Considering consumers' demands—the case of GMO approval and labelling systems

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Abstract

Understanding differences in European and American policies toward genetically modified foods requires a greater understanding of consumers' attitudes and preferences. This paper reports results from the first large-scale, cross-Atlantic study to analyze consumer demand for genetically modified food in a non-hypothetical market environment. We reject the assumption that consumer preferences are identical across countries: the median level of compensation demanded by English and French consumers to consume a genetically modified food was more than twice that in any of the United States locations. Results have important implications for labelling in the context of international trade. Depending on the (unknown) costs of labelling (including segregation costs), it is highly probable that labelling would be welfare reducing in the US but welfare enhancing in the EU. If that is the case, attempts by Codex to harmonise labelling of GM would seem misguided.

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1 Introduction and Background

Few issues in modern agriculture are as contentious as the use of biotechnology in food production. Agricultural biotechnology has the potential to improve food and environmental quality, lower food prices for consumers, and decrease production costs for farmers. Despite the promise of biotechnology, a number of real and perceived risks to the environment and human health exist. Interestingly, the two largest economies in the world, the United State (US) and the European Union (EU), hold widely divergent views about the potential risks and benefits of biotechnology. In the US, 69 percent of cotton, 68 percent of soybean, 55 percent of canola, and 26 percent of corn acres were planted with genetically modified (GM) seeds in 2001 (NASS). In the US, there is no labelling requirement for GM foods and some estimates suggest that over 60 percent of processed foods contain GM ingredients. In contrast, the EU has mandatory labelling laws in place for food produced with biotechnology. A number of large EU retailers have agreed to stop selling GM foods all together, effectively banning GM foods for most EU consumers.

Differing perspectives on biotechnology in the US and the EU could have significant impacts on international trade. The US and EU are each other's largest trading partners and account for the largest bilateral trade relationship in the world, with the value of US agricultural exports to the EU in excess of $6.3 billion in 2001 (Pew). It is often argued by US agricultural producer groups that the more restrictive labelling policies, moratoriums on approving new GM crops, and grocery store bans on GM food are simply a way for the EU to protect domestic agricultural producers from international competition. However, if EU consumers have different preferences for GM foods than consumers in the US it is an interesting issue why these differences exist and how these differences should be addressed in international trade negotiations. Theoretical work such as that by Bureau, Marette, and Schiavina and by Giannakas and Fulton show how differing consumer attitudes toward credence goods, such as GM food, can influence the welfare effects of labeling policies and other trade liberalization policies. Hobbs and

Kerr (2006) show that costless labelling is never welfare inferior to an embargo for the importing country. Whether labelling is welfare inferior or superior to freely allowing unlabelled imports would depend upon the extent of consumer preference for the non-GM product and the cost of labelling (which includes all the cost of segregation).

International trade theory is traditionally motivated by differences in factor endowments or comparative advantage across countries. Although implicit in such models, differences in consumer demand across countries are rarely emphasized. This point was effectively summarized by Horiba, who indicated (p. 650), "The two theories [Ricardian theory of comparative advantage and the Heckscher-Ohiln theory of factor endowments] are broadly similar . . . in the sense that they both identify the ultimate source of comparative advantage on the supply side. No crucial role is assigned by either theory to the demand side . . . Indeed, the demand side is effectively neutralized . . . by the strategic and commonly made assumption that consumer preferences are internationally identical . . ." The existence of different consumer preferences among countries has implications for trade negotiations. With respect to the latter, Hobbs and Kerr (2006) point out that the TBT agreement does not permit mandatory labelling of imports for credence characteristics (like GM), though Caswell (2000) argues that consumers' right to know would be a specific legitimate objective under TBT and is effectively achieved by labelling. There are however implications as well for Codex which has been attempting (unsuccessfully) to develop GM labeling rules since 1993? Since Codex is referenced under the TBT agreement, a successful Codex standard or guideline would become effectively compulsory under international law. In that case, countries whose consumers valued sufficiently the non-GM product would benefit, those who didn't would lose.

Lusk et al. (2005) conducted a Meta analysis investigating the determinants of consumer valuations for GM food. They found that across 25 studies that reported 57 valuations for GM valuations for non-GM food were affected, among other things, by: a) location, with studies of EU consumers generating higher price-premiums for non-GM food over GM food than studies of US consumers, b) valuation method with non-hypothetical methods generating lower premiums for non-GM food over GM food than hypothetical methods, c) the type of good valued, with highest price-premiums for non-GM food coming from studies conducted with meat products and the lowest premiums for non-GM over GM food from studies utilizing oil, and d) whether the food was modified to have a direct benefit for the consumer.

In this study, we constructed an experimental market, where we elicited the minimum amount of compensation randomly recruited female shoppers demanded to consume a GM rather than a non-GM food. Experimental sessions were held with over 160 individuals in three diverse US locations:

Jacksonville, FL, Long Beach, CA, and Lubbock, TX; and with over 200 individuals in two EU locations: Reading, England and Grenoble, France. We strongly reject the hypothesis that consumer preferences for GM food are identical in the US and the EU: the median level of compensation demanded by English and French consumers to consume a GM food was more than twice that in any of the US locations.

2 Experiment

In the summer and early autumn of 2002 a total of 372 randomly recruited females participated in research sessions in three US locations (Lubock, TX, Long Beach, CA and Jacksonville, FL and in Reading UK and Grenoble, France. Participants were given basic information about GM and asked to complete a survey. The survey covered demographics, aspects of trust, attitudes to food, the environment and technology, and risk-benefit perceptions of GM. After completing the survey, subjects participated in an experimental auction. Following Shogren et. al. (1994), subjects were endowed with a non-GM food (a chocolate-chip cookie, clearly labelled as containing no GM ingredients) and asked to bid, in an incentive-compatible auction, the minimum they had to be paid to exchange their non-GM food for an identically appearing GM product (labelled as being made with GM ingredients), with full knowledge that they would be required to consume the food at the end of the auction. Chocolate-chip cookies were chosen as the product is readily available and commonly consumed in both the US and EU and could be readily consumed in a laboratory setting (unlike say vegetable oil or raw potatoes). For further details of the process see Lusk et. al. (2006).

Seventy-eight, 47, and 39 consumers from Lubbock, TX, Long Beach CA, and Jacksonville FL, respectively participated in experimental auctions in the US and 108 English and 98 French consumers participated in the EU experiments. Table 1 reports summary statistics for selected demographic variables. On average, participants were in their mid 40s and virtually all participants were the primary shoppers in their households. There are significant differences in education and income across location; however, the differences correspond well to population demographics across locations. In the analysis that follows, we control for any differences in demographics across location before drawing any definitive conclusions; however, we find that demographics have very little influence on WTA bids, a finding consistent with the work of Hamstra.

Table 1 – Summary Statistics and Definitions of Demographic Variables

Variable	Definition	Lubbock TX	Long Beach CA	Jackville FL	Reading England	Grenoble France
Age	age in years	43.346[a] (10.689)[b]	41.277 (10.221)	44.385 (10.932)	46.206 (10.548)	41.511 (11.432)
Education	1 if obtained university undergraduate degree or higher; 0 otherwise	0.513 (0.503)	0.532 (0.504)	0.473 (0.506)	0.185 (0.390)	0.694 (0.463)
Income	1 if household income is greater than $50,000/year; 0 otherwise	0.544 (0.501)	0.717 (0.455)	0.564 (0.502)	0.514 (0.502)	0.083 (0.278)
Homemaker	1 if full time homemaker; 0 otherwise	0.076 (0.267)	0.149 (0.360)	0.154 (0.366)	0.176 (0.383)	0.113 (0.319)
Child	1 if children under the age of 16 living at home; 0 otherwise	0.392 (0.491)	0.468 (0.504)	0.615 (0.493)	0.519 (0.502)	0.344 (0.477)
Primary Shopper	1 if individual is the primary shopper in the household; 0 otherwise	0.975 (0.158)	0.936 (0.247)	1.000 (0.000)	1.000 (0.000)	0.897 (0.306)
Number of Observations		78	47	39	108	98

[a]Mean value

[b]Numbers in parentheses are standard deviations

2.1.1 Effect of Location on Compensation Demanded

Summary statistics of auction bids are reported in table 2.[1] The distributions of bids in the two EU countries are clearly greater than the bid distributions in the three US locations. For example, median WTA in England is over $0.20 greater than that in all three US locations and the median WTA in France is over $1.00 greater than that in any of the US locations. The percentage of consumers that bid exactly zero in round five was 23%, 11%, 13%, 3%, and 6% in Lubbock, Long Beach, Jacksonville, Reading, and Grenoble, respectively. Test results indicate that bids were similar in Texas and Florida, but that bids from Texas and Florida were significantly lower than in California, England, and France. California bids,

[1] Bids were originally elicited in local currency, but were converted to US dollars given exchange rates at the time of the experiments. Extreme bids were removed from the analysis. Specifically, we removed one observation in Florida and two observations in France that were in excess of $10,000. It is extremely unlikely that these bids represent true preferences for the cookies, but instead are "protest" bids. The removal of such bids is commonplace in contingent valuation (Jorgensen) and experimental (Horowitz, McConnell, and Quiggin) studies.

although greater than those in Texas and Florida, were significantly lower than English and French bids. The distribution of French bids is statistically higher than the bid distributions from the other four locations. That is, consumers in the European locations demanded significantly greater levels of compensation to consume the GM cookie than did the U.S. consumers.

Table 2 – Summary Statistics of Willingness-to-Accept Distribution by Location

Willingness-to-Accept	Lubbock TX	Long Beach CA	Jackville FL	Reading England	Grenoble France
Round 1					
Low Bid	$0.00	$0.00	$0.00	$0.00	$0.00
20% Quantile	$0.03	$0.10	$0.05	$0.16	$0.10
Median Bid	$0.23	$0.50	$0.12	$0.71	$1.57
80% Quantile	$1.00	$5.00	$0.50	$4.74	$9.80
High Bid[a]	$100.00	$100.00	$2.00	$158.00	$98.00
Average	$2.44	$5.23	$0.33	$4.82	$8.51
Standard Deviation	$11.91	$16.44	$0.43	$17.53	$17.08
Round 3					
Low Bid	$0.00	$0.00	$0.00	$0.00	$0.00
20% Quantile	$0.02	$0.05	$0.04	$0.14	$0.10
Median Bid	$0.10	$0.25	$0.06	$0.40	$1.52
80% Quantile	$0.75	$1.75	$0.35	$1.58	$14.70
High Bid[a]	$100.00	$100.00	$2.00	$158.00	$98.00
Average	$2.24	$4.18	$0.22	$3.64	$8.51
Standard Deviation	$11.85	$16.40	$0.41	$17.55	$16.42
Round 5					
Low Bid	$0.00	$0.00	$0.00	$0.00	$0.00
20% Quantile	$0.00	$0.05	$0.02	$0.11	$0.10
Median Bid	$0.10	$0.20	$0.05	$0.40	$1.96
80% Quantile	$0.50	$1.00	$0.15	$1.58	$11.76
High Bid[a]	$100.00	$100.00	$2.00	$158.00	$98.00
Average	$2.13	$4.03	$0.19	$3.58	$6.95
Standard Deviation	$11.84	$16.52	$0.41	$17.67	$13.32

[a]One observation in Florida and two observations in France were in excess of $10,000 and were removed from the analysis.

2.1.2 Determinants of Compensation Demanded

Given that WTA bids are statistically different across location, we now explore why these differences might exist. Previous literature, as well as conventional wisdom in the biotechnology industry, suggests a number of factors that might influence consumer acceptance of GM foods. Bredahl hypothesized that general attitudes toward technology, nature, and food affect individual's perceptions of the benefits and risks of biotechnology, which, in turn, affect attitudes toward GM in food production. Lusk and Bredahl have also found that consumers' knowledge of biotechnology affects acceptance of GM foods. Lastly, it is often suggested that differences in trust of food regulatory agencies in the US and EU might drive differences in acceptance across the two locations.

To investigate these antecedents of GM food acceptance, we asked consumers a number of questions about their knowledge of biotechnology, level of trust in information about biotechnology from the government and activist groups, perceptions of the benefits and risks of biotechnology, and general attitudes toward the environment, food, and technology. Summary statistics for each of these questions are reported in table 3 along with p-values from ANOVA tests of the hypothesis that the mean survey responses are equivalent across location. Table 3 and the following analysis are only based on data from subjects that answered all survey questions; partially completed surveys were discarded. In general, participants perceived themselves to be relatively unknowledgeable about biotechnology, with French consumers stating the highest level of subjective knowledge. Although French consumers stated the highest level of subjective knowledge, their objective knowledge, ascertained by asking "textbook" true/false questions, was not significantly higher than consumers in the other locations. Overall knowledge levels in the five locations were moderate to low. Consistent with conventional wisdom, US consumers placed a greater degree of trust in their governmental food regulator agencies, such as the US Department of Agriculture and the Food and Drug Administration, than did EU consumers. Data in table 3 also indicate that consumers in England and France were more concerned about the environment, in general, and were less optimistic about the degree to which technology enhances civilization than were the US consumers. Lastly, consumers in France and England perceived GM foods to be relatively more risky and less beneficial than the US consumers.

Table 3 – Summary Statistics and Definitions of Attitudinal Variables

Variable	Definition	Lubbock TX	Long Beach CA	Jackville FL	Reading England	Grenoble France	ANOVA P-Value
Knowledge of Genetic Modification in Food Production							
Subjective Knowledge	Knowledge of facts and issues concerning genetic modification in food production (1 = not at all knowledgeable; 9 = extremely knowledgeable)	3.133 (1.639)	3.111 (1.613)	2.843 (1.727)	3.330 (1.436)	4.626 (1.279)	0.01
Objective Knowledge 1	Response to True/False Question: Ordinary fruit does not contain genes, but genetically modified fruit does (1 = correct answer; 0 = incorrect answer or don't know)	0.533 (0.502)	0.444 (0.503)	0.342 (0.482)	0.510 (0.502)	0.527 (0.502)	0.33
Objective Knowledge 2	Response to True/False Question: It is impossible to transfer animal genes to plants (1 = correct answer; 0 = incorrect answer or don't know)	0.240 (0.430)	0.222 (0.420)	0.171 (0.382)	0.240 (0.429)	0.297 (0.459)	0.65
Trust in Information about Genetic Modification in Food Production							
Government	Level of trust in information about genetic modification in food production from government agencies such as the USDA and FDA (1 = strongly distrust; 9 = strongly trust)	6.267 (2.022)	5.400 (2.444)	5.629 (2.184)	4.410 (2.011)	5.044 (2.185)	0.01
Activists	Level of trust in information about genetic modification in food production from activist groups such as Greenpeace (1 = strongly distrust; 9 = strongly trust)	4.200 (2.034)	4.378 (2.358)	4.057 (2.014)	4.960 (1.758)	5.484 (2.354)	0.01
Perception of Risks and Benefits of Genetic Modification in Food Production							
Risk/Benefit	In general I believe the use of genetic modification in food production is (1 = risky; 9 = beneficial)	5.423 (2.062)	4.556 (2.389)	5.125 (2.005)	4.145 (2.121)	3.208 (1.866)	0.01
Views about the Environment							
Environment 1	When humans interfere with nature, it often produces disastrous consequences (1 = strongly disagree; 9 = strongly agree)	5.547 (2.429)	5.622 (2.026)	5.371 (2.224)	6.530 (2.181)	6.758 (2.083)	0.01
Environment 2	Mankind is severly abusing the environment (1 = strongly disagree; 9 = strongly agree)	6.880 (2.169)	6.711 (2.160)	6.514 (1.788)	7.220 (2.101)	7.527 (2.182)	0.06
Views about Food							
New Food	I don't trust new foods (1 = strongly disagree; 9 = strongly agree)	2.840 (1.882)	3.644 (2.134)	2.943 (1.679)	2.650 (1.714)	4.022 (2.165)	0.01
Food Quality	Quality is decisive for me in purchasing foods (1 = strongly disagree; 9 = strongly agree)	7.307 (1.619)	7.533 (1.532)	7.514 (1.651)	6.980 (1.694)	7.648 (1.471)	0.05
Natural Food	I usually aim to eat natural food (1 = strongly disagree; 9 = strongly agree)	5.227 (2.096)	6.022 (2.105)	5.229 (2.030)	6.290 (1.986)	7.648 (1.486)	0.01
Views About Technology							
Technology 1	The degree of civilization of a people can be measured from the degree of its technological development (1 = strongly disagree; 9 = strongly agree)	5.640 (2.442)	5.689 (1.832)	5.314 (2.040)	5.060 (1.999)	5.110 (2.562)	0.30
Technology 2	In this country we are probably better off than ever, thanks to the tremendous progress in technology (1 = strongly disagree; 9 = strongly agree)	6.586 (2.007)	6.800 (2.052)	6.971 (1.599)	6.310 (1.733)	6.879 (1.692)	0.17
Number of Observations		75	45	35	100	91	

To determine how these variables affect WTA, we employed quantile regression methods (Koenker and Hallock; Koenker and Bassett). Quantile regression methods estimate conditional quantile functions, as opposed to conventional ordinary least squares, which estimates a conditional mean function. We use the quantile regression rather than OLS for two primary reasons. First, as indicated by data in table 2, WTA bid distributions are quite dispersed with a number of "large" outliers. Estimates from a conditional mean regression would be extremely sensitive to these few outliers. In contrast, outliers have very little influence on estimates from a conditional median function, for example. Second, there appears to be a bimodal distribution of WTA, with few bids near the mean. By using quantile regression, we estimate the effect of covariates on WTA at different quantiles. This might be especially important in this application, where a particular covariate might influence consumers relatively unconcerned about GM food, but might have little influence on consumers with very large WTA.

In this analysis, we report results for three quantile regressions: a conditional 20% quantile regression, a conditional median regression, and a conditional 80% quantile regression. We began our analysis by initially estimating separate equations for each location at each quantile (i.e., we allowed the effect of age, education, etc. to vary by location and quantile). We then tested whether the location-specific estimates could be pooled into a single equation at each quantile (i.e., we tested whether the effects of age, education, etc. were identical across location at a given quantile). We could not reject the hypothesis that the effects of the independent variables were equivalent across location, as such pooled models for each quantile are reported in table 4.[2] Reported coefficients can be interpreted as the impact of a one-unit change in the covariate on WTA holding other covariates fixed at the given quantile. For example, a one-year increase in age is associated with a $0.013 decline in median WTA.

The only demographic variable with a consistently significant influence on WTA is age, with older consumers demanding less compensation to consume a GM cookie than younger consumers. Education had a statistically significant influence on WTA, but only at the 20% quantile. Overall, demographic factors had little influence on WTA. As shown in table 1, there were significant differences in the levels of education and income in the US and European locations. However, the estimated coefficients for the demographic variables reported in table 4 are much too small for differences in the levels of education and income to explain the magnitude of bid differences across the US and EU. That is, regression results indicate differences in demographic characteristics cannot be the explanation for the drastic differences in WTA across location.

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[2] These estimates use round five WTA bids as the dependent variable. Similar results are obtained regardless of which bidding round used.

Results in table 4 indicate that subjective knowledge was a significant determinant of bidding behavior at the 20% quantile. At this quantile, subjects with higher levels of subjective knowledge levels stated higher WTA. At the 80% quantile, individuals that correctly answered a true/false question about biotechnology bid significantly higher than individuals that did not correctly answer the questions. At the median, higher level of trust in activist groups was associated with an increase in compensated demanded. The most consistently significant result across quantiles was with regard individual's perceptions of benefits and risks of GM food. This variable was statistically significant at all three quantiles reported in table 5 and the magnitudes of the coefficients were relatively large in comparison with other attitudinal and demographic variables. Results indicate the higher level of perceived risk, the greater compensation demanded. Subjects that were less trusting of new foods demanded more compensation to consume the GM cookie at the median, but not at the lower or higher quantiles. Individuals that had a more optimistic view about technology demanded less compensation to consume the GM cookie than individuals with opposing viewpoints and this effect became stronger in the upper tails of the WTA distribution.

The last four rows of table 4 report the effect of location on WTA. Across all three quantiles, Texas and Florida consumers had significantly lower WTA than French consumers. Except for the lowest quantile, California consumers also had significantly lower WTA than French consumers. Estimates in table 4 also suggest that bids from Texas and Florida are significantly different than English WTA for all three quantiles reported in table 4; whereas, bids from California are significantly different than English bids for the latter two quantiles.

An interesting question that arises is whether and to what extent differences in levels of demographic and attitudinal variables explain differences in WTA across location. To address this issue it is important to first recognize that the regression results in table 4 hold constant the effects demographic and attitudinal variables across location. That is, the location dummy variables show the effect of "location" when the levels of age, education, risk/benefit, etc. are held at the same levels across location. The relatively large magnitudes of the estimated dummy variables imply that there is still a significant degree of unexplained variability in WTA across location that is not accounted for by differences in levels of demographics, knowledge, trust, and general attitudes, as measured in this study.[3] Nevertheless, our model can explain some of the unconditional difference in WTA across location. In particular, if we compare the "raw" unconditional bids from round 5 (as reported in table 2) to the estimated dummy variables in table 4, we can get a feel for the extent to which differences in independent variables explain

[3] If the estimated dummy variables were zero, then differences levels of in explanatory variables across location would fully explain the unconditional differences in WTA across location reported in table 2.

the differences in unconditional WTA across location. For example, the unconditional median bid (which does not hold constant differences in any explanatory variable) in TX is $1.86 lower than that in France. However, the conditional median bid (i.e., the dummy variable from table 5) in TX is only $1.46 lower than in France. Thus, differences in levels of demographics, knowledge, trust, and general attitudes, as measured in this study, explain $0.40 (or 21.7%) of the unconditional median difference in WTA across TX and France. Similarly, differences in explanatory variables across location explain 16.7% of the unconditional median different in WTA across CA and France and 20.7% of the unconditional median difference in WTA across FL and France. Although we are only able to explain roughly one-fifth of the difference in unconditional median WTA across the US and France, we find stronger results for England. Calculations imply that our model explains 55.0%, 27.5%, and 44.6% of the unconditional median difference in WTA across England and TX, CA, and FL, respectively. These findings suggest that while differences in levels of demographics, trust, attitudes about food and technology, and perceptions of risks and benefits explain some of the variability in WTA across location, there is still much to learn about what drives differences in values for GM food across the US and EU, especially with regard to France.

Table 4 – Effect of Attitudes and Nationality on Willingness-to-Accept: Quantile Regression Estimates

	Quantile		
Variable	**20%**	**50%**	**80%**
Constant	0.213**	2.443**	12.587**
	(0.093)[a]	(0.328)	(1.878)
Age	-0.002**	-0.013**	-0.043**
	(0.001)	(0.004)	(0.020)
Education	0.057**	-0.014	-0.143
	(0.023)	(0.082)	(0.432)
Income	-0.028	0.003	0.122
	(0.021)	(0.076)	(0.422)
Homemaker	0.007	-0.004	-0.318
	(0.031)	(0.109)	(0.645)
Child	0.001	-0.153**	-0.477
	(0.022)	(0.078)	(0.392)
Subjective Knowledge	0.013*	0.035	0.138
	(0.008)	(0.025)	(0.122)
Objective Knowledge 1	-0.002	0.117	0.206
	(0.020)	(0.074)	(0.380)

Objective Knowledge 2	-0.018	-0.031	2.664**
	(0.022)	(0.078)	(0.414)
Government Trust	-0.004	-0.021	-0.023
	(0.005)	(0.018)	(0.101)
Activist Trust	0.008	0.037**	-0.004
	(0.005)	(0.017)	(0.092)
Risk/Benefit	-0.031**	-0.086**	-0.280**
	(0.005)	(0.021)	(0.107)
environment 1	-0.008	-0.013	-0.029
	(0.005)	(0.019)	(0.101)
Environment 2	0.015**	0.020	0.051
	(0.005)	(0.017)	(0.099)
New Food	0.006	0.037**	0.033
	(0.005)	(0.017)	(0.101)
Food Quality	-0.003	-0.019	0.048
	(0.007)	(0.022)	(0.114)
Natural Food	0.001	0.025	0.044
	(0.005)	(0.019)	(0.109)
Technology 1	-0.001	-0.032*	-0.230**
	(0.005)	(0.018)	(0.098)
Technology 2	0.003	0.022	0.054
	(0.006)	(0.021)	(0.106)
Lubbock, TX[b]	-0.091**	-1.456**	-8.162**
	(0.033)	(0.123)	(0.637)
Long Beach, CA[b]	-0.004	-1.466**	-7.920**
	(0.037)	(0.142)	(0.848)
Jacksonville, FL[b]	-0.082**	-1.515**	-8.575**
	(0.041)	(0.153)	(1.021)
Reading, England[b]	0.050	-1.321**	-8.104**
	(0.033)	(0.130)	(0.592)

Note: dependent variable is round five willingness-to-accept bid

Number of observations in each regression = 346

One (*) and two (**) asterisks represent 0.10 and 0.05 levels of statistical significance, respectively

[a]Numbers in parentheses are standard errors estimated via bootstrapping

[b]Locational dummy variables relative to Grenoble, France

3 Conclusions and Labelling Implications

Some US groups claim that EU compulsory labelling represents a non-tariff trade barrier intended to protect EU producers by the back door.

One key piece of information needed to help resolve this conflict is information about consumer demand for GM foods in the US and EU. In this study, we elicited the amount of compensation consumers' demanded to eat a cookie containing GM ingredients in Lubbock, TX, Long Beach, CA, Jacksonville, FL, Reading, England, and Grenoble, France in an active market environment. We find that English and French consumers demanded significantly larger amounts of money to consume the GM food than did the US consumers. Differences in levels of demographics, knowledge of GM foods, trust in food regulator agencies, and general attitudes toward technology, food, and the environment explain some, but not all of the differences between the US and EU.

Regardless of how current preferences for GM foods were formed, the impact of current trade policies must now be addressed. Our estimates suggest that introducing GM foods in the US has been welfare enhancing (Lusk et. al., 2005) but that even with low labelling (and segregation) costs, labelling would likely be welfare reducing for the average consumer in the three US locations. By contrast, liberalising trade with regard to GM foods without labelling would likely be welfare reducing for the EU, but modest labelling costs would make labelling welfare enhancing for the average consumer in the two locations studied. Our results also suggest that the commonly made assumption of homogenous consumer preferences in international trade theory is likely to be wildly inaccurate, at least for genetically modified foods. Of course, we don't know how much it costs to segregate and label GM foods (a major study in the EU—COEXTRA—is attempting to answer this question for a number of food product chains), nor how representative our results are of the other EU regions, nor how stable preferences are over time.

Meanwhile the Codex Committee on Food Labelling (CCFL) has been working since 1993 to introduce harmonised labelling guidelines for foods containing GM ingredients. The twists and turns in the debate to 2001 were elaborated in MacKenzie (2000). She concluded that what were formally narrow technical issues for Codex have become particularly difficult where science is relevant but not determinative and where there are economic losers as well as winners of the proposed guidelines, but that it was hoped that CCFL would meet its objective of protecting the consumer and facilitating change by developing the best labelling policies for harmonisation. In 2002 the *Independent Evaluation of Codex*, recommended that the lowest priority in standard setting be accorded to informational labelling relating to non-health and non-safety issues, but CCFL persists in its efforts with GM labelling; by 2005 this objective was no nearer to attainment (Codex, 2005). The results presented in this paper are further evidence that harmonised standards are likely to be sub-optimal and that a country by country approach is more likely to produce global welfare gains.

4 References

Bredahl, L. "Determinants of Consumer Attitudes and Purchase Intentions With Regard to Genetically Modified Foods – Results of a Cross-National Survey." *Journal of Consumer Policy*. 24(2001):23-61.

Bureau, J.C., S. Marette, and A. Schiavina. "Non-Tariff Trade Barriers and Consumers'

Information: The Case of the EU-US Trade Dispute Over Beef." *European Review of Agricultural Economics.* 25(1998):437-62.

Cherry, T., T. Crocker, and J. Shogren. "Rationality Spillovers." *Journal of Environmental Economics and Management* 45(2003):63-84.

Codex (2002). Report of the Evaluation of the Codex Alimentarius and other FAO and WHO Food Standards Work, Rome and Geneva, 113pp.

Codex (2005). Report of the Thirty-third session of the Codex Committee on Food Labelling, Alinorm 05/28/22, pp6-9.

Coursey, D.L., J.L. Hovis, and W.D. Schulze. "The Disparity between Willingness to Accept and Willingness to Pay Measures of Value." *Quarterly Journal of Economics*. 102(August 1987):679-90.

Cummings, R. G., G. W. Harrison, and E. E. Rutström. "Homegrown Values and Hypothetical Surveys: Is the Dichotomous Choice Approach Incentive-Compatible?" *American Economic Review* 85(1995):260-266.

Fox, J.A., J.F. Shogren, D.J. Hayes, and J.B. Kliebenstein. "CVM-X: Calibrating Contingent Values with Experimental Auction Markets." *American Journal of Agricultural Economics.* 80(1998):455-65.

Gaskell, G., M.W. Bauer, J. Durant, and N.C. Allum. "Worlds Apart? The Reception of Genetically Modified Foods in Europe and the U.S." *Science*. 285(July 1999):384-87.

Hamstra, A. M.. *Consumer acceptance model for food biotechnology – final repor*t. The

Hague:The SWOKA Institute, 1995.

Hanemann, W.M. "Willingness To Pay and Willingness To Accept: How Much Can They

Differ?" *American Economic Review* 81(1991):635-47.

Hayes, D.J., J.F. Shogren, S.U. Shin, J.B. Kliebenstein. "Valuing Food Safety in Experimental Auction Markets." *American Journal of Agricultural Economics.* 77(1995):40-53.

Hoban, T.J. "Consumer Acceptance of Biotechnology: An International Perspective." *Nature Biotechnology*. 15(March 1997):232-234.

Hobbs JE and Kerr WA (2006). Consumer information, labelling and International trade in Agri-food Products, *Food Policy*, 31, 78-89.

Horiba, Y. "Testing the Demand Side of Comparative Advantage Models." *American Economic Review*. 69(1979):650-661

Horowitz, J.K., K. McConnell, and J. Quiggin. "A Test of Competing Explanations of Compensation Demanded." *Economic Inquiry*. 37(October 1999):637-46.

Huffman, W.E., M. Rousu, J.F. Shogren, and A. Tegene, "Public Good Value of Information from Agribusinesses on Genetically Modified Foods." *American Journal of Agricultural Economics*. 85(2003):1309-1315.

INFOREGIO. *The Urban Audit: Toward Benchmarking the Live of 58 European Cities*. Volume 1. Luxembourg: Office for Official Publications of the European Communities, 2000. Available online at: *http://europa.eu.int/comm/regional_policy/urban2/urban/audit/ftp/volume1.pdf*

INSEE. Institut National de la Statistique et des Études Économiques Web address: http://www.insee.fr/en/home/home_page.asp

Jorgensen, B.S. "Protest Responses in Contingent Valuation." *Environmental and Resource Economics*. 14(1999):131-50.

Kagel, J.H., R.M. Harstad, and D. Levin. "Information Impact and Allocation Rules in Auctions with Affiliated Private Values: A Laboratory Study." *Econometrica.* 55:6 (1987), 1275-1304.

Kahneman, D., J.L. Knetsch, and R.H. Thaler. "The Endowment Effect, Loss Aversion, and Status Quo Bias." *Journal of Economic Perspectives* 5(1991):193-206.

Kolstad, C.D. and R.M. Guzman. "Information and the Divergence between Willingness to Accept and Willingness to Pay." *Journal of Environmental Economics and Management*. 38(1999):66-80.

Koenker, R. and G. Basset. "Regression Quantiles." *Econometrica*. 46(1978):33-50.

Koenker, R. and K.F. Hallock. "Quantile Regression." *Journal of Economic Perspectives*. 15(2001):143-156.

List, J.A., and C. Gallet. "What Experimental Protocol Influence Disparities between Actual and Hypothetical Stated Values? Evidence from a Meta-Analysis." *Environmental and Resource Economics* 20(2001):241-54.

List, J.A. and J.F. Shogren. "Price Information and Bidding Behavior in Repeated Second-Price Auctions." *American Journal of Agricultural Economics*. 81(1999):942-949.

Lusk, J.L., J. Roosen, and J.A. Fox. "Demand for Beef from Cattle Administered Growth Hormones or Fed Genetically Modified Corn: A Comparison of Consumers in France, Germany, the United Kingdom, and the United States." *American Journal of Agricultural Economics*. 85(2003):16-29.

Lusk, J.L., L.O. House, C. Valli, S.R. Jaeger, M. Moore, B. Morrow, W.B. Traill. "Effect of Information about Benefits of Biotechnology on Consumer Acceptance of Genetically Modified Food: Evidence from Experimental Auctions in United States, England, and France." *European Review of Agricultural Economics*. 31(July 2004): 179-204.

Lusk, J.L., M.S. Daniel, D.R. Mark, and C.L. Lusk. "Alternative Calibration and Auction Institutions for Predicting Consumer Willingness-to-Pay for Non-Genetically Modified Corn Chips." *Journal of Agriculture and Resource Economics.* 26(July 2001):40-57.

Lusk, J.L., M. Jamal, L. Kurlander, M. Roucan, L. Taulman. "A Meta Analysis of Genetically Modified Food Valuation Studies." *Journal of Agricultural and Resource Economics*. 30(April 2005):28-44.

Lusk, J L, Traill WB, House, L O, Valli, C, Jaeger, S R, Moore, M, Morrow, B. (2006). Heterogeneity in Consumer Preferences as Impetus for Non-Tariff Barriers? Experimental Evidence of Preferences for Genetically Modified Food in the United States and European Union, *Journal of Agricultural Economics,* 57(1),1-21.

MacKenzie AA (2000). The Process of Developing labelling Standards for GM Foods in the Codex Alimentarius, *AgBioForum,* 3(4), 203-208.

Milgrom, P.R. and R.J. Weber. "A Theory of Auctions and Competitive Bidding." *Econometrica*. 50(1982):1089-1122.

National Agricultural Statistics Service (NASS), Agricultural Statistics Board, U.S. Department of Agriculture. Acreage Report. June 29, 2001.

Noussair, C., S. Robin and B. Ruffieux. "Do Consumers Not Care about Biotech Foods or Do They Just Not Read Labels?" *Economics Letters*. 75(2002): 47-53.

Noussair, C., S. Robin and B. Ruffieux. "Do Consumers Really Refuse to Buy Genetically Modified Food?" *The Economic Journal*. 114(2004):102-120.

Plott, A.E. and K. Zeiler. "The Willingness to Pay/Willingness to Accept Gap, the 'Endowment Effect,' Subject Misconceptions and Experimental Procedures for Eliciting Values." Working Paper, California Institute of Technology, 2003.

Progressive Grocer. 69th Annual Report of the Grocery Industry. April 2002.

Roosen, J., D.A. Hennessy, J.A. Fox, and A. Schreiber. "Consumers' Valuation of Insecticide Use Restrictions: An Application to Apples." *Journal of Agricultural and Resource Economics.* 23(1998):367-84.

Rutström, E.E. "Home-Grown Values and Incentive Compatible Auction Design." *International Journal of Game Theory*. 27(1998):427-41.

Shogren, J.F., S. Cho, C. Koo, J. List, C. Park, P. Polo, and R. Wilhelmi. "Auction Mechanisms and the Measurement of WTP and WTA." *Resource and Energy Economics*. 23(2001a):97-109.

Shogren, J.F., M. Margolis, C. Koo, and J.A. List. "A Random *n*th-Price Auction." *Journal of Economic Behavior and Organization*. 46(2001b):409-421.

Shogren, J.F., S.Y. Shin, D.J. Hayes, J.B. Kliebenstein. "Resolving Differences in Willingness to Pay and Willingness to Accept." *American Economic Review*. 84(1994):255-70.

Shogren, J.F. "Experimental Methods and Valuation." in *Handbook of Environmental Economics*. K.G. Mäler and J. Vincent, eds. North-Holland, Amsterdam, forthcoming.

Tanner-Ehmke, M., J.L. Lusk, and J.A. List. "Is Hypothetical Bias a Universal Phenomenon? A Multi-National Investigation." Working Paper, Department of Agricultural Economics, Purdue University, 2005.

Tversky, A. and Kahneman, D. "Loss Aversion in Riskless Choice: A Reference-Dependent Model." *Quarterly Journal of Economics.* 106(1991):1039-61.

Zhao, J. and C.L. Kling. "A New Explanation for the WTP/WTA Disparity." *Economics Letters* 73(2001):293-300.

U.S. Census Bureau. Web address: http://www.census.gov.