IMPACT OF PRODUCER AND USE OF BIOTECHONOLOGY ON CONSUMER WILLINGNESS TO PAY: DISCOUNTS REQUIRED FOR ORANGES PRODUCED WITH BIOTECHNOLOGY

Abstract: Genetically modified organisms (GMOs) have been present within the food industry for years. Past research focuses on consumer's willingness to pay for GMOs based on labels, and perceived risks and benefits. An online survey with a choice experiment will estimate different willingness to pay estimates for various producers and uses in the US, Germany and Spain. Respondents were divided into five treatment groups and presented with various uses of biotechnology. The choice experiment included price, producer and seedless as attributes for a pound of oranges. Results showed that respondents in all countries required a discount to purchase oranges produced with biotechnology regardless of information treatment or producer type. The discount rate was consistently larger for German participants than US or Spanish participants.

Keywords: biotechnology, genetic modification, willingness to pay, choice experiment, multinomial logit
JEL Codes: D12, D40, Q18

1. Introduction

"The Food Industry: Son of Frankenfood," GMOs:Up from the Dead", and "Kids Take up Fight for 'Real Food'" [1]are the headlines consumers read. These headlines influence the perception of new genetic modification technology. The headlines propagate an idea that GM foods are dangerous, unnatural and in a way not real. These headlines and countless others drive the consumer conversation about genetically modified foods. While scientific research has found no evidence of long term safety risks, consumers are still reluctant to accept the technology (National Acadmies,2016). Research has been done to understand how labels, prior knowledge and perceived benefits all impact a consumer's willingness to accept GMOs. One aspect that has yet to be explored is how the source of technological development and corporate trust affect a consumer's willingness to pay for GMOs.

The willingness to pay for various GM products has been researched in the past. Studies have found consistent results that there exists a premium for non-GM products. A study using university students found about half of the participants were more likely to pay a premium to avoid GM corn chips, and a large majority of participants were unwilling to pay for non-GM corn chips (Lusk et. al,2001). The same study concluded a final bid of $0.07/oz to exchange a bag of GM corn chips for non-GM chips. However, the wide range of exchange bids implies that there could be niche market for non-GM foods. Huffman and Shrogan (2003) found similar to results. In a Vickrey auction, French participants were asked to place bids on chocolate over three periods as information about the product became available. When the participants were informed the chocolate contained GM ingredients the bidding price decreased. The authors concluded that the impact of a GM label and hostility toward the technology influences consumer behavior. In contrast, Noussair et. al (2004) found an opposite effect. The authors calculated the premium for non-GM goods, but many participants were willing to purchase GM

[1] News articles are from The Economist (2006,2008) and CNN (2012)

goods if the price was sufficiently low. Unlike Huffman and Shrogan, Noussair et.al claim that revealing background information about GMOs had little effect on consumer behavior. Price purchase patterns underscore the importance of GMOs. The preceding authors all found decreasing WTP in both US and European consumers, Moon and Balasurbramanian (2003) concluded that the magnitude decrease between the two groups is different. Participants from the UK require a much lower price compared to US participants to accept a breakfast cereal made with GM ingredients. However, both groups would be less likely to pay a premium for the product if there was a perceived benefit. The difference in perception between the US and European studies cannot be justified only by the label alone. The US allowed GM technology while the EU took a position against the technology, because of the different initial regulations consumer interest changed, the US as supporters and the EU as proponents (Swinnen an Vandmoortele, 2011). The difference in regulation propelled the conversation.

The above studies explore how the introduction of a GM label influences a consumer's WTP for a particular product. Bredahl (2001) states the adoption of a new GM product is contingent on the benefits outweighing the potential risks. Various other studies focus on the perceived risk and benefit of the technology to calculate a WTP estimate. Harrison et. al (2004) found that as perceived risk of GMOs increases the likelihood of purchase decreases for both US and Italian participants. However, Italian consumers were much less likely to purchase GM foods compared to US consumers. Consumers in the US, France, German and the UK were willing to pay a premium for beef fed non-GM corn because of a lower perceived risk (Lusk, Roosen and Fox,2003). Chen and Chern (2002) found that while price, attitude, perception, and labeling play a significant role in consumer choice, the opposition of GM foods decreases when a benefit becomes evident to the consumer. However not all benefits are given the same weight. First generation biotech crops improve input characteristics like herbicide or pesticide resistance. Second generation biotech crops focus on improvements to output characteristics like nutritional value or taste. Consumers were found to be more willing to accept first generation crops; a large majority were wary that second generation crops could be harmful to human health or the environment (Moon and Balasurbramian,2003). Hampel, Pfenning, and Peters (2000) found results consistent with Moon and Balasurbramian. The use of biotechnology to modify flavor, increase shelf life or improve outward appearance was viewed more critically than technology use to improve resistance. There are conflicting views about the importance of perceived benefits. The use of GM technology to increase longevity in bread and milk did not offset the negative views associated with new products (Fortin and Renton,2003). Loureiro and Bugbee (2005) asked US participants at what premium level they would be willing to pay for a GM tomato based on technology benefit. Participants were willing to pay the highest premium for an enhancement on nutritional value, followed by pesticide resistance. The smallest premium came from increased profits for farmers.

GM products are not a new concept in the food industry. While most commercial GM products are not available for direct consumption, the introduction of GMO for fresh fruits and vegetables creates a new environment to study the impact of the technology. In the past a GM tomato Flavr-Savr failed due to poor variety selection, production issues and high prices. Similarly, the failure of the New Leaf Potato buckled under pressure from consumer advocate groups to halt its use in fast food (Huffman,2010). Although there have been failures, the papaya is an example of a successful public sector GM food crop. The Rainbow variety has been used to create a virus free ring of papaya production (Gonsalves and Ferrira,2003). While there have been both failures and successes of GM food crops, researchers cannot predict with certainty if a

new product will survive. Past research has shown reluctance towards GM technology. Consumer knowledge, use of technology, and perceived risks and benefits all influence a consumer's willingness to accept the new technology. Also associated with the new technology is a lack of trust in the federal government, grocers and industry regarding GM foods, but more confidence in universities, and advocacy groups. (Lang and Hallman, 2005). To date, how trust of developers and the use of the technology interact to influence consumer acceptance has not been investigated. Limited past studies show that trust in GM did not vary between American and European participants (Frewer et.al, 2013). While it is evident consumers are more willing to accept GM technology if there is benefit associated with the product and that they are more likely to trust universities in comparison to corporations, there is no work to tie those two ideas together. Using a choice experiment with information treatments portraying different uses of GM, this research will estimate different willingness to pay estimates for various developers and uses.

2. Experimental Procedure

2.1 Choice Experiment

An online survey was conducted in the United States, Spain, Austria and Germany. The experiment was conducted in different countries to identify varying feelings towards genetic modification. A choice experiment was included in which each respondent was presented with three different alternatives for purchasing fresh oranges-the third alternative for each choice set allowed the respondent to choose neither product. Oranges were chosen because all three regions[2] have high levels of consumption, and the US and Spain are both producers. For each type of orange, the price, producer of technology and presence of seeds were provided. There were five different price levels within each location. The mean per pound price was used and was consistent with market value. The additional price levels represented 10% and 20% above and below the mean. The currency, mean and unit of measurement was changed for the region in which the survey was administered. There were four attribute levels for producer of technology. If biotechnology was used for that option it may have been produced by a large, multinational corporation (MNC) such as Monsanto, a small family company, or a university. The fourth level of the producer attribute allowed for no biotechnology. The final attribute used was the presence of seeds. If seeds were present there was no information, or it was labeled seedless. Attributes and levels are reported in Table 1. The D-efficiency was used to identify the best combination of choice sets resulting with nine choice sets in the choice experiments. The optimal combination of the choice sets were determined to be the optimal using the "mktruns", "mktex", "mktlab" and "choiceff" macros available in SAS.

2.1.1Information Treatment

Each participant in the survey was randomly assigned to receive an "information treatment" or in the case of the control group, -no information treatment prior to the choice experiment. Each treatment provided a potential use for biotechnology: the reduction of pesticide use, to combat citrus greening, an emotional and a simple explanation of disease was given, and a consumer benefit, each of which are described below:

1) **Reduction of Pesticide Use**: Genetic engineering can be used to produce products with less pesticide use. The agricultural crops are produced in a way that when they are

[2] Participants in Germany and Austria were pooled to account for one region in the survey.

combined with specific pesticide (usually produced by the same entity that made the technology), the effectiveness of the pesticide is supposed to increase (which would allow the farmer to use less).

2) **Emotional Explanation of Citrus Greening:** Citrus greening, Huanglonbing (HLB), is an incurable disease that affects citrus trees. The disease starves the tree, causing fruit to fall off while it is still green. Greening is found in citrus groves around the world. In Florida, USA, production of oranges has fallen by over 60% in the last ten years, largely a result from this disease.

   Researchers have scoured the world looking for naturally immune trees, but have not located any. They have investigated many ways to curb the disease, from cutting down trees to steam-treating trees, and have not found a solution. An emerging scientific consensus now finds that genetic engineering is required to defeat citrus greening. Some scientist have even said "People are going to drink genetically modified orange juice or they're going to drink apple juice."
   To save the industry and the loss of millions of jobs, science may be the only viable answer. Genetic modification, or the use of biotechnology, may be the last chance to save the citrus industry.

3) **Simple Explanation of Citrus Greening**: Citrus greening, Huanglongbing (HLB), is an incurable disease that effects citrus trees. The disease starves the tree, causing fruit to fall off while it is still green. Genetic engineering can be used to make the tree resistant to the disease.

4) **Consumer Benefit**: Oranges are recognized providing a significant amount of Vitamin C. It is less known that they also contain Potassium, but a smaller amount. Genetic engineering can be used to produce oranges with the same great taste and characteristics of regular oranges, but with a significant amount of Potassium. Potassium is a mineral that the body needs to work normally, helping nerves and muscles communicate. A diet rich in potassium helps to offset some of sodium's harmful effects on blood pressure.

Following each information treatment, the participants were asked to rate on a seven-point scale how comfortable they were with the use of biotechnology based on the information given. The follow up question provided more information about consumers' attitudes toward the information treatments. Studies find that information influences consumers' WTP, and the source of the information matters, and that behavior is affected by the information that is available when making WTP decisions (Huffman & McCluskey, 2015)

2.2 Scales

Participants also read a series of statements which they rated on a 7-point scale from strongly disagree to strongly agree. The statements were randomized to comprise the Corporate Distrust Scale (Adams et. al, 2010), a technological acceptance scale adopted from the PATT-USA questionnaire and the New Ecological Paradigm. Participants responded to a total of 35 statements. A total score was calculated for each scale for each participant to understand his or her sentiment regarding the three scales. A greater average in the Corporate Distrust Scale indicates a higher level of distrust. The greatest possible score for the Corporate Distrust Scale is 91. The scores for the technological acceptance scale ranges from zero to 35, with zero indicating no acceptance and 35 being total acceptance. Similarly, a higher score for the NEP

indicates greater concern for the environment with the greatest score being 105. Table 4 represents all average scale scores and standard deviations across all three regions.

3. Econometric Model

The estimation was done in two steps. A random parameters models using the choice experiment to estimate individual willingness to pay (WTP). WTP was estimated for each of the producer levels as well as the seedless attribute. Following the random parameters model, an ordinary least square regression was run with each WTP as the dependent variable for all three countries, totaling twelve OLS regressions.

3.1 Random Parameters Model

The choice experiment was analyzed with a random parameters (RP) model (also known as a mixed logit). The RP model allows for random taste variation, unrestricted substitution patterns and correlation in unobserved factors over time, alleviating the limitation of the standard logit model (Train,2003).

An individual's utility is composed of observable variables and an error term that is independently and identically distributed (iid) extreme value. The utility level of the i^{th} product for the n^{th} respondent given choice occasion t is written as

$$(1) U_{nit} = \beta' \mathbf{x}_{nit} + \eta' z_{nit} + \varepsilon_{nit}$$

where $\mathbf{x}_{nit}$ and z_{nit} are vectors of observed variables related to alternative i. β is a vector of fixed coefficients and η is a vector of random terms with mean zero; and ε_{nis} is an iid extreme value error term.

In the choice experiment, the participants were asked to make nine choices between oranges offered at different prices with different attributes. The choice data was analyzed using the following RP model

$$(2) U_{nit} = \beta_{0it} + \beta_1 MNC_{nit} + \beta_2 Fam_{nit} + \beta_3 Pub_{nit} + \beta_4 Seed_{nit} + \beta_5 Price_{it} + \varepsilon_{nit}$$

Where β_{0it} is the alternative specific constant for alternative i; MNC_{it}, Fam_{it}, Pubit are random parameter dummy variables taking the value of one that is the producer of the choice i, zero otherwise; $Price_{nit}$ is the nonrandom parameter of alternative i. The WTP each producer type and seeds can be calculated by dividing coefficient of that parameter by the individual price coefficient.

3.2 Ordinary Least Square (OLS) Regression

Following the RP model an OLS regression was run to evaluate the impact of demographics and the scales on WTP estimates. Twelve regressions were run: one regression for each WTP estimator in the three countries. The model was written as

$$(3) WTP_i = \beta_0 + \beta_1 Age + \beta_2 Female + \beta_3 Kids + \beta_4 MediumIncome + \beta_5 HighIncome + \beta_6 College + \beta_7 Graduat + \beta_8 Retired + \beta_9 Student + \beta_{10} CDScale + \beta_{11} TechScale + \beta_{12} NEP + \beta_{13} PestRes + \beta_{14} Emotional + \beta_{15} Simple + \beta_{16} Benefit$$

Where WTP_i are individual WTP estimates for each of the producer attributes and the seedless attribute; *Age* is the age of the respondent; *Kids* is a dummy variable if children are in the home, 1 if children are present, 0 otherwise; income was separated into a categorical variable comparing *Medium Income* and *High Income* to low income individuals; *Graduate School* and

College compares those groups to high school or lower respondents; *CD, Tech, NES* and *Foodie* are scale scores; *PestRest, Emotional, Simple*, and *Benefit* are dummy variables indicating a respondent was in the identified information treatment.

4. Results and Discussion

The survey was designed to compare consumer attitudes across cultures. Comparisons were made among US, Austrian/German and Spanish participants. Austrian and German participants were grouped together because of similar cultures in the countries. The final number of observations for the three samples are 2,045, 1,996 and 1,996 in the United States, Austria/Germany and Spain, respectively. In each of the regions, participants were randomly assigned to one of the four information treatments or the control group. Table 2 provides summary statistics of demographic variables.

4.1 Willingness-to-Pay by Country

Willingness-to-pay estimates were calculated using the random parameters model. Estimates are reported in table four. For each country, four WTP estimates were estimated for each individual. The price parameter is nonrandom and used to calculate WTP by dividing the individual specific producer variable by the price coefficient. Average WTPs and standard deviations are reported in table 4 by information treatment for each country. In addition, an average WTP for the full sample of each country is included. Most WTP estimates are negative indicating respondents required a discount to purchase GM oranges compared to non-GM oranges. WTP estimates for the seedless oranges are mostly positive indicating that consumers would be willing to pay a premium for seedless oranges regardless of the information treatment they were given.

4.1.1 United States

Across all information treatments as well as the full sample the greatest discount is needed to purchase GM oranges when created by a large multinational corporation. The largest discount to purchase GM oranges from a multinational corporation when information is presented is observed when the emotional information treatment is presented. When participants are presented with the information treatment about pesticide reduction it elicited one of the lowest average WTP for multinational corporations. This indicates that in the United States information can make consumers more comfortable with GM technology. The simple explanation of citrus greening elicited a similar WTP estimate as pesticide reduction for multinational corporations, indicating, again, information made consumers less skeptical of GM technology. However, the emotional information treatment required the lowest discount when the biotechnology is produced by a small family company. The control treatment required the greatest discount for oranges produced with biotechnology for all producer types. Compared to Germany and Spain the discount needed to purchase GM oranges is less. The US production of oranges is decrease as citrus greening continues to reduce area in Florida. Overall, Florida accounts for about 60 percent of US production (USDA Foreign Agriculture Service,2017). As this production of oranges continues to decrease because of citrus greening, consumers may be more amenable to a GM orange to increase orange production domestically. Additionally, a price premium for seedless oranges is between six cents and fifteen cents.

4.1.2 Germany

There was less consistency among German participants. Unlike the United States, the largest discount is not always needed to purchase GM oranges from a multinational corporation. The impact of information is also not steady. In the United States, the control group always required the greatest discount for GM oranges. However, in Germany depending on the producer the control group sometimes required the small discount. Germany participants are willing to pay a premium for GM oranges when they are produced by a multinational corporation or a public institution when no information is given. The introduction of information made participants more skeptical of the technology requiring a greater discount to purchase the same product. This is not true for small family companies. The average discount is larger for the control group than compared to the other information treatments. When information was introduced respondents were more comfortable with GM oranges in all treatment groups. Multinational corporation required the greatest average discount for the pesticide reduction, emotional and benefit information treatments needing $1.87, $1.97 and $1.84 discounts, respectively. These discounts are considerably greater than the parallel discounts in the US and Spain. Since Germany does not produce oranges there is less at stake for the economy of the country. The threat of citrus greening does not directly affect German consumers; therefore, the implications of the disease are not as evident. Germany is one of the top importers of Spanish oranges, importing about 488,000 MT in 2014-2015 ((USDA Foreign Agriculture Service, 2016). German participants are also willing to pay the greatest premium for seedless oranges compared to their American and Spanish counterparts.

4.1.3 Spain

Spanish participants followed similar patterns as US participants but at larger magnitudes. Spain has been identified with high potential of EU countries to accept GM foods (Vlontzos and Duquenne,2015).The greatest discounts across all information treatments and control group was to purchase GM oranges from large multinational corporations. Discounts ranged from $1.33 to $1.69 compared to $0.96 to $1.19 in the United States. Similarly, small family companies required the smallest discounts between $0.34 and $0.91. Unlike the United States the control group did not always require the greatest discount. When looking only at the control group, the greatest discount was needed for technology created by multinational corporations and public institutions. This discount decreased as information was introduced. When the participants were exposed to the pesticide reduction information this caused the smallest reduction in price to purchase GM oranges. Spain is the leading citrus producer in the EU-28 and is predicted to produce 7.11 million tons of total citrus production (USDA Foreign Agriculture Service, 2016). A decrease in the price of oranges have negative effects on the country's economy. Spanish participants could be aware of this causing them to be more cautious about a great reduction in oranges. Average WTP was also negative for seedless oranges with some information treatments.

4.2 OLS Regression

Demographics, scale scores and a dummy variable for information treatment group was regressed against the individual WTP estimates for all producers and the seedless attribute. Table 5 includes OLS coefficient estimates.

4.2.1 Demographics

Age, income, education, employment, and children in the household are the included demographics. Age as negative and significant for most regressions, with older participants required a greater discount. Income is divided into three categories: low, medium and high income based on the six options within the survey. Medium and high income was compared to low income and was not significant. Employment was significant when predicting the WTP for seedless orange in the US and Spain. All employment levels show an increase in the WTP for seedless oranges compared to those participants who chose not to disclose employment status.

4.2.2 Scales

Corporate Distrust

The corporate distrust score for all countries and all WTP estimators is negative. As the scale score increases greater discounts are needed for the purchase of GM oranges. All producer option coefficients are negative indicating that for any producer a distrust of corporations lower the price consumers are willing to pay. Similar to average WTPs, Germany required the largest marginal increase in discount for each additional point on the consumer distrust scale for all producers. German participants are wearier of corporations. The estimates for the United States and Spain were similar.

Technological Acceptance

The acceptance of technology has the opposite effect of corporate distrust. All the coefficients are positive and significant. In all three countries respondents were accepting of technology. As their acceptance scores increased by one point the discount required to purchase GM oranges decreased. The decrease was consistent in the US across producers. In Spain, the discount decrease ranged from 0.008 to 0.019. Compared to the US and Germany, Spain showed the greatest variation in coefficients among producers and seedless WTP estimates. The technological acceptance coefficient was the most consistent between countries compared to the other scale scores.

New Ecological Paradigm

The NEP was significant when regressed against the WTP for large multination corporations, and small family businesses in all three countries; it was also significant for public institutions in Germany and Spain. All coefficients were negative. As the concern for the environment increased a greater discount is required to purchase GM oranges. Within each country, there was little difference in coeffienct between producer.

4.2.3 Information Treatment Dummy Variables

Dummy variables were added indicating which information treatment group the respondent was in. The control group was eliminated from the regression to act as a point of comparison. In the United States, the information treatment was significant for all WTP estimators and all information treatments excluding the emotional and consumer treatment for the seedless WTP. All the coefficients are positive showing that as information is presented the discount needed to purchase GM oranges decreased. Spain showed similar patterns as the United States. There were fewer significant coefficients but all were positive. The consumer benefit information treatment was only significant to predict seedless WTP. Like the US, the positive coefficients indicate as information is included Spanish respondents reduce the discount needed to purchase GM oranges. German results indicated the opposite result about information

acquisition. All dummy variables in the German analysis are significant, but with some negative coefficients. When the WTP for multinational corporations and public institute are the dependent variable, all information treatments are negative. Compared to the control group when information was presented the discount increased. Information about the use of the biotechnology did not encourage participants to lower the discount needed, but rather would increase the discount. However, when WTP for small family companies was the dependent variable, coefficients are positive so that exposure to information decreased the price reduction.

4.3 Cross Country Comparison

The results from both the RP model and the OLS regression show similarities among the three countries. Although there are similarities the results still show stark differences between cultures and citrus producing countries. Table 6 uses the coefficients from the OLS regression to estimate the WTP discount needed for a female participant from each of the three countries at the average age of their respective country that has a college education, a medium income, with children that is employed either full time or part-time. The scale scores used was the average scale score for each country. The representative participants consistently required greater discounts in Germany to purchase GM citrus created by a large multinational corporation for any information treatment. The German discount was typically greater than $0.60 in the US and between $.60 and $.30 in Spain; the difference between the US and Spain estimates are on average $.22 and consistently lower in the US. The US required the lowest discounts across all producers and information treatments. The US perceives greater benefit and less risk associated with GM compared to European participants (Frewer et. al, 2013). Again, this can be attributed to similar citrus production in the two countries. The greater discounts required in Germany and Spain are consistent with previous studies showing that EU countries have higher willingness-to-accept estimates when compared to the US (Lusk et.al, 2006).

Comparing the estimates to the control group to those when information is given for MNC willingness to pay yields different patterns when comparing the US, Germany and Spain. In the United States as information is revealed regardless of information treatment the discount decreases from $1.24 to as low as a $1.00. In Spain information had similar effects but to a lesser effect. The decrease in discount was not as drastic as the US ranging from $.01 to $.32. However, an interesting result occurs in Germany. When no information is given, no discount is required; however, once information is given regardless of the information treatment discounts are needed for German participants.

5. Conclusion

Genetic modification for fresh fruits and vegetables has various levels of success. As the food industry evolves, the use of technology is becoming more necessary. Previous work aimed to show how consumers react to labels, knowledge and perceived risks and benefits of GM technology, this research aimed to create a relationship between the technology developer and acceptance. US, German and Spanish participants all required a discount to purchase GM oranges compared to non-GM oranges. The levels of discount varied among the regions. Germany required the greatest discounts and the US required the lowest discounts. Technology developed by small family companies elicited the need for the smallest discount compared to a large corporations and universities. The use of the Corporate Distrust Scale, technological acceptance scale and New Ecological Paradigm all provide insight into the WTP estimates. The

scale scores correlate the amount of discount required particularly as it relates to Germany's high NEP score and discount rates.

The discount patterns between US and Spanish participants are similar. Since both countries are orange producers, consumers may act in the same way. As information was presented to participants, the discount required to purchase GM oranges decreased compared to the control group. The opposite is true in German participants; as additional information was given, the discount needed increased. All three countries discounted biotechnology from small family companies at the lowest rate and had the greatest comfort level with the simple explanation of citrus greening. The US had the lowest discount rate for biotechnology produced by large corporations and by universities for all uses explored.

Germany consistently required higher discount values for biotechnology created by large corporations for all uses. However, this is not consistent with the average corporate distrust score. A higher score indicates a greater level of distrust. Of the three countries studied, Spanish participants showed the greatest level of corporate distrust followed by German participants; however, the latter group required higher discounts for technology created by large corporations. In addition to having the highest level of corporate distrust, Spanish participants are the most willing to accept new technologies with an average score of 24.68 compared to 23.92 and 23.94 for the US and Germany, respectively. It was hypothesized that a greater acceptance score would be associated with lower discount rates; however, the US consistently had lower discount rates for all uses and producers. German participants indicated the greatest concern for the environment with the highest average score on the New Ecological Paradigm followed by Spain and then the US. A greater concern for the environment could explain the higher discounts needed for GM technology. When information is given German consumers commonly require a greater discount. The large discount maybe directly correlated to environmental concerns.

The results are consistent was past work. European consumers required higher discount rates compared to US consumers similar to the conclusions in Moon and Balsurbramanian (2003). In contrast to other work, consumer benefit does not always decrease opposition. The discount needed to purchase potassium fortified oranges is greater than the other uses of biotechnology. Similarly, the largest discount was not to increase profits for farmer. It is clear that the developer and the use of biotechnology have implications on the WTP for biotech oranges. As more information about biotechnology and consumer acceptance is revealed, policy can be modified to better suit consumer needs. In the case of citrus greening, as the disease spreads and alternative solutions are not found, genetic modification may be the only option. However genetic modification cannot be easily implemented or marketed to consumer unwilling to accept the technology. Understanding how pricing changes with the implementation of biotechnology allows policy makers to foresee potential obstacles and best prepare. However, to understand all the policy implications, future research should consider producer implications and the cost to implement biotechnology. Before policy changes are made careful consideration must be taken to understand how the cost of production interacts with consumer willingness to pay estimates.

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Table 1. Attributes and Levels

Attribute	Levels
Price	$1.24, $1.54, $1.99, $2.34, $2.54
Producer	Large Multinational Firm, Small Family Company, University, No Biotech
Seeds	Seedless, With Seeds

Table 2: Summary Demographic Statistics

		Location		
Variable	Definition	US	Germany	Spain
Age	Mean	48.80	41.89	40.00
	St. Dev	16.63	15.81	12.73
Education	College or higher	67.14%	48.25%	52.05%
	Otherwise	32.86%	51.75%	47.95%
Income	Under Country Median Income	51.84%	62.78%	69.49%
	Otherwise	48.16%	37.22%	30.51%
Employment	Full Time Job	37.41%	43.59%	52.51%
	Otherwise	62.59%	56.41%	47.49%
Family Size	Mean	2.55	2.32	3.01
	St. Dev	1.34	1.17	1.16
Children	Mean	1.33	1.10	1.52
	St. Dev	1.16	0.97	0.95
Observation	N	2,045	1,996	1,996

Table 3: Average Scale Scores

	Location		
Scale	US	Austria	Spain
Corporate Distrust	64.18	66.53	70.29
	(13.98)	(10.68)	(12.41)
Technology Acceptance	23.92	23.94	24.68
	5.23	(4.64)	(4.64)
New Ecological Paradigm	70.75	76.73	74.35
	13.20	(10.74)	(10.29)

Table 4.1: Average WTP: United States

	Information Treatment					
WTP	Monsanto	Emotional	Simple	Benefit	Control	Full
MNC	-0.97	-1.04	-0.96	-1.01	-1.19	-1.03
	(0.442)	(0.474)	(0.463)	(0.392)	(0.337)	(0.433)
Family Company	-0.39	-0.44	-0.36	-0.55	-0.69	-0.48
	(0.488)	(0.576)	(0.461)	(0.673)	(0.631)	(0.583)
Public	-0.54	-0.63	-0.56	-0.67	-0.87	-0.65
	(0.370)	(0.342)	(0.333)	(0.288)	(0.328)	(0.371)
Seedless	0.13	0.10	0.15	0.08	0.06	0.10
	(0.328)	(0.337)	(0.337)	(0.385)	(0.439)	(0.368)

Table 4.2: Average WTP: Germany

	Information Treatment					
WTP	Monsanto	Emotional	Simple	Benefit	Control	Full
MNC	-1.87	-1.97	-0.72	-1.84	0.04	-1.50
	(0.715)	(0.638)	(0.671)	(0.545)	(0.724)	(0.947)
Family Company	-0.47	-0.54	-0.38	-0.58	-0.74	-0.54
	(0.883)	(0.875)	(0.900)	(0.912)	(0.416)	(0.826)
Public	-1.06	-1.15	-0.97	-1.19	0.15	-0.84
	(0.583)	(0.531)	(0.602)	(0.616)	(0.298)	(0.696)
Seedless	0.21	0.18	0.28	0.17	0.01	0.17
	(0.309)	(0.388)	(0.312)	(0.341)	(0.242)	(0.331)

Table 4.2: Average WTP: Spain

	Information Treatment					
WTP	Monsanto	Emotional	Simple	Benefit	Control	Full
MNC	-1.33	-1.64	-1.57	-1.68	-1.69	-1.58
	(0.634)	(0.663)	(0.596)	(0.766)	(0.607)	(0.665)
Family Company	-0.34	-0.72	-0.71	-0.91	-0.90	-0.72
	(0.890)	(0.845)	(0.891)	(0.909)	(0.798)	(0.886)
Public	-0.75	-1.07	-1.07	-1.18	-1.20	-1.05
	(0.585)	(0.655)	(0.497)	(0.805)	(0.544)	(0.649)
Seedless	-0.01	0.01	-0.13	0.04	-0.09	-0.04
	(0.413)	(0.418)	(0.584)	(0.382)	(0.536)	(0.466)

Standard deviations are given in parentheses

Table 5: OLS Regression

	United States				Germany				Spain			
Parameter	MNC	Fam	Pub	Seed	MNC	Fam	Pub	Seed	MNC	Fam	Pub	Seed
Intercept	-0.456*	-0.380*	-0.706*	0.056	1.080*	-0.384	0.647*	-0.071	-0.466*	-0.394	-0.861*	0.036
Age	-0.002*	-0.004*	-0.003*	-0.003*	-0.003*	-0.001	-0.004*	-0.003*	-0.002	-0.004*	-0.004*	-0.004*
Female	-0.107*	-0.049	-0.079*	-0.055*	0.014	0.074	-0.037	0.013	-0.034	0.038	-0.063*	-0.086*
Kids	-0.013	0.038	0.031	0.045*	0.024	0.116*	0.026	0.015	-0.033	-0.028	-0.038	-0.029
Income												
Medium	-0.004	-0.008	0.005	0.026	-0.058	0.026	-0.012	0.000	-0.008	0.037	0.013	0.034
High	-0.003	0.029	0.007	0.008	0.007	0.039	0.026	0.038	-0.135*	-0.099	-0.071	0.024
Education												
College	0.004	-0.001	0.019	-0.004	-0.082*	-0.142*	0.032	-0.020	-0.006	-0.075	0.053	0.030
Graduate	0.016	0.017	0.038	0.017	-0.031	-0.212*	0.079*	-0.042	0.008	-0.087	0.021	-0.009
Employment Status												
Retired/Unemployed	0.013	-0.015	0.009	-0.013	0.040	0.054	0.016	0.005	-0.055	-0.072	0.005	-0.017
Student/Home Worker	-0.020	-0.016	-0.007	-0.017	-0.022	-0.051	0.035	-0.001	-0.051	-0.101	0.025	0.056
Scales												
Corporate Distrust	-0.006*	-0.003*	-0.001*	-0.002*	-0.005*	-0.008*	-0.005*	-0.001*	-0.008*	-0.005*	-0.003*	-0.003*
Technology Acceptance	0.005*	0.012*	0.010*	0.011*	0.010*	0.018*	0.017*	0.012*	0.012*	0.014*	0.022*	0.010*
NEP	-0.002*	-0.003*	-0.001	0.001	-0.006*	-0.004*	-0.004*	0.000	-0.007*	-0.008*	-0.004*	-0.002
Information Treatment: Dummy Variable												
Pesticide Resistance	0.226*	0.303*	0.331*	0.075*	-1.683*	0.241*	-1.060*	0.177*	0.315*	0.483*	0.389*	0.066*
Emotional	0.159*	0.252*	0.248*	0.041	-1.771*	0.184*	-1.124*	0.151*	0.045	0.141*	0.095*	0.073*
Simple	0.239*	0.339*	0.318*	0.093*	-1.673*	0.336*	-0.966*	0.244*	0.111*	0.145*	0.108*	-0.045
Benefit	0.190*	0.143*	0.212*	0.027	-1.675*	0.131*	-1.184*	0.138*	0.009	-0.023	0.000	0.101*

* p-value < 0.05

Table 6: Willingness to Pay Estimates at Means

Information Treatment	United States				Germany				Spain			
	MNC	Fam	Pub	Seed	MNC	Fa	Pub	Seed	MNC	Fam	Pub	Seed
Pesticide Resistance	-1.01	-0.40	-0.56	0.14	-1.68	-0.50	-0.95	0.15	-1.07	-0.24	-0.62	-0.07
Emotional	-1.08	-0.46	-0.64	0.11	-1.77	-0.56	-1.02	0.12	-1.34	-0.59	-0.91	-0.06
Simple	-1.00	-0.37	-0.57	0.16	-1.67	-0.41	-0.86	0.22	-1.28	-0.58	-0.90	-0.18
Benefit	-1.05	-0.56	-0.68	0.10	-1.68	-0.61	-1.08	0.11	-1.38	-0.75	-1.01	-0.03
Control	-1.24	-0.71	-0.89	0.07	0.00	-0.74	0.11	-0.03	-1.39	-0.73	-1.01	-0.14