Research Articles

Do Consumers Really Care about Biodiversity? Large Scale Choice-Experimental Evidence of Genetically Modified Soymilk in Taiwan

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ABSTRACT

Although there is no lack of empirical evidence on the determinants of genetically modified (GM) food purchase behavior, most of the available studies focus on the effects of market price and individual socio-economic characteristics. Far less is known about whether consumers will respond to environmental protection in their purchase decisions. This paper contributes to an enormous body of literature on the demand for GM food by taking biodiversity protection into account. In particular, we investigate a trade-off between consumers'

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willingness to pay and the conservation of biodiversity. Using a large scale choice-experimental survey dataset of 1,188 individuals, drawn from the Taiwan Genomic Survey conducted in 2011, we estimate a sequential logit model for the sequential decision making process. Our results show that demand for GM food is not simply determined by market price, but is also highly correlated with consumers' awareness of biodiversity conservation. Consumers would be less likely to purchase GM soymilk if the GM production process damages the environment. Moreover, the trade-off between market prices and conservation of biodiversity is found to be non-linear.

Keywords: GM soymilk, willingness to pay, biodiversity, Taiwan

消費者是否在意生物多樣性？以臺灣基改豆漿為例

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摘要

過去研究消費者基因改造食品購買行為的文獻多著重於價格及個人社經特質的分析，探討消費者購買行為與環境保護關係的文獻卻付之闕如。本研究旨在探討消費者生物多樣性認知對其基因改造食品購買行為之影響。本研究使用 2011 年進行的臺灣基因體意向調查面訪資料，以順序羅吉斯模型估計消費者購買基因改造食品的決策行為。研究結果顯示消費者對基因改造食品的需求不僅僅受價格的影響，環境保護亦是重要的影響因子，當消費者了解基因改造食品的生產過程會破壞自然環境後，消費者會傾向不購買基改豆漿，除此之外，我們也發現消費者對市場價格和環境保護之間的補償作用為非線性關係。

關鍵字：基改豆漿、願付價格、生物多樣性、臺灣

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I. Introduction

Genetic modification techniques have continued to play an important role in agricultural production and food industries. Modern techniques have enabled scientists to develop desired traits in many different types of crops to increase pest resistance and drought tolerance. These improvements have led to a reduction in production cost and an increase in production yield; in turn, they have increased agricultural profits (Brookes and Barfoot, 2005). Over the past 15 years, the global adoption of biotech crops has continued to spread dramatically. According to a statistical report by the International Service for the Acquisition of Agri-biotech Applications, the global area of biotech crops has increased from 1.7 million hectares in 1996 to 148 million hectares in 2010, and the corresponding global value of the biotech market has also expanded from US$93 million in 1996 to US$11.22 billion in 2010 (James, 2010).

While biotechnology development has improved crop productivity, the merits of GM crops remains controversial in many regards. One of the primary debates is the uncertain impacts of GM crops production on nature environment (Hails, 2000; 2005; Nap et al., 2003; Wolfenbarger and Phifer, 2000). Some studies have suggested that growing GM crops have negligible effects on environmental quality. For example, Lozzia (1999) found that species diversity and community structure did not significantly differ between treated (GM) and untreated corn fields in a two-year field trial in northern Italy. However, other studies have raised the concern that releasing GM crops into the natural environment may affect the biodiversity of natural species. Losey et al. (1999), for instance, found that monarch larvae feeding on milkweed leaves covered with BT corn pollen experienced higher mortality than larvae that were not exposed to BT corn pollen. Although the findings of studies examining the effects of GM crop cultivation on the natural environment have been mixed, no commonly accepted evidence exists supporting the claim that GM crops are completely safe to the ecological system.

In addition to the dispute over the potential ecological risks of GM crops, as noted by Lusk et al. (2004), consumers seem to have little knowledge regarding GM technology. Surprisingly, many consumers exhibit a high level of acceptance of GM technology/foods. In Boccaletti and Moro's study (2000), for example, while only 17.5% of respondents from the survey reported that they had sufficient knowledge of GM technology, 46% of the respondents showed positive attitudes towards GM foods. Similar patterns were also exhibited in a study of consumer acceptance of GM tofu in Taiwan. Jan et al. (2007) found that the majority of the respondents (79%) accepted GM technology, even though only a small proportion of the respondents (19%) thought they had enough knowledge of GM technology. Given consumers' unfamiliarity with GM technology it should be useful to both proponents and antagonists to understand how the introduction of new information influences consumers' purchase decisions; precisely because such an analysis can serve to inform pro-biotech and anti-biotech organizations marketing strategies. In this respect, there is a need to develop a deeper understanding of the effects of information dissemination on public attitudes toward GM foods.

Although the relationships between consumer characteristics and acceptability of GM foods, as well as willingness to pay/accept have been extensively investigated in recent years (e.g., Baker and Burnham, 2001;

Grimsrud et al., 2004; Jan et al., 2007; Kaneko and Chern, 2005; Lusk and Coble, 2005; see Costa-Font et al. (2008) for a review), far less is known about how consumers respond to the introduction of new information on their GM food purchases. To our knowledge, only a few economic studies have investigated the effects of new information on consumers' preferences towards GM foods (Huffman et al., 2003; Lusk et al., 2004; Rousu et al., 2007). A recent work by Rousu et al. (2007) used experimental auctions to elicit consumers' willingness-to-pay for non-GM foods when new information is given. Their results indicate that bidders who received information about the benefits of biotechnology seemed to discount non-GM foods, and paid a greater value for non-GM foods when introduced to anti-biotech information. Lusk et al. (2004) investigated how consumers respond to the introduction of new information about the benefits of biotechnology. They found that consumers are willing to accept less compensation to give up non-GM food and to buy GM foods when receiving such information, although the estimated amounts varied between different types of information and regions. However, these studies mainly focused on information about the benefits of GM technology. An exception can be found in Rousu et al. (2007) who investigated the extent to which consumers' valuation of GM foods may be affected by the introduction of negative information; because the information treatment used in their study consists of various perspectives (including general, human, financial, and environmental impacts), it is difficult to disentangle the effects of different types of information.

While some insights have been gained in understanding the relationship between consumer acceptance of GM foods and the introduction of information, existing studies are silent on how consumers respond to ecological risks when purchasing GM food. That is, how much are consumers concerned with loss in biodiversity? This study aims to make contribute to this knowledge gap by developing a better understanding to demonstrate the changes in consumers' purchase decision and their willingness to pay for GM soymilk when the information of ecological risks resulted from GM production is introduced. Our objectives are twofold. First, we determine whether consumers' GM food purchase decisions are affected by the introduction of new information regarding ecological risk. Second, we identify to what extent consumers change their food choices when made aware of different levels of biodiversity loss.

The remainder of this paper is divided into four sections. Section 2 introduces the survey and defines the variables. Section 3 outlines our econometric strategy and provides the model specification. Section 4 presents estimation results, and a final conclusion is drawn in section 5.

II. Data

Data used in this study were drawn from the 2011 Taiwan Genomic Survey (TGS) conducted by the Survey Research Center of Academia Sinica. The TGS sample was selected using a three-stage stratified design with probability proportional to size sampling at each stage. The first stage of sample selection is a probability sample of administrative districts (towns and cities); the second stage is a probability sample of villages within sampled districts; and the third stage is a probability sample of population within sampled villages. The number of respondents drawn from each region is proportional to its population size. A total of 1,503 respondents aged between 18 and 70 years old were successfully face-to-face interviewed. After deleting samples with incomplete information, we ended up with 1,188 individuals in our sample.[1]

The objective of the TGS survey was to understand consumers' public attitudes toward GM technology. Rich information related to respondents' knowledge, risk perceptions and attitudes regarding GM technology, as well as willingness to purchase GM products were collected. Also collected was information on individual demographic and socioeconomic characteristics.

A. Willingness to Purchase Soymilk

To understand consumers' willingness to conserve biodiversity, in contrast to earlier waves of the TGS survey, the TGS survey in 2011 asked respondents a series of questions regarding their purchase decisions for GM food products. In particular, a series of questions was designed to provide a hypothetical scenario regarding the trade-off between market prices and biodiversity of GM soybean milk. Each respondent was asked to choose between GM and non-GM soymilk. In the first round of choices, given that the attributes of these two products were equal but the prices of GM and non-GM products were 50 and 65 NTD, respectively, respondents were asked which product they were willing to purchase. For those who decided to purchase GM soymilk, a follow-up question related to biodiversity was added. Each respondent was told that the production process of GM soybean cultivation will harm biodiversity to a certain extent. Given this information, respondents were asked if they were willing to purchase GM soymilk if 10 out of 100 species were known to have become extinct

1. We selected our sample as follows. We first deleted respondents who did not complete the entire series of choice experiments of GM soymilk. In addition, nearly 10% of the respondents who were unwilling to report their risk perception characteristics of GM foods were further excluded.

due to GM soybean production. Those who answered “yes” were then asked a similar question, where 20 out of 100 species were assumed extinct. Figure 1 shows the decision-making tree which consists of three sets of binary choices. According to the decision process, we defined several corresponding binary indicators in each stage as follows.

$d_{1i}=0$ if respondent i chose to purchase non-GM soymilk

$d_{1i}=1$ if respondent i chose to purchase GM soymilk

$d_{2i}=0$ if respondent i chose not to purchase GM soymilk given 10 out of 100 species will become extinct during GM production

$d_{2i}=1$ if respondent i chose to purchase GM soymilk given 10 out of 100 species will become extinct during GM production

$d_{3i}=0$ if respondent i chose not to purchase GM soymilk given 20 out of 100 species will become extinct during GM production

$d_{3i}=1$ if respondent i chose to purchase GM soymilk given 20 out of 100 species will become extinct during GM production

B. Explanatory Variables

A number of explanatory variables were defined to reflect the effects of individual demographic and socioeconomic characteristics on purchase behavior. These variables include: age (up to 30, 31–60 and 61 and above), gender, marital status, education (junior high school/lower, senior high, and college or higher), employment status, urbanization and personal income (income4). It has been well documented that the decision to purchase GM food depends significantly on consumers’ attitudes to biotechnology. Following Jan et al. (2007), there are two dummy variables defined to explore the effects of consumers’ opinions and knowledge on their purchase decisions. Acceptance measures respondents’ acceptance of GM food and it is

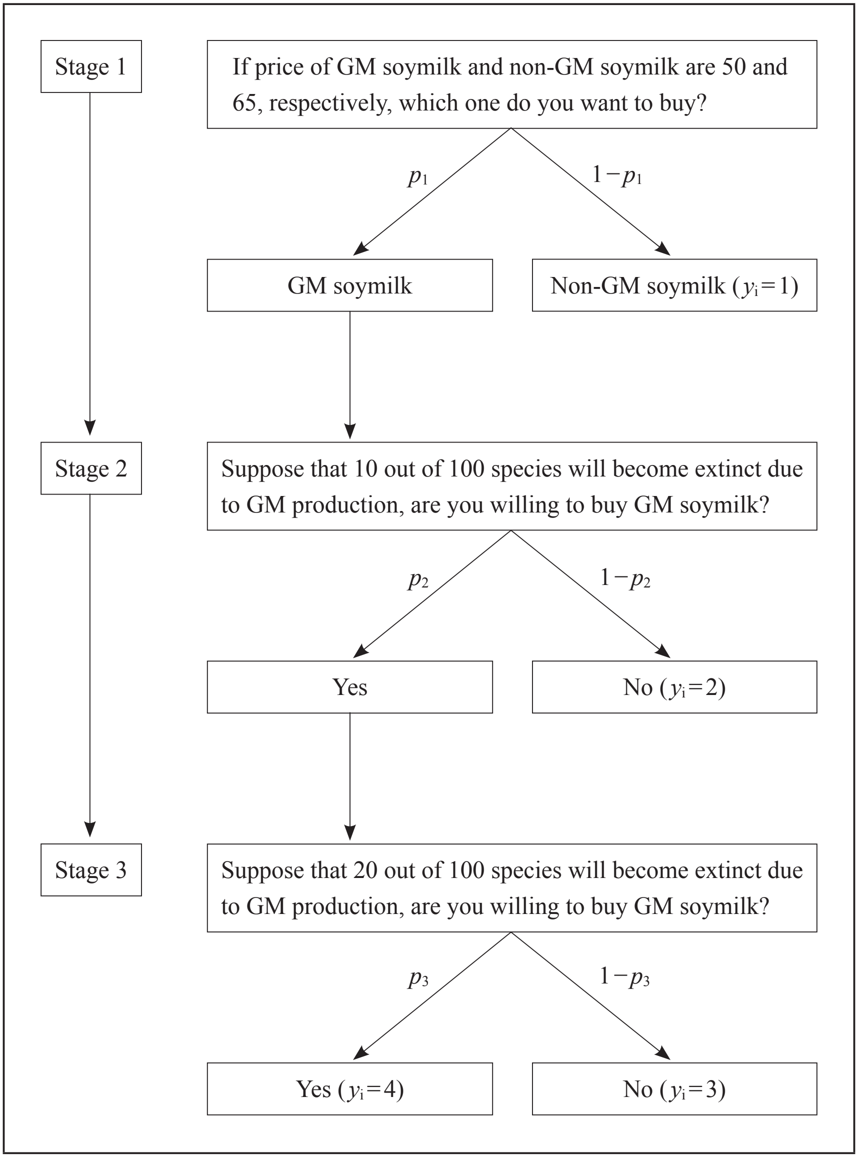

Fig. 1. Structure of the decision making process (sequential logit model)

defined as 1 if respondents can accept GM food and 0 if otherwise. Similarly, the variable knowledge was constructed to reflect respondents' knowledge of GM technology. It was coded as 1 if the respondent very much or somewhat understood GM technology and 0 if otherwise. Finally, we included a binary variable, natural risk, to capture the effects of respondents' risk perceptions regarding the natural and ecological environment. It is defined as 1 if respondents thought GM products extend no or little risk towards nature and the ecological environment and 0 if otherwise.

III. Econometric Strategy

Our empirical model was guided by the decision process of GM soybean purchase as presented in Figure 1. Respondents' purchase decisions with regard to GM soymilk are made in three sequential stages. Thus, a sequential logit model is an appropriate method to investigate the effects of explanatory variables on respondents' purchase choices.[2] Following the standard framework of the binary choice model, respondent i's choices between GM soymilk and non-GM soymilk at each stage can be specified as the following equation:

$$d_i^* = X_i\beta + \varepsilon_i \tag{1}$$

where d_i^* is a latent variable measures the difference in unobserved utility

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2. Sequential logit model is an applicable method to study the effects of determinants on a consequence of choice decisions, and has been widely used in many areas of study. For instance, Weiler (1986) and Buis (2011) employed this method to educational attainment, Zhang (1994) to fertility decision, Jiménez—Martín et al. (2006) to labor force participation and Lee et al. (2010) to health care utilization.

received by respondent i between GM soymilk and non-GM soymilk, X_i is a set of explanatory variables, β is a vector of the corresponding coefficients to be estimated, and ε_i is the random error term. Respondent i would decide to buy GM soymilk ($d_i=1$) if he received net positive utility:

$$d_i=\begin{cases}1 \text{ if } d_i^* \\ 0 \text{ otherwise}\end{cases}. \tag{2}$$

Assuming ε_i follows logistic distribution yields the well-known binary logit model. The associated probability of buying GM soymilk can be derived as:

$$\Pr(d_i=1)=F(X_i\beta), \tag{3}$$

where $F(.)$ is the cumulative density function of the logistic distribution.

As presented in Figure 1, the model consists of three sets of binary choices, and thus there are four responses of interests. Let p_{1i}, p_{2i} and p_{3i} be the probability of buying GM soymilk at the first, second and third stage, and $y_i=1$, 2, 3 or 4 if respondent i chose to purchase non-GM soymilk at the first stage, chose not to purchase GM soymilk at the second stage, chose not to purchase GM soymilk at the third stage or chose to purchase GM soymilk at the third stage, respectively (see Figure 1). The corresponding probabilities for each scenario can be derived as:

$$P_i=\begin{cases}1-p_{1i}= & 1-F(X_{1i}\beta_1) & \text{if } y_i=1 \\ p_{1i}\times(1-p_{2i})= & F(X_{1i}\beta_1)\times[1-F(X_{2i}\beta_2)] & \text{if } y_i=2 \\ p_{1i}\times p_{2i}\times(1-p_{3i})= & F(X_{1i}\beta_1)\times F(X_{2i}\beta_2)\times[1-F(X_{2i}\beta_2)] & \text{if } y_i=3 \\ p_{1i}\times p_{2i}\times p_{3i}= & F(X_{1i}\beta_1)\times F(X_{2i}\beta_2)\times F(X_{3i}\beta_3) & \text{if } y_i=4\end{cases}. \tag{4}$$

The entire model then can be simultaneously estimated by the following log-likelihood function:

$$\log L = \sum_{i=1}^{N} \sum_{j=1}^{4} I(y_i) \times \ln P_i, \tag{5}$$

where $I(y_i)$ is an indicator function equals to 1 if $y_i = j$ and 0 otherwise. The consistent estimates of $(\beta_1, \beta_2, \beta_3)$ can be obtained using the maximum likelihood estimation (MLE) method.

It is of note that the estimated coefficients can only explore the qualitative relationship between the explanatory variables and the purchase decision for GM soymilk, the magnitudes of the effects can be better understood using the marginal effects. To determine the roles of explanatory variables on the choice to purchase GM soymilk at each decision-making stage, the marginal effects were also calculated. For the continuous explanatory variables, we differentiate the following (conditional) probabilities with respect to each continuous variable.

$$\begin{aligned} \Pr(d_1=1) &= F(X_1\beta_1) \\ \Pr(d_2=1 \mid d_1=1) &= F(X_1\beta_1) \times F(X_2\beta_2) \\ \Pr(d_3=1 \mid d_1=1 \wedge d_2=1) &= F(X_1\beta_1) \times F(X_2\beta_2) \times F(X_3\beta_3) \end{aligned} \quad . \tag{6}$$

For the discrete variables, the marginal effects were obtained by differencing the predicted probabilities with one unit increase from zero in each of the explanatory variables when holding other variables at sample means. Since the predicted probability and marginal effects are nonlinear in the parameter estimates, the corresponding standard errors were calculated using the delta method (Greene, 2003). All the estimation are performed by STATA 10.0.

IV. Results

Before beginning the discussion of the estimation results, it is informative to look at basic sample statistics of the data. Table 1 presents the frequency tabulation of GM soymilk purchases at different stages. At the first stage, 33.16% of respondents were willing to buy GM soymilk. However, only 25.38% of those who previously chose to purchase GM soymilk still chose to purchase GM soymilk at the second stage when given the information that 10 out of 100 species would become extinct during GM soybean production, i.e., nearly three fourths of the respondents changed their food choice after realizing that GM crops production would threaten biodiversity. When we looked at the third stage, we found that an additional 10 units of biodiversity loss had a smaller effect on consumers' purchase choices than the first 10 units of biodiversity loss. For those who chose to purchase GM soymilk at the second stage, 59% of them chose to keep purchasing GM soymilk. In short, our preliminary findings yielded two noteworthy observations: (i) information of ecological risk has significant negative effects on consumers' food choices (i.e., whether to keep purchasing GM soymilk), and (ii) consumers seem to respond differently

Table 1. Frequency tabulation of the GM soymilk purchases by stage

Stage	Sample size	Frequency	Percentage (%)
Stage 1	1,188	394	33.16
Stage 2	394	100	25.38
Stage 3	100	59	59

to different levels of biodiversity loss. As a result, a trade-off between prices and biodiversity may not be linear.

Detailed definitions and sample statistics of the explanatory variables at each stage are presented in Table 2. The average age of the respondents was about 41 years old, with 29%, 61% and 10% of them aged 30 or less, 31 to 60 and 61 or more. Moreover, 52% of the respondents were male. Approximately 57% and 59% of the respondents were married and had at least one child, 80% of the respondents had at least finished senior high school and a small proportion (23%) of respondents lived in urban areas. Nearly 25% of the respondents had a monthly income of more than NT$40,000. Regarding individual cognitive characteristics, the majority of respondents seemed to have limited knowledge of GM technology. Only 21.5% of them indicated that they very much or somewhat understood GM technology. Nearly half of the respondents indicated that they totally accepted or accepted GM foods and 33% thought that GM products had no or little risk in regard to nature or ecology.

Table 3 presents the estimation results of the sequential logit model. The first stage results present the effects of the explanatory variables on respondents' GM soymilk purchase choices without providing any information of biodiversity loss to consumers. The results show that respondents' age has a negative effect on consumers' choices. Compared to their younger cohorts, respondents aged 31 to 60 are less likely to purchase GM soymilk by 11.8%. Male respondents are 5.1% more likely to purchase GM soymilk. Surprisingly, respondents with at least one child are 9.3% more likely to purchase GM soymilk. This may due to the limited budget constraint. Thus, they tend to buy cheaper food products to control food expenses. Contrary to the relatively small effects of demographic variables,

Table 2. Sample statistics of the selected variables

Stage		Stage 1		Stage 2		Stage 3	
Variable	Definition	Mean	Std.	Mean	Std.	Mean	Std.
Age	Age in years.	40.802	14.053	38.018	14.192	42.280	14.218
Age30	If age $\leq$30 (=1).	0.290	0.454	0.388	0.488	0.260	0.441
Age3060	If 31 $\leq$ age $\leq$ 60 (=1).	0.614	0.487	0.518	0.500	0.610	0.490
Age60	If age $\geq$61 (=1).	0.096	0.295	0.094	0.292	0.130	0.338
Male	If male (=1).	0.517	0.500	0.579	0.494	0.680	0.469
Married	If married (=1).	0.567	0.496	0.497	0.501	0.600	0.492
Junior	If junior high school or lower (=1).	0.200	0.400	0.173	0.378	0.180	0.386
Senior	If finished senior high school (=1).	0.430	0.495	0.398	0.490	0.480	0.502
College	If college education or higher (=1).	0.370	0.483	0.429	0.496	0.340	0.476
Child	If had at least a child (=1).	0.589	0.492	0.538	0.499	0.680	0.469
Urban	If lived in primary city (=1).	0.229	0.420	0.226	0.419	0.190	0.394
Income4	If personal income > NT$ 40,000/month (=1).	0.248	0.432	0.234	0.424	0.330	0.473
Knowledge	If understand GM technology well (=1).	0.215	0.411	0.264	0.441	0.260	0.441
Acceptance	If accepted GM food (=1).	0.481	0.500	0.749	0.434	0.720	0.451
Risk	If producing GM products is of little risk to nature or ecology environment (=1).	0.334	0.472	0.487	0.500	0.520	0.502
Sample size		1,188		394		100	

Table 3. Estimated marginal effects of sequential logit model

Stage	Stage 1		Stage 2		Stage 3	
Variable	Coefficient	SE	Coefficient	SE	Coefficient	SE
Age3060	−0.118**	0.048	−0.010	0.025	−0.003	0.020
Age60	−0.085	0.058	0.014	0.036	0.004	0.027
Male	0.051*	0.030	0.043***	0.017	0.038***	0.013
Married	−0.040	0.049	−0.030	0.026	−0.015	0.020
Senior	0.039	0.044	0.035	0.025	0.014	0.019
College	0.077	0.055	0.039	0.032	0.013	0.024
Child	0.093*	0.053	0.063**	0.026	0.042**	0.021
Urban	−0.028	0.033	−0.021	0.017	−0.022*	0.011
Income4	−0.023	0.038	0.013	0.022	−0.005	0.015
Knowledge	0.062*	0.036	0.013	0.019	0.008	0.014
Acceptance	0.311***	0.027	0.061***	0.018	0.049***	0.014
Risk	0.185***	0.032	0.057***	0.020	0.023	0.015
Log likelihood			−914.140			
Sample size	1,188		394		100	

Note: ***, **, * indicate significance at the 1%, 5%, and 10% level.

individual cognitive characteristics have a stronger influence on consumers' food choices. The marginal effects of acceptance and risk suggest that respondents with a higher acceptance of GM foods and a lower risk perception of nature are more likely to purchase GM soymilk by 31.1% and 18.5%, respectively. Respondents' knowledge of GM technology, however, has smaller effects on their GM soymilk purchase decisions. Respondents who are more knowledgeable about GM technology are only 6.2% more likely to buy GM soymilk.

As expected, the estimated results at the second and third stage support our prior expectation that the effects of the variables would change after the introduction of new information about the loss in biodiversity. Male respondents are 4.3% and 3.8% more likely to continue purchasing GM soymilk, a comparatively slight decrease when no information is given. Similarly, the probability of continuing to buy GM soymilk also slightly decreases for respondents with at least one child. They are 6.3% and 4.2%, respectively, more likely to keep buying GM soymilk when they were told that 10 or 20 species would become extinct resulted from the GM production process. This may suggest that when introduced the information about biodiversity loss, respondents with at least one child are aware of environmental protection. They trade off some food consumption to biodiversity conservation.

Urbanization also significantly determines consumers' decision. Respondents who live in urban areas are 2.2% less likely to buy GM soymilk. Individual cognitive characteristics are also strong determinants on consumers' food choices. While knowing the biodiversity loss during GM production, respondents with higher acceptance of GM foods are 6.1% and 4.9%, respectively, more likely to keep buying GM soymilk. Respondents who have lower risk perception of the natural environment are 5.7% more likely to keep buying GM soymilk.

Since our dependent variable is the same (i.e., whether or not to purchase GM soymilk) in all of the three stages, we can understand how consumers respond to biodiversity loss by comparing the estimated coefficients across these stages. Interestingly, when comparing the effects of explanatory variables on respondents' GM food purchase decisions at each stage, we found that there may exist a nonlinear relationship between consumers' willingness to purchase GM food and to conserve biodiversity. To show the possible nonlinear effects of biodiversity conservation, we plotted the marginal effects of probability of continuing to purchase GM soymilk for the selected variable in Figure 2. As presented in Figure 2, respondents with a higher acceptance of GM foods seem most likely to be affected by information about biodiversity loss, followed by respondents with a lower risk perception of the natural environment. Consumers with a higher acceptance of GM foods are 31.1% more likely to purchase GM soymilk initially, but their marginal probability of continuing to buy GM soymilk decreases by 25.0% and 1.2% respectively, after the introduction

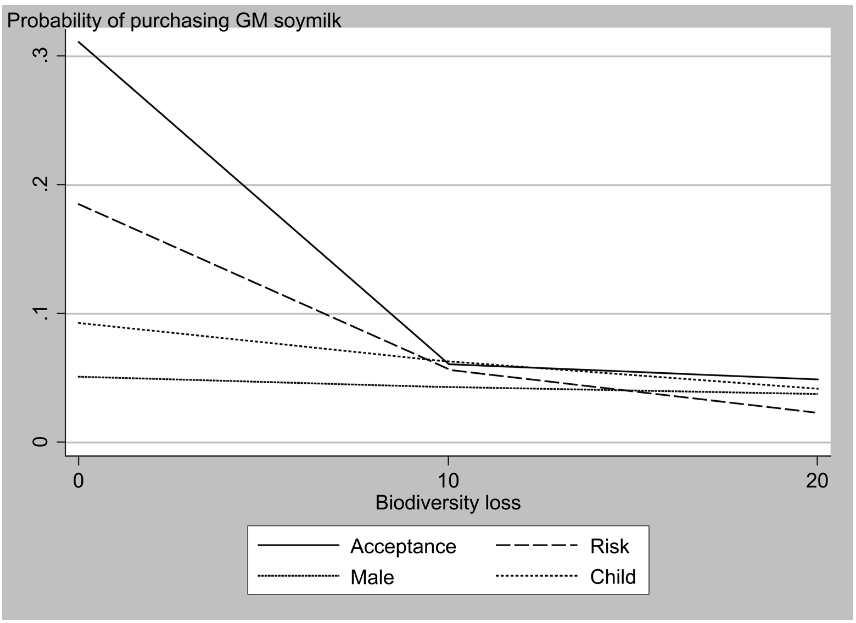

Fig. 2. The relationship between consumers' willingness to buy GM soymilk and willingness to conserve biodiversity

Note: 0 in the x-axis does not mean that GM soybean cultivation results in no biodiversity loss, but represents that no information is given to consumers.

of information that 10 or 20 species would become extinct. Similar patterns can be found in consumers' risk perception of the natural environment (while it is insignificant at stage 3). The marginal effect of risk on the probability of continuing to buy GM soymilk decreases by 12.8% (3.4%) at stage 2 (3). However, not all variables exhibit such a nonlinear relationship. Male and Child, for instance, display a liner relationship. When the information that 10 (20) species would become extinct was given, respondents who were male and had at least one child decreased their likelihood of purchasing GM soymilk by 0.8% (0.5%) and 3.0% (2.1%), respectively.

V. Conclusion

Although it has been suggested that consumers may care about the natural environment when making purchase decisions, little evidence has been provided regarding the trade-off between market prices and the protection of biodiversity. This study aimed to provide a better understanding of how consumers respond to ecological risks during their food purchases of GM soymilk. Using a choice experiment and a unique survey in Taiwan, we not only investigated the effects of consumer characteristics on consumers' acceptance of GM soymilk, but also elicited consumers' willingness to conserve biodiversity to some extent.

Several primary findings can be summarized. Consistent with the findings of previous studies, the introduction of new information has a significant effect on consumers' acceptance of GM food. The majority of consumers who previously chose to purchase GM soymilk would switch their choices to non-GM soymilk when informed of the ecological risks of GM food production. Our results also suggest that consumers are environmentally conscious, resulting in a trade-off between market price and the conservation of biodiversity. That is, even though consumers were given a favorable price for GM soymilk, they were willing to pay more to choose environmental friendly food products when knowing about ecological risk. Moreover, our results show that a nonlinear relationship may exist between consumers' willingness to purchase GM soymilk and their willingness to conserve biodiversity. Consumers with different characteristics seem to respond differently to differing degrees of biodiversity loss.

Several policy implications can be inferred from our study. First, consumer theory predicts that rational consumers make decisions based solely on the cost and benefit of the product, regardless of how their decisions may affect others or the environment. However, is this always true in reality? Our findings provide new insights by underscoring the fact that consumers are altruistic and do care about biodiversity or environmental protection. As a result, promoting environmentally friendly products and providing consumers more information can create a higher price premium between green and non-green food. Moreover, we find a decreasing effect of environmental protection on consumers' choices. From the policy perspective, government can provide more information of ecological concerns to the consumers through the educational training programs or the public media to effectively affect consumers' purchase decisions toward healthy food products.

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