An Analysis of Producers' Opinions on Mandatory Labeling of GM Products

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Abstract

This study evaluates producers' perceptions on mandatory labeling of GM food products. The analysis is based on a sample of 1,887 farmers in 10 southern states who claimed to be "somewhat knowledgeable" about biotechnology. A logistic regression model was employed to isolate characteristics of farmers assumed to influence their opinions on mandatory labeling.

Introduction

The objective of the Nutritional Labeling Education Act (NLEA) was to provide consumers with nutritional information to help them make informed choices that would assist in maintaining healthy dietary practices. As science evolves more producers are using genetic engineering ingredients in their products. For consumers, the question becomes one of whether or not producers should label accordingly genetically modified food products. The question for producers becomes "will consumers continue to purchase the product once genetically modified (GM) the label is implemented?"

Hoban (2000) finds that "approximately 92 percent of food industry leaders believe that mandatory biotech food labeling - which proponents often position simply as an informational tool - will instead be perceived as a "warning" by at least some consumers," (Hoban, 2000). Will there be any repercussion for producers implementing a mandatory labeling GM program? Furthermore, by implementing such a program merely for "consumers-right to know" attitude, will it assist or cause greater confusion? As an alternative to mandatory labels of GM products, "USDA certified organic" labels implies GM free products are now offered for consumers. But for the zero tolerance consumers, that is not enough. They contend nothing short of a "GM free" label would be adequate.

Rationale and Objectives

Currently, the biggest debate in regards to agriculture biotech is labeling genetically modified (GM) food products. In the United States, consumers and consumer advocacy groups are concerned about implementing a mandatory labeling program for all GM products regardless of the product's health related significance. Meanwhile, producers' support the current FDA's policy there mandatory labeling is required only when the nutritional content has changed or that is a *de miniimus* risk of an allergenic reaction to consumers. Numerous studies have been conducted regarding consumers' perceptions of genetically modified food products. However, very few studies exist that have evaluated producers' perceptions on labeling genetically modified food products. Do producers behave as consumers when it comes to labeling GM products? Based on data from a survey of in 10 southern states producers, this study is intended to contribute to the understanding of how producers perceive mandatory labeling of GM food products.

On the zero tolerance for risk end of the spectrum, consumer advocacy groups believe there is a need for full information on the labels of GM products. Consumer advocacy group position is based on distrust in FDA's GM food products policy. Therefore, advocates seek complete disclosure of GM ingredients on mandatory labels. U.S. Consumers generally prove to be much more flexible and open to information on both fronts. Producers' support of current FDA policies may vary more than its current document as well. And producers' perceptions remain uncertain because little is known and documented about their stand on the issue. Knowledge of how producers perceive labeling genetically modified food products has significant implications in terms of future food production, consumption and trade.

The purpose of this study is to determine the region producers' perceptions and to understand the source of their perceptions. The regions centrality to markets and favorable climate warrant this focus. Specially, this study profiles producers' opinions about biotechnology and genetically modified food products, farmers' demographics and farm enterprise characteristics, and it compares these profiles to characterize those who would and would not require mandatory labeling for genetically modified food products. The general working hypothesis is that producers' demographic characteristics, and their perceived limitations and benefits of biotechnology have no significant impact on labeling their preferences for mandatory GM food products.

Literature Review

As many consumers are looking for ways to age gracefully, many are focusing on their physical health, especially what they are consuming and how much. Consumers appear to be increasingly hungry for information. A national survey of American consumers conducted in 1997 found that over three-quarters of consumer supported the FDA nutritional labeling policy (Hoban, 2001). One of the most complicated labeling issues now involves the role of biotechnology in food and food product development. By introducing biotech ingredients into products consumers have become more concerned about the long term effects of biotech products on their health, and the environment (Miller, 2002).When asked in consumer's surveys about the need for a mandatory labeling program for genetically modified products, consumers appear to agree, (Kirchhoff, 2001; Kirchhoff 2001 originally from Runge and Jackson 2000; Nayga, 1996; Lillsston, 1997; Gutlin et.al., 2002; Teisel et al, 2002; Ohr, 2000; and Consumer International, 1998). Also, in February 1997 a poll was conducted by biotech giant Novartis

which found that about 93 percent of American consumers want to see mandatory labeling of genetically engineered foods and about73 percent claim to "feel strongly" about this, (Lillisston, 1997). In order to appreciate this literature an understanding of the positions of the consumer advocacy groups, consumers, and producers must addressed. However, in the interest of time and space, this section focuses on consumers and producers.

Consumers' Opinions

Consumers want to know the positive (benefits) and negative (consequences/risk or uncertainties) effects resulting from the consumption of GM products. An example of the consumers' demand for labeling genetically modified products were the citizens in the State Oregon. This dilemma was taken to the polls and placed in the voting rights of the consumers to finally be able to voice there opinions. In anticipation of a favorable vote, a political committee in Oregon launched a campaign for labels on genetically engineered products. The Oregon Concerned Citizens for Safe Foods campaign successfully gathered enough signatures to get the labeling initiative on the ballot. On November 5, 2002, Oregon was the first state to take the labeling of genetically modified products to the voting polls (The Alliance for Better Foods, 2002, and Herbert, 2002). Following an intensive informational campaign from all sides, the people of Oregon voted an amazing 71 percent against labels on genetically engineered products. If approved Oregon would have been the first state to begin the labeling process of genetically modified products. Evidence in this particular case, unlike prior research surveys proved consumers were reluctant to vote for a mandatory labeling program. In the end, Oregon voters emphatically rejected mandatory biotech labeling as unnecessary and expensive (The Alliance for Better Foods, 2002). Evidently, Oregonians received the facts about the unnecessary nature

and additional costs of mandatory labels on GM products, and they made the right choice for the Oregon and the United States, (The Alliance for Better Foods, 2002). While the consumer advocacy groups are permanently fixed; the general public perceptions about labeling GM products continues to evolve.

Agribusiness Processor (Firms)/Farm Producers' Opinions

Agribusiness processors and producers are in favor of the FDA's policy on the "GE Voluntarily Labeling policy." For producers using genetically modified ingredients this policy is great for individuals whom want or do not want to advertise their product with the labels. Furthermore, there are guidelines developed by the USDA FDA department on the proper process to label products with or without GM ingredients.

Currently, all U.S. foods developed using GM ingredients must pass stringent FDA and U.S. Department of Agriculture safety test, while the federal Environmental Protection Agency and state government regulate other aspects of bioengineered products (Ridenour, 1999). The U.S. approval process for bioengineered foods is so stringent, it takes eight to ten years for a new product to be developed and approved. It is estimated that the average company spends half a billion dollars per product on this process alone (Ridenour, 1999).

Under the FDA policy developers of GM foods are expected to consult with the agency before marketing such foods, to ensure that all safety and regulatory questions have been fully addressed. The FDA's policy also requires special labeling for GM products in certain circumstances. For example, a genetically modified product would need to be called a different or modified name if its nutritional composition were significantly different from its conventionally grown counterpart, or if its nutritive value has been significantly altered. Special

labeling would be required of other products consumers need to be informed about a safety issue, such as the possible presence of an allergen that would not normally be found in the conventionally-grown product (Foulke, 1999 and Ridenour, 1999). Furthermore, scientific descriptions and data about new crops or food animals, including information about genetic modification and the potential to cause allergic reactions, would be put on the Internet during the agency's review (Wired News, 2001). The change of nutrition composition or allergenicity requires labels on all products, not just GM products (DJ Nordquist, 2002).

Based on documented evidence summarized by Golan (2000), the processors' general perception is that GM specifications on labels, rather than providing useful information, will cause greater confusion among consumers and reduce public acceptance and market efficiency. For instance, if risk adverse consumers assume GM foods have health and environmental risks, they would reject them indiscriminately. According to Golan (2000), the FDA leadership is clearly needed at this point to help educate the public (producers and consumers alike) about guidelines for all products produced and consumed in the U.S.

Conceptual Framework

The idea of an acceptable level of risk implies the existence of some standard or tolerance against which the risk is to be judged. The term tolerance refers to the amount of pesticides, residues, food additives or food borne illnesses. Any tolerance level higher than zero implies the willingness to accept some level of risk. As cited by Knutson et al. (1998), Archibald (1988) represented tolerance levels or acceptable levels of risk on a continuum from the zero-tolerance option to the risk-benefit option. This measurement scale was developed and utilized by displaying various degrees of acceptance of risk. The zero tolerance starting point on this

continuum is rooted in the 1958 "Delaney clause," (Knutson et al, 1998:430). The clause is a zero standard tolerance meaning the "product should be completely devoid of scientific evidence indicating specific harmful substances have been directly or indirectly added to the food supply." The Delaney clause became known as an unworkable standard (Knutson, 1998).

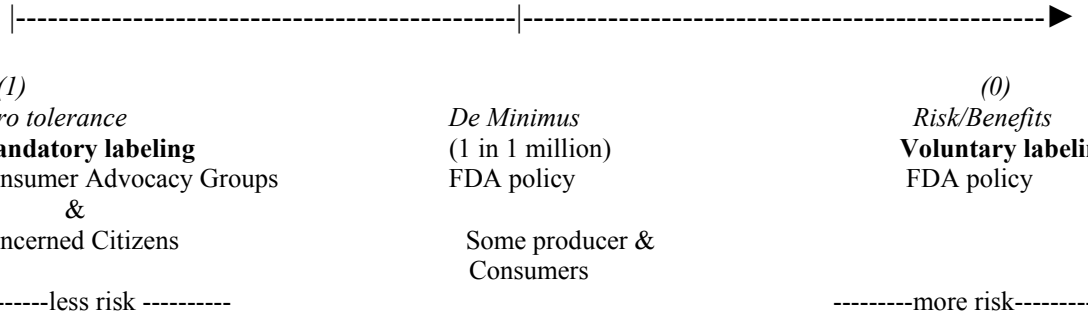
Next on the Archibald (1988) acceptable levels of risk continuum as adapted by Knutson et al. comes the *reasonable certainty of no harm* point between some risks and zero risk/tolerance. In 1996, the Food Quality Protection Act (FQPA) developed this tolerance of *reasonable certainty of no harm* requiring the establishment of a threshold at which there are discernable health effects. This threshold has not been interpreted. Several more tolerant and unworkable standards have evolved since 1958. The *de minimus or negligible risk* also stemmed from the Delaney clause, which unfolded between 1985 and 1988 (Holloway et. al., 1996). The specific *de minimus* tolerance level was established as 1 in 1 million- meaning that an additive or residue could not cause more than one additional death per million people over their lifetime.

Next at a higher level of risk on the Archibald continuum (1998) came the *no significant risk* level point. In 1986, the California's Safe Drinking Water and Toxic Enforcement Act adapted this position of the no significant risk level point of 1 in 100,000. At this point on the continuum, the no significant risk level involved one additional death per 100,000 people over their lifetime.

Finally, there is the *risk-benefit* approach on the acceptable level of risk continuum. The risk-benefit approach takes into account the economic, social, and environmental costs and benefits. Moreover, this is the one standard that recognized the social aspect as well as the economic aspect by measuring both the risks and benefits (Knutson, et al., 1998). In summary

mandatory labeling is a zero tolerance of risk position. The two positions may be viewed as occupying opposite ends of the risk tolerance continuum.

Illustration: Continuum of Tolerance Options for Food Safety



The range of the continuum scale based on the dependent variable: "Biotech food labeling should be mandatory. "
Figure 1: Risk tolerance continuum for food safety. (Archibald (1988) adapted by Knutson, et al. (1998).

Methodology

A survey was developed and tested on a sample portion of the population. The questionnaire consisted of 32 questions relating to various aspects of the producers' understanding and attitudes toward agricultural biotechnology. The background information questions for the producers included demographics such as gender, race, age, education, hours worked, acres owned, production on operation, gross value of sales, percentage of household income from all sources, interest in future workshops, and name and contact number. Other questions in the survey solicited information on the familiarity of producers with biotechnology, sources of information about biotechnology, benefits and limitation of biotechnology, assistance to starting biotechnology application, and a matrix of producer opinions about biotechnology.

The population for this survey was farmers in the states of Alabama, Louisiana, Texas, Oklahoma, Florida, Mississippi, Tennessee, South Carolina, Arkansas, and Georgia. The study is

based on survey data collected by the Southern Agbiotech Consortium for Underserved Communities (SACUC) to determine farmers' understanding and attitudes toward agricultural biotechnology. Two sub-samples of farmers were drawn, one from "underserved counties" and another from the remaining "better served counties." According to PCUL (2001), underserved counties are defined as an area within an Enterprise Zone under the Internal Revenue Code, an area where the percentage living in poverty is at least 20 percent, an area outside of a Metropolitan area where the median family income is at or below 80 percent of the statewide or national non-Metropolitan area median family income, whichever is greater, an area where the unemployment rate is at least 1.5 times the national average. NASS was then contracted to conduct this survey for the Consortium (SACUC, 2002).

The Logistic Regression Model

The logit model was selected in this analysis because of its asymptotic characteristics which constrain the predicted probabilities to between range 0 and 1. The logit model is commonly used in settings where the dependent variable is binary. Because the data source provided is based on individual, rather than grouped observations, the common estimation method is the maximum likelihood (Gujarati, 2003). Among the beneficial characteristics of maximum likelihood estimation are consistent and asymptotically efficient parameters (Pindyck and Rubinfeld, 1991).

The conceptual framework presented earlier in this paper is based on total agreement with mandatory labeling versus at least some reservations on opinions about mandatory labeling. This necessitated the binary coding of the dependent variable. BLABEL was coded as "0" for farmers who had at least some reservations and "1" for those who were in total agreement with

mandatory labeling. The following general model was specified and estimated to predict the likelihood or probability of the producers favoring mandatory labels on GM food products.

$$BLABEL = \beta_0 + \beta_1 DEMOGR + \beta_2 BENEFT + \beta_3 LIMITN + \beta_4 STATES + \beta_5 PRODUC + \beta_6 INFOSC + \beta_7 UNDERSC + \varepsilon \quad (1.)$$

Where DEMOGR represents demographic variables, BENEFT represents whether biotech has benefited or will benefit the farming operation, LIMITN represents the limitations that would prevent one from using more (any) biotechnology, PRODUC represents enterprise currently produced by farmers (cotton, beef cattle, hay, etc.); INFOSC stands for information sources (newspaper, magazines, radio/television); STATES represents each of the 10 states within the SACUC (Alabama, Tennessee, North Carolina, etc.); UNDERSC defines whether a county was underserved or not, and β_i's are the parameters to be estimated, and ε is an error term with zero mean and constant variance. The variable UNDERSC was included to test whether a difference in perceptions existed between producers within and outside underserved areas. Similarly, the STATES variables were included to test if differentiated opinions or responses existed among the ten states. Thus, the model specified takes into account producers' demographics, benefits and limitations of biotechnology, the type of production enterprises in which producers are engaged, and information sources.

Empirical Results

The maximum likelihood estimates of the model are shown in Table 1. In arriving at these results, a number of statistical problems had to be overcome, many of which related to multicollinearity or high correlation among explanatory variables. In dealing with these problems, some variables within a sub-group had to be excluded from model. For instance, because of the problems, not all demographic variables were used. Similarly, not all benefits or limitations variables were included in the model. The selection or exclusion of variables from the

model was accomplished through stepwise or block (forward likelihood ratio) logistic regression. Extra care and personal judgment was employed to make sure relevant variables were not excluded even though they may have been statistically insignificant. This was done because statistically insignificant variables still contained important information.

As shown in Table 1, approximately 63 percent of the observations for all producers are correctly predicted, and sixteen of the forty variables in the model are statistically significant at the 10 percent level or better. The χ^2 test of the measure of the overall significance of the model with 40 degrees of freedom is approximately 62.7 and is significant at the 5 percent level. The Log-likelihood ratio which measures the goodness of fit is 2422.004. This ratio is relatively high, implying that the model fit is less than perfect. Similarly the Cox & Snell R^2 is relatively low, suggesting a low explanatory power. These results, however, are less surprising given that we are dealing with cross section data and variables that are all qualitative and binary in nature.

Given the above discussion and the results, we reject the hypothesis that benefits and limitations of biotechnology do not significantly influence producers' perceptions on mandatory labeling of genetically modified food products. The GROSSR variable is statistically significant at about (1) one percent level suggesting that producers whose gross income is at least $10,000 are less likely to agree to mandatory labeling and want to sell more of their produce on a larger scale. Small producers with marginal gross sales or smaller volumes of products may not care for an expanded market. As a result, it is reasonable to expect them not to favor mandatory labeling. Education (COLLEGE) was positive and statistically significant at about (1) one percent level, implying that producers with at least a college education are less likely to favor mandatory labeling. The age and race variables do not significantly influence the producers' decisions to

Table 1: Logistic Regression On Mandatory Labeling Food Products

		B	Change in Probabiity	S.E.	Wald	Sig.
Step 1[a]	AGE4690	.008	.002	.153	.003	.957
	COLLEGE	-.395	-.095	.110	12.884	.000
	GENDER	-.505	-.119	.184	7.504	.006
	RACE/M	.290	.071	.187	2.416	.120
	NEWSPAP	.074	.018	.105	.490	.484
	MAGAZI	-.214	-.053	.103	4.334	.037
	RADIOTV	-.030	-.007	.106	.078	.780
	HEALTHL	-.415	-.099	.140	8.776	.003
	WETGAI	-.208	-.051	.128	2.640	.104
	NOINFO	.332	.081	.119	7.853	.005
	NOLAND	-.044	-.011	.131	.111	.738
	DONTLK	1.496	.224	.241	38.695	.000
	GROSSR	-.303	-.074	.109	7.761	.005
	UNDERSC	.075	.019	.106	.501	.479
	NORTH CAROLINA	-.840	-.177	.235	12.750	.000
	MISSISSIPPI	-.605	-.138	.221	7.484	.006
	OKLAHOMA	-.401	-.096	.231	3.015	.083
	TENNESSEE	-.425	-.102	.239	3.164	.075
	GEORGIA	-.301	-.074	.230	1.715	.190
	ALABAMA	-.299	-.073	.202	2.181	.140
	ARKANSAS	-.278	-.068	.251	1.227	.268
	TEXAS	-.261	-.064	.228	1.313	.252
	LOUISIANA	-.254	-.062	.232	1.197	.274
	GRAINSOI	-.037	-.009	.157	.056	.813
	NUSGREH	-.221	-.055	.248	.790	.374
	VEGMEL	.287	.070	.193	2.213	.137
	COTTON	-.769	-.166	.270	8.139	.004
	FRUITNTB	-.227	-.056	.149	2.309	.129
	GARDENHM	.233	.057	.125	3.483	.062
	HAY	.188	.047	.107	3.080	.079
	OTHCROP	-.108	-.027	.218	.245	.621
	BEFCAT	.006	.001	.117	.003	.958
	POULEGGS	-.385	-.093	.245	2.481	.115
	SHEGTSWO	.545	.127	.225	5.882	.015
	DAIRY	.099	.025	.505	.038	.844
	HOGS	-.272	-.067	.315	.744	.388
	AQUACUL	-.278	-.068	.268	1.078	.299
	TIMBERCR	-.129	-.032	.113	1.304	.253
	EQUINE	.297	.073	.149	3.978	.046
	LIVSTKPO	-.145	-.036	.236	.377	.539
	Constant	1.103	.206	.315	12.230	.000

** Indicates significance at .10 level and * indicates at .05 or less than level.

a. Cox & Snell R-squared: .098
Log-Likelihood: 2422.004
Chi Square, 0.05, 40: 193.780
Corrected Prediction: 62.7
Biotech food labeling should be mandatory. Coded as Totally agree "1" and At least some reservation "0".

VARIABLES		DEFINITIONS
AGE4690	=	1 if age is 46-90 years and over; 0 otherwise
COLLEGE	=	1 if some college; 0 otherwise
GENDER	=	1 if male; 0 otherwise
RACE	=	1 if Minorities (blacks, Hispanics, & other); 0 otherwise
NEWSPAP	=	1 if information source is newspaper; 0 otherwise
MAGAZIN	=	1 if information source is magazines; 0 otherwise
RADIOTV	=	1 if information source is radio/television; 0 otherwise
HEALTHL	=	1 if benefit is healthier livestock/poultry; 0 otherwise
WETGAIN	=	1 if benefit is faster weight gains for livestock/poultry; 0 otherwise
NOINFOR	=	1 if limitation is "not enough available information"; 0 otherwise
NOLAND	=	1 if limitation is "not enough land"; 0 otherwise
DONTLKB	=	1 if limitation is "I don't like biotech"; 0 otherwise
GROSSR	=	1 if gross value sales is $\geq$ \$10,000; 0 otherwise
UNDERSC	=	1 if underserved counties; 0 otherwise
NORTH CAROLINA	=	1 if North Carolina; 0 otherwise
MISSISSIPI	=	1 if Mississippi; 0 otherwise
OKLAHOMA	=	1 if Oklahoma; 0 otherwise
TENNESSE	=	1 if Tennessee; 0 otherwise
GEORGIA	=	1 if Georgia; 0 otherwise
ALABAMA	=	1 if Alabama; 0 if otherwise
ARKANSAS	=	1 if Arkansas; 0 otherwise
TEXAS	=	1 if Texas; 0 otherwise
LOUISIAIA	=	1 if Louisiana; 0 otherwise
FLORIDA	=	1 if Florida; 0 otherwise
GRAINSOI	=	1 if Grains and Oilseeds enterprise; 0 otherwise
NUSGREH	=	1 if Nursery, Greenhouse & floriculture enterprise; 0 otherwise
VEGMEL	=	1 if Vegetables & melons enterprise; 0 otherwise
COTTON	=	1 if Cotton enterprise; 0 otherwise
FRUITNTB	=	1 if Fruits, nuts, & berries enterprise; 0 otherwise
GARDENHM	=	1 if Garden for home use; 0 otherwise
HAY	=	1 if Hay enterprise; 0 otherwise
OTHCROP	=	1 if Other crops enterprise; 0 otherwise
BEFCAT	=	1 if Beef cattle enterprise; 0 otherwise
POULEGGS	=	1 if Poultry & eggs enterprise; 0 otherwise
SEGTSWOO	=	1 if Sheep, goat, wool & mohair enterprise; 0 otherwise
DAIRY	=	1 if Dairy enterprise; 0 otherwise
HOGS	=	1 if Hogs enterprise; 0 otherwise
AQUACUL	=	1 if Aquaculture enterprise; 0 otherwise
TIMBERCR	=	1 if Timber (including CRP); 0 otherwise
EQUINE	=	1 if Equine enterprise; 0 otherwise
LIVSTKPO	=	1 if Other livestock & poultry enterprises; 0 otherwise
UNDERSC	=	1 if underserved counties; 0 otherwise

choose mandatory labeling, thereby, failing to reject the hypothesis that these demographics characteristics do not influence producers opinions about mandatory labeling.

Consistent with literature, Knutson, et. al (1988) observed that the well or better informed farmers usually apply a cost-benefit perspective. They trust the government labeling policy, but do not believe additional regulation is necessary. Various studies have also concluded that higher

levels of education lead to increasing levels of information search (Katona and Muller, 1995; Schultz, 1975; and Nayga 1996). Similarly, Archilbald (1988) observes that the well informed are against labeling of GM food products because of the associated cost. They acknowledge the risk but rationalize that the benefits outweigh the risk.

Similarly, the fact that the variable UNDERSC is statistically insignificant suggests that there is no difference in perceptions with respect to GM product labeling between producers within and outside the underserved counties.

Finally, information sources variables, NEWSPAP and RADIO/TV, were statistically insignificant suggesting that they do not significantly influence producers whether or not they must favor mandatory labeling of GM products. However, the MAGAZN variable is negative and statistically significant suggesting that producers who read and obtain information from agricultural magazines (i.e. Progressive Farmer, Agricultural Research, etc.) are less likely to favor mandatory labeling of GM food products. These results are consistent with literature (Kirchhoff, 2001). For instance in Oregon State, there was much propaganda through these sources of information. However, the decision was finally about 71 percent against mandatory labeling. These results may suggest that once consumers or producers look past the mass media and consumer advocates they weighed the benefits and risk/costs of mandatory labeling.

This study finds that college graduates, larger producers and those who recognize benefits specifically health of livestock of biotechnology have reservations about mandatory labeling, while hobby farmers (equine, sheep, and goats) and those voicing limitations such as lack of available information dislike for biotechnology, and lack of enough land more frequently "totally agree" with mandatory labeling. After adjustments for all other variables, producers in North Carolina, Mississippi, Oklahoma, and Tennessee they are less likely to insist on mandatory

labels. Relatively more non-food crops may make a difference in these states. Producers in states with major food crops (rice, fruits, and vegetables) were more favorable toward labeling.

The negative sign of the demographics (education and gross value of sales) and benefits variables have significant implications in relation to the conceptual framework. The results suggest that educated producers or those with gross value of sales above $10,000 and those who view biotechnology as beneficial are moving away from the zero tolerance on the risk tolerance continuum scale. These producers are evaluating the risks or costs and benefits of mandatory labeling. In this case, the benefits outweigh the risks or costs, forcing the producers to not support mandatory labeling. The significant and positive sign of the limitations variables has the opposite effect and implications. That is, producers who don't like biotechnology or don't have enough land or think there isn't enough available information about biotechnology are concerned only about the risks or costs. They don't have reason to care about the benefits, and as a result they advocate mandatory labeling (zero tolerance).

Concluding Remarks

The overall goal of this study was to analyze factors influencing producers' perceptions and opinions regarding mandatory labeling of biotech food products. The analysis involved a number of descriptive statistics followed by the estimation of a logistic regression model. The working hypothesis in the analysis was that producers' perceptions regarding mandatory labeling are not influenced by producers' demographic characteristics, limitations and benefits of biotechnology, enterprise characteristics, sources of information, and whether a county was underserved or better served. We also hypothesized that there are no state differences in producer's opinions regarding labeling of GM food products.

The study has highlighted a number of important findings with significant implications. It reveals that most of the farmers in the 10 states are older (average is 58 years), fairly educated with some college education, but remain part time farmers, dependent largely on off-farm income for their livelihood. The majority raises beef cattle or produce hay and timber (including CRP). Most producers are in favor of mandatory labeling even though only half of the respondents totally agree with it. They believe biotech will benefit larger farmers and that farmers will be dependent on large corporations that develop and market biotechnology inputs. The majority are neutral about whether consumers will accept biotech crop products. They also remain undecided about government's ability to properly regulate biotechnology.

Limitations and benefits of biotechnology, education and enterprise characteristics significantly influence producers' probability in favor or not in favor of mandatory labeling. Information sources such newspaper and radio/tv, race, age, and the fact that a county was underserved or better served do not significantly affect producers' perceptions regarding mandatory labeling of GM food products. That demographic characteristics (gender, education and gross value sales), and benefits (healthier livestock/poultry), are negative and statistically significant has important implications regarding the conceptual framework. These results suggest that these producers are not in favor of mandatory labeling or are moving away from the zero tolerance on the risk tolerance continuum scale. This suggests that such producers are evaluating the risks or costs and benefits of mandatory labeling. In this case, the benefits seem to outweigh the risks or costs, causing producers not to favor mandatory labeling. Similarly, the significant and positive sign of the limitation variables (i.e. I don't like biotech, not enough land, and not enough available information) implies that these producers don't care about the benefits. They are only concerned about the risk, hence the decision to advocate mandatory labels.

Benefits (healthier livestock/poultry) significantly decrease the probability of producers favoring mandatory labeling by about (9) nine percent. As pointed out earlier, most livestock producers believe that biotechnology is beneficial since it entails cheaper feed and shorter fattening period for their poultry/eggs or livestock, in general. Also, when producers evaluate an innovation that is beneficial to their operation, they are more likely to embrace that innovation. These results suggest that producers are evaluating these benefits, causing them to move from the zero tolerance of mandatory labeling and getting closer to voluntary labeling (risk/benefit) side of the Continuum of Tolerance Options for Food Safety.

North Carolina, Mississippi, Tennessee, and Oklahoma were statistically significant due to the fact that they were non-food commodities producing states. For instance, Tennessee is known for cotton production, which might explain why Tennessee producers are less likely to favor mandatory labeling. As long as a product is not intended for human consumption, producers do not seem to perceive the real risk of biotechnology. As a result producers of such commodities are less likely to agree to mandatory labeling.

BIBLIOGRAPHY

The Alliance for Better foods. "Food for Thought" http.//wwwbetterfoods.org/news/fftnov.08.htlm. November 2002.

Consumers' International position paper on the proposed draft Recommendations for the labeling of foods obtained through Biotechnology. http://www.consumersinterantonl.org/campaigns/codex. (1998).

Foulke, Judith. "FDA Announces Public Meetings On Bioengineered Foods." http://www.fda.gov/ topics/ news/ new00695.html. October 1999.

Golan, Elise. Information Policy: Overview. Economic Research Service U.S. Department of Agriculture.http://www.ers.usda.gov/briefing/InformationPolicy/ overview.htm. July 2001.

Golan, Elise. Information Policy: Education Programs. Economic Research Service U.S. Department of Agriculture. September 2001.

Golan, Elise., Fred Kuchler, and Lorraine Mitchell. "Economics of Food Labeling" Economics Research Service. United States Department of Agriculture. Agricultural Economics Report No. 793: 2000.

Gujarati, Damodar N. Basic Economics. McGraw-Hill .3rd Edition, 1995.

Gutlin, Anna., Thomas Glowczweski, Anjali Misra, Laura Deluca, and Gabriela Imrisek, "Labeling: GM Foods and Flavr Savr." November 2002. http://dragon.zoo.utoronto. ca/~jlm-gmf/to0101a/labeling.html.

Herbert, Martha. "What Is Genetically Modified (And Why Should You Care)?" EarthSave Magazine, Spring 2002. www.earthsave.org.

Hoban, Thomas J. "Trends In Consumer Attitudes About Agricultural Biotechnology" October 2001. http://www.agbioforum.org/vol/nol/hoban/htm.

Hoban, Thomas J., "Market Acceptance of Agricultural Biotechnology," North Carolina State University, electronic multimedia presentation.

Holloway, Rodney, and Melissa Rowell. "The Delaney Clause." Texas Agricultural Services 1996.

Jessup, Amber. "Economics of Food Labeling." Part Two: Case Studies and Examples Nutrition Labeling. Economic Research Service/USDA 2000.

Katona, G., and E. Muller. "A Study of Purchase Decisions." Consumer Behavior: The Dynamics of Consumer Reactions. New York: New York University Press 1995:30-87.

Kirchhoff, Stepfanie. "A Simple Model of Voluntary versus Mandatory Labeling of GMO's" AAEA Meeting 2001.

Knutson, Ronald D., and Barry Flinchbaugh. Agricultural and Food Policy Prentice Hall, Inc. Upper Saddle River, New Jersey. 4th Edition, 1998.

Lilliston, Ben and Ronnie Cummins. "USDA Prepares for an Unfriendly Takeover of the Natural Food Industry." http://www.pnc.com.au/~cafmr/online/freedom/usda/htm. July 9, 1997.

Lusk, Jayson L., and John A. Fox. "Consumer Demand For Mandatory Labeling of Beef from Cattle Administered Growth Hormones or Fed Genetically Modified." Journal of Agricultural and Applied Economics. 34(2002): 27-29.

Miller, Henry. "Fight Against Biotech Foods Is Real Target Free Trade? Investor's Business Daily News." December 2002.

Nayga, Jr., Rodolfo M. "Toward an Understanding of Consumers' Perceptions of Food Labels." International Food and Agribusiness Management Review, 2:(1999) 29-45.

Nayga Jr., Rodolfo M. "Determinants of Consumers' Use of Nutritional Information on Food Packages." Journal of Agricultural and Applied Economics. December 1996.

Nordquist, DJ. The Pew Charitable Trusts, "How Consumers Process Information at Heart of the Debate over Labeling of Genetically Modified Foods." www.eurekaler.org/release/2002.06/nsda-hep062602.php. June 2002.

Ohr, Linda Milo Sr. "A Defining Time for GMO's" http://www/preparedfoods.com/archives/2000/2000-06/0006biotech.htm 2000.

Pennsylvania Credit Union League (PCUL). www.pcul.org/compliance/quicksheet. August 2001.

Ridenour, Amy."Taste Great, Less Filling New Bioengineered Food Brings Benefits to Consumers." National Policy Analysis #272. www. nationalcenter.org/npa272.html. 1999.

Schultz, T.W. "The Value of the Ability to Deal with Disequilibria." Journal of Economic Literature, 13: (1975)837-846.

Teisl, Mario., Lynn Halverson, Kelly O'Brien, Brian Roe, Nancy Ross, and Mike Vayda Focus Group Reactions to Genetically Modified Food Labels. AgBioforum, 5 1(2002):6-9.

Thompson, Paul B. "Food Labels and the Ethics of Consent." *Choices*, 1996(1):11-13.

United States Food and Drug Administration. "The New Food Label- The Food Label" http://www.fda.gov/opacom/backgrounders/foodlabe/new label.html May 1999.

United States Food and Drug Administration. "A Labeling Guide" Chapter V—Nutrition Labeling. Center for Food Safety and Applied Nutrition. A Food Labeling Guide http://www.cfsan.fda.gov/~dms/flg-5-1.html September, 1994. Editorial revisions June, 1999

USA: Consumer Groups Denounce FDA Guidelines on GE Food. 2000

Wired News. FDA Proposes Gene Food Rules. www.wired.com/news/medtech/0,1286,41259,00.html. January 17, 2001.