Demand for a Transgenic Good with Nutritional, Medical, and Environmental Qualities

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Background

■Most GM crop varieties are designed to reduce farm costs, herbicide tolerance and insect resistance being current examples. These cost features have direct appeal only to producers. In developed areas, consumers generally see no particular advantage in consuming these products other than their arguably lower prices. To the contrary, they are concerned about them, especially in their perceived risks to health and environment[3]. Yet GM food technology can provide direct consumer as well as producer value[4], [5]. Takaiwa[8], for instance, has developed a new recombinant-gene rice variety (hereafter, medical rice) useful in the treatment of cedar-pollen allergies.

■Recent survey reveals that 30% of the Japanese population displays allergic reaction to cedar pollen and other allergens[2]. The definitive treatment for these reactions presently is immunotherapy, the injection of a diluted form of the allergen. The regular intake of GM medical rice mitigates allergic reactions to cedar pollen by gradually accumulating allergens within the body (see details in survey script).

■Because medical rice is still in the development stage, we carry out a choice experiment (CE) to investigate patients preferences[6].

Hypothesis

■***Medical Rice Benefit:*** Direct benefits such as medical or functional, besides lower product price, attract consumers/patients to receive GM rice. Less frequent visit to hospital is an attractive feature for busy patients.

■***Environmental Risk of GM Plants:*** GM plants produced in factory minimize the environmental risk of pollen dispersal. Patients who are conscious of the environmental risk of GM plants prefer such factories.

Method: Online Survey

■Data are obtained from an online survey conducted by MACROMILL in March 2015. Respondents are those who live in Japan and are already allergic to cedar pollen.

■We carry out **CE** questions, in which respondents are asked to choose their most preferred alternative, including an opt-out option. Alternatives are designed using a labeled format (Figure 1) : each alternative in a choice set can be distinguished from the other alternatives using the label (name).

Figure 1. CE sample

Alternative	[1]	[2]	[3]
Treatment	Medical Rice	Injection	I do not choose
Fee per month	1,000	500	
Rice production	Closed factory		

Table 1. Product Attributes in the Experimental Choice Sets

Product attribute	Level
Treatment	(a) Rice (b) Injection
Rice production	(a) Open field (b) Closed factory
Treatment fee (yen per month)	(a) 500 (b) 1,000 (c) 1,500 (d) 2,000 (e) 2,500 (f) 3,000

Survey Script - Medical Rice for Cedar Pollen Allergy (English Translation)

■Assume the hospital at which you receive medical treatment is 20 minutes away. Medical fee is fixed no matter which treatment you choose (rice or injection); however, medicine fee does vary. In the case of injection treatment, you will have to visit the hospital once a week or once a month, while in the case of medical rice, you will eat one bowl of medical rice per day and visit the hospital once a month. You will have to continue this treatment for two to three years including non-spreading season of the cedar pollen. In terms of the rice production process, there are two different ways of production (open field or closed factory). Open field means a conventional production site, while closed factory requires negative-pressured ventilation in the plant. Based on this information, please choose the most preferred treatment from the three choices including "I do not choose". Please imagine that the "I do not choose" option means you continue your current treatment.

Empirical Model Specification

■The systematic components of the utility of respondent i for "medical rice" alternative (j = 1), "injection" alternative (j = 2), and the opt-out option (j = 3) are expressed as follows:

$$V_{i1} = \beta_{1i} ASC + \beta_2 FEE_1 + \beta_{3i} RICE_1 + \beta_{4i} FACTORY_1 \quad (1)$$

$$V_{i2} = \beta_{1i} ASC + \beta_2 FEE_2 \quad (2)$$

$$V_{i3} = 0 \quad (3)$$

where,

$$\beta_{1i} = \beta_{10} + \beta_{11} MALE_i + \beta_{12} AGE_i + \beta_{13} SEVERE_i + \beta_{14} IM\_k_i \quad (4)$$

$$\beta_{3i} = \beta_{30} + \beta_{31} MALE_i + \beta_{32} AGE_i + \beta_{33} BUSY_i + \beta_{34} less\_k\_GM_i + \beta_{35} less\_s\_GM_i \quad (5)$$

$$\beta_{4i} = \beta_{40} + \beta_{41} ENV_i \quad (6)$$

■R[7] and the packages[1], [9] are used for the CE question design and the conditional logit estimation.

Expected Signs

■β_{13} $(SEVERE) > 0$ if the asymptomatic condition is severe.

■β_{14} $(IM\_k) > 0$ if the respondent knows more about immunotherapy treatment.

■β_{3i} $(RICE) > 0$ if medical rice is preferred to other treatments.

■β_{33} $(BUSY) > 0$ if the patient has a high opportunity cost of the hospital visit.

■β_{34} $(less\_k\_GM) < 0$ if the respondent is less knowledgeable about GM products.

■β_{35} $(less\_s\_GM) < 0$ if the respondent is less supportive of GM use for food functionality.

■β_{4i} $(FACTORY) > 0$ if medical rice produced in a closed plant is preferred.

■β_{41} $(ENV) > 0$ if the respondent is cautious about the environmental risk of GM rice.

Utility Function Estimates and Marginal Willingness to Pay

■Estimated parameters take the expected signs and are significant (Table 2).

■***Immunotherapy:*** Respondents with severe conditions have higher utility from immunotherapy treatment (*SEVERE*). Knowledge of immunotherapy is an important factor in choosing either injection or medical rice (*IM_k*).

■***Medical Rice:*** The time saving effect of medical rice is attractive to a certain type of patients, who has a high opportunity cost of the hospital visit (*BUSY*). Respondents who are less knowledgeable or less supportive to GM technology lose utility from GM rice treatment (*less_k_GM, less_s_GM*).

■***Environmental Risk:*** Respondents who are more cautious about environmental risk realize higher utility with medical rice produced in a closed factory (*ENV*).

Table 2. Utility Function Estimates and MWTP

Variable		Coefficient	SE	MWTP (Thousand JPY/Month)
ASC	*Constant* (β_{10})	-0.559***	0.187	-0.890
	MALE (β_{11})	0.038	0.069	0.061
	AGE (β_{12})	-0.007***	0.003	-0.011
	SEVERE (β_{13})	1.147***	0.155	1.827
	IM_k (β_{14})	1.095***	0.109	1.743
FEE	β_{20}	-0.628***	0.025	
RICE	*Constant* (β_{30})	1.242***	0.197	1.978
	MALE (β_{31})	0.375***	0.071	0.597
	AGE (β_{32})	0.001	0.003	0.001
	BUSY (β_{33})	0.372***	0.102	0.592
	less_k_GM (β_{34})	-0.438***	0.144	-0.698
	less_s_GM (β_{35})	-1.510***	0.139	-2.406
FACTORY	*Constant* (β_{40})	-0.271**	0.116	-0.432
	ENV (β_{41})	0.376**	0.165	0.600

Note: *** and ** indicate statistical significance at the 1% and 5% levels, respectively.

Conclusion

Consumer acceptance of GM products is still low in Japan, but those who are allergic to cedar pollen respond positively to the medical benefits of GM rice. Especially, if they have a higher opportunity cost of the hospital visit or if they are more familiar with GM products, they are more likely to consume medical rice. Finally, patients concerning about environmental risks of GM plants tend to buy medical rice produced in a factory. As a result, in addition to enhance consumer knowledge of GM crops, targeting busy patients is effective when promoting medical rice.

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