 (0.042)	-0.049 (0.040)	-0.069 (0.041)*	-0.172 (0.048)***	-0.098 (0.040)**	-0.100 (0.044)**
NONTRADVALUESDIS	0.185 (0.026)***	-0.013 (0.025)	0.025 (0.025)	-0.122 (0.029)***	0.006 (0.026)	0.009 (0.027)
NONTRADVALUESDK	-0.016 (0.040)	-0.017 (0.037)	-0.080 (0.038)**	-0.102 (0.044)**	-0.029 (0.038)	-0.087 (0.041)**
ENTERPRISEDIS	-0.019 (0.026)	0.022 (0.025)	-0.010 (0.025)	-0.097 (0.029)***	-0.020 (0.026)	-0.030 (0.026)
ENTERPRISEDK	-0.074 (0.032)**	-0.018 (0.031)	-0.048 (0.031)	-0.151 (0.037)***	-0.056 (0.031)*	-0.104 (0.034)***
POLITICALLEFT	-0.121 (0.048)**	-0.035 (0.047)	0.037 (0.047)	-0.116 (0.055)**	0.089 (0.048)*	0.100 (0.051)**
POLITICALCENTER	-0.148 (0.046)***	-0.111 (0.044)**	0.003 (0.045)	-0.007 (0.052)	0.106 (0.045)**	0.093 (0.048)*
POLITICALRIGHT	-0.204 (0.051)***	-0.224 (0.049)***	-0.086 (0.049)*	0.073 (0.056)	0.143 (0.050)***	0.116 (0.053)**
POLITICALRIGHT++	-0.275 (0.069)***	-0.306 (0.067)***	-0.248 (0.067)***	0.194 (0.074)***	0.179 (0.068)***	0.040 (0.072)
POLITICALREFUSAL	-0.158 (0.049)***	-0.212 (0.047)***	-0.100 (0.048)**	-0.034 (0.055)	-0.001 (0.048)	0.014 (0.052)
Intercept	-0.808 (0.176)***	-0.278 (0.171)	-0.221 (0.172)	-0.094 (0.198)	0.246 (0.172)	-1.062 (0.187)***
Log pseudo-likelihood	-50828.874					
Wald $\chi_2$ (426)	5914.85***					
LRtest of $\rho_{ij}$ (15)	3169.99***					
$\rho$	<b>OPP</b>	<b>TRUSTENVI</b>	<b>TRUSTCONSO</b>	<b>TRUSTINDUSTR</b>	<b>TRUSTSCIENCE</b>	<b>TRUSTPUBLIC</b>
OPP	-	0.048 (0.014)***	-0.013 (0.014)	-0.065 (0.017)***	-0.094 (0.014)***	-0.104 (0.015)***
TRUSTENVI		-	0.507 (0.014)***	0.287 (0.016)***	0.110 (0.014)***	0.153 (0.014)***
TRUSTCONSO			-	0.319 (0.016)***	0.197 (0.014)***	0.234 (0.015)***
TRUSTINDUSTRI				-	0.264 (0.017)***	0.279 (0.017)***
TRUSTSCIENCE					-	0.311 (0.016)***
TRUSTPUBLIC						-

Note: \*  $p$ -value < 0.1; \*\*  $p$ -value < 0.05; \*\*\*  $p$ -value < 0.01, Robust standard errors in parentheses. Model controlled by dichotomous variables of countries. Other control variables not-presented are: marital status, socio-professional category.

More precisely, to put into evidence the way in which the different dependant variables are linked to one another, we can calculate the different conditional probabilities:

$$\left( i.e., p\left(\frac{y_i = 1}{y_j = 1}\right) \forall i, j = 1, 2, 3, 4, 5, 6 \right)$$

In comparison with the *unconditional* probability  $(p(y_i = 1), \forall i = 1, 2, 3, 4, 5, 6)$  of being opposed, from which we deduce that trusting association leads to a rise of 7.9% in the probability of being opposed to GMOs. On the other hand, trusting the industrialists, scientists or the public institutions leads to a lowering of the probability of being opposed to GMOs (by 14.6%, 6.4% and 17% respectively) (Table 2). It is notable that the probability of trusting a certain actor in the debate is always positively influenced by the trust shown to another party (with more or less important factors).

**Table 2: Table of percentage increases**

Increase in the probability of row term given column term with respect to unconditional probability	TRUST-ENVI	TRUST-CONSO	TRUST-INDUSTR	TRUST-SCIENCE	TRUST-PUBLIC
OPP	+7.9	+0.9	-14.6	-6.4	-17.0
TRUSTENVI		+37.5	+34.4	+7.1	+17.3
TRUSTCONSO			+34.1	+10.4	+28.2
TRUSTINDUSTR				+21.7	+56.6
TRUSTSCIENCE					+23.5

*Lecture: The fact having trust in environmental associations increases the probability of being opposed to GMO by 7.9%*

#### 4. CONCLUSION

Trust in the information given by certain actors (such as environmental organizations, scientists, industrialists and governments) but also in their action, is a determining factor to explain the differences of attitudes concerning GM products consumption. Our work confirms the results of different studies, using the same type of data (transnational surveys including the last Eurobarometers) (Gaskell *et al.*, 2004; Priest *et al.*, 2003; Pardo *et al.*, 2002 ; Sturgis *et al.*, 2005) or other methodologies (Cook *et al.*, 2002 ; Lang *et al.*, 2003), on the importance of individual values and attitudes and of the participation in certain social networks, or « the importance of general value orientations or worldviews » (Pardo *et al.*, 2002 : 9). More

precisely, our conclusions confirm those of Huffman (2003) on the important impact of trust in environmental associations. According to Becker (1996) and Huffman (2003), there is inside the same individual a coexistence of trusts in different actors involved in GMO-related information, and it is the relation between the levels of each of them which determines the final decision. This leads to important theoretical propositions in terms of economic analysis. It is necessary to take into account values and perceptions in the economic theory of the consumer. Our empirical analysis can then be understood as a first corroboration of such theoretical analysis. To go further on this point and be able to really confirm this result, it would be necessary to have subjective scales of trust in one actor of the debate (which would then provide a scale of 'trust gap' at the individual level).

The absence of consensus towards GMOs leads some of the actors to suggest Labeling as a compromise, before any definitive consensus is reached. However, the debate on Labeling has only deepened the disagreement between pro and anti-GMOs. Indeed the proponents of GM-products Labeling hold on the principle that citizens have the right to be informed and hence the choice to buy or not, to accept or not genetically modified food. In contrast, the agri-business lobby claims that the consumers could draw the conclusion of the inferiority of GM products and hence ask for a negative Labeling such as 'this product does not contain GMOs'. Labeling implies costs that have to be borne in part by the industrial sector, in part by the public institutions. These costs could be reflected in a price rise for the consumers (FAO, 2004). This rise is unfair, according to the proponents of the ethical theory (Thompson, 1997), as consumers didn't ask for GM products. The Labeling debate shows the issue of the coexistence of GM and non-GM sectors (Heslop, 2006). A segregation policy of the two sectors entails important costs at the early processing stage of the sector. These costs are divided in two categories: the costs of the separation of the two sectors, and the control costs. The first are borne, in part, by the non-GM sector to avoid for instance GMO

pollination, invest in new equipment, and guarantee that the product is under the GMO threshold. The second are borne by public control institutions that consider that the technology fails the means to assure the monitoring function. This separation of sectors answers the need of the consumer-citizen to be properly informed and have the right to choose according to his or her preferences or beliefs.

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## 6. APPENDIX: DESCRIPTIVE STATISTICS

Variables	Mean	Std. Dev.	Min	Max	Signification
SCALEOPP	3.496	2.290	0	6	Scale of opposition to GMO
OPP	0.329	0.470	0	1	Total opposition to GMO
SCALEKNOWLEDGE	5.039	1.913	0	9	Scale of knowledge in biotechnology
SCALEKNOWLEDGE2	29.050	17.944	0	81	(Scale of knowledge in biotechnology) <sup>2</sup>
AGE	45.083	18.012	15	99	Age
AGE2	23.568	17.345	2.25	98.01	(Age) <sup>2</sup> / 100
MALE	0.469	0.499	0	1	Sex: 1: Male - 0: Female
EDUC16-19	0.380	0.485	0	1	Age education 16-19 years (ref. up to 15 years)
EDUC20+	0.269	0.444	0	1	20 years and more
EDUCSTILL	0.106	0.308	0	1	Still student
INCOME-	0.180	0.384	0	1	Income in 4 quartiles: 2 <sup>nd</sup> quartile (ref. 1 <sup>st</sup> quartile)
INCOME+	0.155	0.362	0	1	3 <sup>rd</sup> quartile
INCOME++	0.168	0.374	0	1	4 <sup>th</sup> quartile
INCOMEDK	0.322	0.467	0	1	Don't Know
SMTOWN	0.384	0.486	0	1	Type of community: Small or middle sized town (ref. Rural area or village)
LARGETOWN	0.278	0.448	0	1	Large town
POLITICALLEFT	0.189	0.392	0	1	Political Spectrum : Left + (Ref. Left++)
POLITICALCENTER	0.332	0.471	0	1	Centre
POLITICALRIGHT	0.152	0.359	0	1	Right +
POLITICALRIGHT++	0.043	0.203	0	1	Right ++
POLITICALREFUSAL	0.215	0.411	0	1	Refusal
PUBBIOTECHDIS	0.529	0.499	0	1	Biotech: Take part in public discussion: tend to disagree (ref. tend to agree)
PUBBIOTECHDK	0.132	0.339	0	1	don't know
TVBIOTECHDIS	0.225	0.417	0	1	Read articles and watch tv about biotech: tend to disagree (ref. tend to agree)
TVBIOTECHDK	0.083	0.276	0	1	don't know
FREQTALKBIO	0.063	0.242	0	1	Ever talked about biotechnology: Yes, frequently (ref. No, never)
OCCASTALKBIO	0.271	0.444	0	1	Yes, occasionally
ONCETALKBIO	0.164	0.371	0	1	Yes, only once or twice
SOMEINTSTPOL	0.383	0.486	0	1	Interest in politics: Some of the time (ref. Most of the time)
HARDLYINTSPOL	0.276	0.447	0	1	Hardly any of the time
SOMEINTSCIENCE	0.390	0.488	0	1	Interest in science: Some of the time (ref. Most of the time)
HARDLYINTSCIENCE	0.292	0.455	0	1	Hardly any of the time
SOMEINTFOOD	0.334	0.472	0	1	Concerned about food quality: Some of the time (ref. Most of the time)
HARDLYINTFOOD	0.161	0.367	0	1	Hardly any of the time
GROWTHDIS	0.302	0.459	0	1	Economic growth brings better quality of life: tend to disagree (ref. tend to agree)
GROWTHDK	0.104	0.305	0	1	don't know
EXPNATUDIS	0.434	0.496	0	1	Exploiting nature is unavoidable: tend to disagree (ref. tend to agree)
EXPNATDK	0.108	0.311	0	1	don't know
TRADVALUESDIS	0.591	0.492	0	1	Traditional values should not guide us in this new century: tend to disagree (ref. tend to agree)
TRADVALUESDK	0.141	0.349	0	1	don't know
ENTERPRISEDIS	0.421	0.494	0	1	Private enterprise is the best way to solve our country's problems: tend to disagree(ref .tend to agree)
ENTERPRISEDK	0.226	0.418	0	1	don't know