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Are Consumers Willing to Pay a Premium for Pure Rice Noodles? A Study of Discrete Choice Experiments in Taiwan

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Abstract: Most consumers in Taiwan have never eaten pure rice noodles (PRNs) and some may mistakenly treat corn starch-based rice noodles as PRNs. This study examines consumers' willingness to pay (WTP) for PRNs using discrete choice (DC) experiments with a blind tasting test to understand consumers' ability to identify PRNs with varying rice content on the basis of their appearance and taste. Collecting data from the Taipei metropolitan area, our DC experimental results of both pre- and post-experiment conditions show that Taiwanese consumers do prefer PRNs and their WTP for PRNs was strengthened. A latent class model highlights that attribute preferences tend to differ by group and thus rice content ratios should be properly labeled so that consumers can make a better choice according to their preferences. Our WTP estimates also imply that offering tasting trials to consumers is an effective marketing strategy to encourage potential purchases of PRNs for the rice noodle industry.

Keywords: pure rice noodles; discrete choice experiments; willingness to pay; premium; Taiwan

1. Introduction

Food safety is a major consideration, particularly for consumers, who value high-quality food products and are willing to pay a premium for safe products [1–6]. Consumers are increasingly concerned about how a food is produced, what it is produced from, and where it is produced [7–10]. Even though food labeling can reveal this valuable information, food safety may still be a critical issue and affect a society's confidence in food labeling when consumers lack the professional capability to assess the authenticity of food labels [11–14].

Producing food with or without food additives is always controversial [15–17]. Food additives act as preservatives that extend a product's shelf life, enhance the color and flavor of food, and even partially replace certain ingredients to help reduce production costs. However, some consumers consider food additives a risk factor that may result in food safety concerns [18–20]. As a result, natural foods are considered relatively safe and are thus becoming increasingly popular, making additive-free foods an effective marketing strategy [21–24]. The willingness to pay (WTP) a premium for natural foods has unfortunately motivated producers to distort product claims to boost their profits [8].

Rice is an important staple food and is representative of the food culture in Taiwan. The Taiwanese government has actively promoted diversified and healthy rice products, including rice noodles [25]. From a cultural and policy perspective, rice noodles significantly benefit the promotion of rice. Taiwan's rice noodle industry peaked in the 1960s, with Hsinchu alone reporting more than 100 rice noodle factories [26]. Since the 1980s, however, the industry lost its competitiveness owing to the increasing price of rice and the introduction of alternative ingredients, such as corn starch. For example, long-grain rice costs about 40 NTD per kg; but corn starch is priced at 16 NTD per kg, making it a significantly lower-priced ingredient to use. In addition, the whole production process for pure rice noodles is complex, involving a total of 17 processes and taking two days to complete. However, the use of corn starch can reduce the production duration to one day and increases the potential for mechanical assistance. The manufacturing process for pure rice noodles is costly and time-consuming given its low degree of mechanization and high demand for manpower. Moreover, the output for rice noodles is much lower than that for noodles made from corn starch. Consequently, numerous large-scale rice noodle factories are producing rice noodles made entirely from corn starch. In Taiwan, the product is still named with the phrase "rice noodles" even though rice is no longer the main ingredient.

Food additives, such as gums, are generally used to maintain cohesiveness while producing corn starch-based rice noodles, causing a negative effect on starch digestion and a high glycemic index [27,28]. Although rice noodles made mainly from corn starch have obvious advantages in both cost and yield, they require a longer digestion time and have a lower nutritional value than pure rice noodles. However, many consumers in Taiwan believe that the "springy" taste of rice noodles is due to technological advances in the production process. Administered jointly by Taiwanese consumer protection groups and the media in 2013, a survey revealed that 45 out of the 52 rice noodle products under investigation failed to meet the national standard that states that the percentage of rice in rice noodles should be 50% or more. There were 39 cases with a rice content of 20% or less, and even worse, nine misreports of the amount of rice in their products [29]. The survey findings gained significant public attention in Taiwan and almost ruined consumers' confidence in rice noodles.

The government implemented regulations to govern the labeling of rice noodles on July 1, 2014. The regulations mandate that only pure rice noodles, i.e., with 100% rice content, can be labeled "rice noodles"; products with 50–99% rice content should be labeled "blended rice noodles"; those with less than 50% can be labeled "steamed rice noodles" [30]. Subsequently, pure rice noodles were distinguished from rice noodles with high corn starch content and consumers began paying more attention to whether rice noodle products were in fact made from rice. Thus, how much consumers are willing to pay for pure rice noodles is a topic worth studying. This paper analyzes consumers' preferences for rice noodle products with various levels of rice content by conducting a discrete choice (DC) experiment in Taiwan and thus the WTP for rice noodle products is calculated to assess the market price of rice noodles.

In addition, Taiwan's rice noodle industry has been using corn starch since the 1970s, and thus most consumers, especially the younger generation, may have never eaten pure rice noodles and some may mistakenly treat steamed rice noodles as pure rice noodles. Pure rice noodles and steamed rice noodles differ in appearance and taste, and consumers must be aware of this distinction to make an informed comparison. However, the low market share of pure rice noodles has deprived consumers of sufficient opportunities to try the product. Thus, this study employs blind taste experiments to understand consumers' ability to identify pure rice noodles with varying rice contents on the basis of their appearance and taste. The participants are informed about the use of corn starch in the rice noodle industry and the varying nutritional values of rice noodles depending on the rice content. The DC experiment is divided into two stages, pre- and post-information provision, to observe whether the provided information influences participants' decision-making behavior. The experimental results are then used to evaluate the impact on participants' WTP.

This study conducts a stated preference estimation of a DC experiment to analyze consumers' purchasing behavior of rice noodles. In the experiment, participants can choose their preferred option from a set of hypothetical product profiles on the basis of attribute levels [31]. Participants' WTP is estimated and calculated according to their final choices. This is a widely adopted approach in food preference surveys, particularly in those on food labeling [32–35]. Compared with contingent valuations, DC experiments do not directly measure consumers' WTP for goods but highlight their preferences as per various attributes. Moreover, participants are required to choose only one option, thus reducing potential biases caused by miscommunication or misinterpretations [36–38].

2. Material and Methods

2.1. Data Collection

2.1.1. Sampling Procedure

It is important to understand how consumers make purchasing decisions about rice noodles based on rice content. In this study, the target population was the consumers in the Taipei metropolitan area (i.e., Taipei City and New Taipei City), representing about 28% of the population in Taiwan and about half of food expenditure nationwide [39]. To draw a representative sample from the Taipei metropolitan area, the 2015 year-end population distribution in terms of gender, age, and education level was referenced to form a sampling scheme [40]. Table 1 presents the distribution of gender, age, and level of education per 100 residents of the Taipei metropolitan area. Participants in this study were recruited based on this demographic distribution.

Table 1. Population distribution per 100 residents of the Taipei metropolitan area.

Gender	Ages (Years)	Education			Sum
		Junior High School and Below	Senior High School	College and Above	
Male	20–34	0	3	12	15
	35–49	2	5	10	17
	50–64	4	5	7	16
	Subtotal	6	13	29	48
Female	20–34	0	3	12	15
	35–49	2	6	11	19
	50–64	6	6	6	18
	Subtotal	8	15	29	52

Source: Department of Household Registration, Ministry of the Interior, Taiwan (2016) [40].

We conducted the experiment on four separate occasions, two sessions each on a weekend (Sunday, 12 March 2017) and a weekday (Wednesday, 22 March 2017). The number of people recruited for each session was designed as follows: 36 people for each of the Sunday sessions at 10:00 a.m. and 3:00 p.m., respectively; 31 people for each of the Wednesday sessions at 6:00 p.m. and 8:00 p.m., respectively. In total, 134 people were recruited. Each participant was given 500 NTD cash and a gift box of rice noodles (market value: 500 NTD) as an incentive for participation. All experiment sessions were held at National Taiwan University, a convenient location for consumers in the Taipei metropolitan area to participate in the experiment.

Participants were mainly recruited using either National Taiwan University's bulletin board system, PTT, the most widely used system in Taiwan, or the application LINE system, through which friends and family shared or forwarded the recruitment message with their own contacts. As for sampling groups with certain characteristics, such as "35–64 years old with a junior high or lower level of education" or "males 35–49 years old with a high school or vocational high school level of education," qualified participants were difficult to recruit; therefore, we asked for referrals from our friends and family and initiated contact with residents of the Taipei metropolitan area. Even so, we were unable to recruit some middle-aged or older males and thus female primary food shoppers with similar ages and education levels were substituted because females accounted for approximately 80% of the households' primary food shoppers [41,42]. Therefore, this deficiency in recruitment could be a limitation of this study. Overall, the actual number of participants was 128.

2.1.2. Choice Experimental Design

To understand consumers' perception of rice noodles (RNs), our experiments were designed to mimic the actual market. In the questionnaire, the hypothetical size of the rice noodle products was 300 g, the most common size found on the market. Table 2 lists the attributes (and levels) of the hypothetical products: rice content (pure rice noodles, blended rice noodles, or steamed rice noodles); food additives (yes or no); price per 300 g (20, 30, 60, 120, 150, or 200 NTD); and designation of origin (yes or no).

Table 2. Attributes and their levels.

Attribute	Level	Number of Levels
Rice content (in %)	PRNs (100%); BRNs (50–99%); SRNs (0–49%)	3
Price (NTD per 300 g)	20; 30; 60; 120; 150; 200	6
Food additives	Yes; No	2
Designation of origin (e.g., Hsinchu RNs)	Yes; No	2

Note: PRNs: pure rice noodles; BRNs: blended rice noodles; SRNs: steamed rice noodles.

Rice content is the primary attribute of interest in this study. FDA rules designate rice contents of 100% and 50% as distinguishing criteria for rice noodle products. Three levels are defined in this study: "pure rice noodles" (PRNs) containing 100% rice; "blended rice noodles" (BRNs) of at least 50% but less than 100%; and "steamed rice noodles" (SRNs) referring to rice noodle products with less than 50% rice content. The proportion of rice content and the color of rice noodles are highly related, i.e., the more corn starch used in the making of rice noodles, the whiter the color; the more rice content, the more yellow the rice noodles in appearance. Therefore, their appearance also affects their purchase, as consumers are apt to notice the difference in color when purchasing rice noodles [43,44].

Price has been proved to be one of the most important economic factors affecting consumers' food purchasing decision [21,32–35,45,46]. In addition, based on the attributes, consumers' WTP can be efficiently estimated with price information. Since most of the commercially available products of rice noodles on the market were sold at 300 g per pack, the prices were divided into six levels, i.e., 20, 30, 60, 120, 150, and 200 New Taiwan Dollars (NTD) per pack of 300 g.

From surveying commercially available rice noodle products, we found they were marked with food additives placed in a less prominent place on the package or marked conspicuously as "no preservatives added" or "no food additive". Whether food additives are listed on the label or not may have an impact on consumers' purchasing decision [18–20]. As a result, the usage of food additives or not is defined as one of the attributes in our study.

The origin reported on the label, such as country of origin labeling, the name of the region, and local labeling, has been intensively studied in foods [7,9,47–49]. In Taiwan, FDA regulations allow businesses to include a designation of origin (DOO) on the package of rice noodle products. Labeling a DOO such as "Hsinchu rice noodles" on the package is a common practice in Taiwan because of its popularity. These labels give consumers the impression that a specific product is related to an area well known for its rice noodles and increase their willingness to purchase these products. Many rice noodle manufacturers include the term "Hsinchu" on their product labels even if they are not located in Hsinchu. Therefore, this study included a designation of origin as an attribute to empirically test the hypothesis that whether an inclusion of a designation of origin, especially the most representative "Hsinchu rice noodles," increases consumers' WTP.

Based on these aforementioned attributes and levels, a full factorial design resulted in 72 ($3 \times 6 \times 2 \times 2$) distinct product profiles. Following the conventional DC experiments [10,50], each choice set was designed to comprise one basic product profile and two alternative product profiles, resulting in an enormous 2485 (C_2^{71}) choice sets. To make the number of choice sets practicable, we adopted the orthogonal design to generate sufficient product profiles using the software SPSS 22.0 [51] and then eliminated unreasonable profiles (e.g., pure rice noodles with food additives) based on the advice of industry and academic experts. As a result, the twelve distinct product profiles listed in Table 3 were retained to produce 55 (C_2^{11}) choice sets. Among them, some trivial choice sets (e.g., two alternatives with identical attributes but different prices) were again removed, resulting in 50 choice sets in total. Finally, five choice sets were assigned to each questionnaire and thus there were ten versions of the questionnaire in our experiment. Figure 1 shows a sample choice set in a questionnaire.

Table 3. Product profiles of rice noodles.

Profile	Rice Content	Price (NTD)	Food Additives	Designation of Origin
basic	SRNs	20	Yes	No
1	PRNs	120	No	No
2	BRNs	200	No	No
3	SRNs	60	No	No
4	PRNs	150	No	No
5	BRNs	60	No	Yes
6	PRNs	150	No	Yes
7	SRNs	120	Yes	Yes
8	SRNs	30	No	No
9	BRNs	120	No	No
10	BRNs	150	Yes	No
11	PRNs	120	No	Yes

Note: PRNs: pure rice noodles; BRNs: blended rice noodles; SRNs: steamed rice noodles.

Attribute \ Profile	Basic	Profile A	Profile B	None of these profiles
Rice content	SRNs (0–49%)	SRNs (0–49%)	PRNs (100%)	
Price	$20	$60	$120	
Food additives	Yes	No	No	
Designation of origin	No	No	Yes	
Which one to buy?	□	□	□	□

Figure 1. A sample choice set.

2.1.3. Designing Tasting Tests

In addition to exploring consumers' purchasing behavior toward rice noodle products with varying rice contents, this study conducts tasting experiments and administers a questionnaire with relevant content to test for changes in purchasing behavior. Prior to disclosing information and conducting the tasting experiment, the researchers perform a choice experiment in which participants are asked to choose from various imaginary goods. Following the tasting experiment, a second choice experiment is performed to determine if participants' purchasing behavior differs from that observed before the tasting experiment. The primary objective of the tasting experiment is to allow participants to understand differences in appearance and taste among the three types of the rice noodles. This helps reduce the influence of consumers' existing perceptions of rice noodles in the second choice experiment and facilitates a more accurate reflection of consumer preferences as per the tasting results.

Thin rice noodles were used as tasting samples because they are commonly seen on the market with the largest market share in Taiwan [28]. The researchers chose Sheng Kuang's "100% Hsinchu Pure Rice Noodles" as pure rice noodles, Buddha's "Hsinchu Blended Rice Noodles" as blended rice noodles, and Long Kow's "Ichi Ban Soul Noodles" as steamed rice noodles. Unlike rice, which can be tasted without any seasoning [52], rice noodles are conventionally eaten either stir-fried or as soup rice noodles. In our experiment, an expert with more than 10 years of experience in cooking stir-fried rice noodles was recruited to standardize the quality and taste of the stir-fried rice noodles. The rice noodle products used the same amount of seasoning, which included Korean cabbage, carrot strips, soy sauce, Great Day Five Treasures Oil, and dressing (made from shiitake mushrooms, shrimp, shallots, shredded pork, and lard). The ingredients for the seasoning were weighed using an electronic scale. Tasting cups of 2.5 ounces (approximately 71.03 mL) were filled to 70% of their capacity with the rice noodle products. The experiment was performed in the form of a blinded test and used the following steps:

1. The principal investigator shows the participants the three types of rice noodle products in transparent packages, each weighing 300 g. The transparent packaging only features labels 1, 2, and 3. The investigator then asks the participants to determine the pure rice noodles, blended rice noodles, and steamed rice noodles on the basis of appearance.
2. The three products are distributed to the participants in tasting cups. The cups are labeled A, B, and C. The participants must identify the type of noodles as per the appearance of the cooked rice noodle products.
3. The investigator then requests the participants to taste the rice noodles. To prevent the taste of each product from influencing each other's, the participants are provided a cup of water between each tasting. The participants must determine the type of noodles as per the taste of the cooked rice noodle products.
4. Finally, the principal investigator provides the participants with the correct answers for each package and tasting cup. The investigator then addresses participant questions to deepen their understanding of rice noodle products.

2.1.4. Descriptive Information of Participants

There were 128 participants in total in our experiment, including 57 males (44.53%) and 71 females (55.47%). The four age categories between 20–59 years old were evenly distributed, with each category comprising approximately 20% of all participants. Participants 60 or older comprised 14.84% of all participants. The average age of the participants was about 43 years. For the level of education, the category "university" had the most participants (31.25%). In addition, the majority of participants were the primary household shopper (67.97%). More than half of the participants had an individual pre-tax income that ranged between 20,000–49,999 NTD (55.47%), followed by those between 50,000–79,999 NTD (14.84%) and 10,000–19,999 NTD (11.72%). For household weekly food expenditures, the category 1,000–1,999 had the most participants (28.13%), followed by 2,000–2,999 NTD (24.22%) and 3,000–3,999 NTD (18.75%). Details about our participants can also be found in Appendix A.

2.2. Econometric Models

Our DC experiment is designed based on both the Lancaster characteristics model [53] and the random utility model [54]. Consumers are presumed to maximize their utility, which consists of two components: the observable deterministic part (V_{ij}) and unobservable random component (ε_{ij}). According to Hanley et al. [55], V_{ij} can be assumed to be an additive and linear function of the attribute

x_{ij} and thus the level of utility derived by consumer i when product profile j is chosen (U_{ij}) can be expressed as:

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \sum_k \beta_k x_{ijk} + \varepsilon_{ij} \tag{1}$$

where x_{ijk} represents the kth attribute of alternative j chosen by the consumer i and β_k is corresponding coefficient for the kth attribute, which is unaffected by alternative product profiles or individual consumers.

Conventionally, choice experiments assume that consumers are homogeneous and that consumer choices are unaffected by alternative product profiles. Therefore, the assumption of independence of irrelevant alternatives (IIA) must be validated, typically by multinomial logit (MNL) model analysis [55–57].

2.2.1. The Random Parameter Logit Model

Different from the MNL model, the random parameter logit (RPL) model takes into account heterogeneity in random parameters. The RPL model also allows for any distribution of error terms and the validity of IIA is not required, meaning that the RPL model can estimate observable and unobservable heterogeneity in preferences within a sample [58,59]. Therefore, for trial k, the utility derived from the alternative profile j chosen by consumer i can be expressed as [60]:

$$U_{ijk} = \beta_i x_{ijk} + \varepsilon_{ijk} \tag{2}$$

where β_i is the estimated marginal utility derived by the consumer i and x_{ijk} is an explanatory variable. The conditional probability L_i of choosing β_i when consumers face a series of K trials can be expressed as [35]:

$$L_i(\beta_i) = \prod_{k=1}^{K} \frac{e^{\beta_i x_{ijk}}}{\sum_{j=1}^{J} e^{\beta_i x_{ijk}}} \tag{3}$$

The conditional probability of all possible choices β_i can be expressed as [35]:

$$P_i = \int f(\beta_i) L_i(\beta_i) d\beta_i \tag{4}$$

In this study, each participant faced a set of three choices; this is considered a repeated choice specification. Equation (4) is a closed form of estimation that requires using the maximum likelihood estimation (MLE) [60].

2.2.2. Latent Class Model

Even though the RPL model can be used to analyze heterogeneity in consumer preferences, Boxall and Adamowicz [61] show that latent class (LC) models can improve the performance by using the RPL models. The LC models can segment an original heterogeneous sample into subsamples with homogeneous preferences based on consumer characteristics [62]. LC models can be used to estimate preferences for attributes in different consumer groups and can evaluate the effects of socioeconomic factors among different groups [63].

As for deriving the probability function for a consumer choosing the jth alternative (from among a choice set C) using the LC models, let the sample comprise n latent classes. In these classes, estimated parameters for utility functions can be used to capture heterogeneity that cannot be observed in individual samples. Assume the ith consumer is a member of the nth class and Z_i represents the socioeconomic attributes of the ith consumer. The utility function can be expressed as:

$$U_{ij|n} = V_{ij|n}\left(Z_{j|n}\right) + \varepsilon_{ij|n}\left(Z_{j|n}\right), \ \mathrm{n} = 1, 2, \ldots, \mathrm{N} \tag{5}$$

The probability of a choice made by the ith consumer in the nth class is:

$$P_{ij|n} = \frac{exp\left(V_{ij|n}\left(Z_{j|n}\right)\right)}{\sum_{c=1}^{C} exp\left(V_{ij|n}\left(Z_{c|n}\right)\right)} \tag{6}$$

Assume a member grouping variable M that is used to divide consumers into n classes and that socioeconomic attributes Z_i influence this grouping of members. The member grouping coefficient for the ith consumer in the nth class is $M_{in} = \lambda Z_i + \varepsilon_{in}$. Next, assume that the error terms for the member grouping coefficient obey a Type I extreme value distribution and the error terms for samples in the same class are iid. The probability H_{in} of the ith consumer in the nth class can be expressed as:

$$H_{in} = \frac{exp(\alpha\lambda_n Z_i)}{\sum_{n=1}^{N} exp(\alpha\lambda_n Z_i)} \tag{7}$$

where α is a scale parameter that is often standardized to 1; $\lambda_n(1,2, \ldots ,N)$ is the estimated parameter for a specified class and represents the contribution of the samples in the class to the probability of the members in the class; and Z_i is the socioeconomic attributes that formed the basis of grouping. Solving Equations (6) and (7) for the probability of choosing the jth alternative produces the following:

$$\begin{aligned} P_{ij} &= \sum_{n=1}^{N} P_{ij|n} H_{in} \\ &= \sum_{n=1}^{N} \left[\frac{exp\left(V_{ij|n}\left(Z_{j|n}\right)\right)}{\sum_{c=1}^{C} exp\left(V_{ij|n}\left(Z_{c|n}\right)\right)}\right] \times \left[\frac{exp(\alpha\lambda_n Z_i)}{\sum_{n=1}^{N} exp(\alpha\lambda_n Z_i)}\right] \end{aligned} \tag{8}$$

To estimate the average WTP for each attribute, the marginal WTP for each attribute can be calculated by dividing the marginal utility of each attribute by the marginal utility of price [57,64]. The estimation equation is as follows:

$$WTP_{Attribute} = -\frac{\frac{dV}{dAttribute}}{\frac{dV}{dPrice}} = -\frac{\beta_{Attribute}}{\beta_{Price}} \tag{9}$$

2.2.3. Definition of Variables

We used effect coding to estimate the potential non-linear effects of attribute levels because of its advantage in estimation effectiveness [65–67]. Pedhazur [65] found that effect coding produced better results for larger numbers of categorical variables. Lusk et al. [66] found that orthogonal design could be preserved using effect coding. Bech and Gyrd-Hansen [67] asserted that effect coding and dummy coding produce identical effects in most situations; however, when dummy coding is used with more than one categorical variable, a correlation may exist between the intercept and the variables, producing issues when explaining the intercept.

Four attributes were defined in this study: rice content (pure rice noodles, blended rice noodles, or steamed rice noodles); food additives (yes or no); designation of origin, such as "Hsinchu rice noodles" (yes or no); and price. Six variables were defined based on these attributes (Table 4). The intercept was named *ASC*. Based on rice content, we defined *PRNs* (pure rice noodles) and *BRNs* (blended rice noodles). We also defined *ADD* as whether a product used food additives; *DoO* as whether product packaging included a designation of origin; and *PRICE* as the product price. In addition to these variables for attribute levels, we created dummy variables for continuous factors in terms of their median value (Juutinen et al., 2011). The dummy socioeconomic variables included gender (*MALE*), age (*AGE*), level of education (*EDU*), income (*INCOME*), and the primary household shopper (*MAINBUY*). The purchasing behavior variable was *SIGN*, indicating whether the participant usually pays attention to the rice content labeling on packages when purchasing rice noodle products.

Table 4. Definition of variables in the choice experiments.

Variable	Definition	Coding
	Attribute levels	
ASC	Intercept term	1 = basic profile was chosen 0 = profile #1 or #2 was chosen
PRNs	Pure rice noodles	1 = pure rice noodles; 0 = otherwise
BRNs	Blended rice noodles	1 = blended rice noodles; 0 = otherwise
ADD	Food additives	1 = with food additives; 0 = otherwise
DoO	Designation of origin	1 = with designation of origin; 0 = otherwise
PRICE	Price levels	Continuous variable: six levels of 20, 30, 60, 120, 150, and 200 NTD per package of 300 g
	Socioeconomic variables	
MALE	Gender	1 = male; 0 = female
AGE	Age	1 = 42 years old or above; 0 = less than 42 years old
EDU	Education level	1 = university or graduate school;0 = otherwise
INCOME	Personal monthly income	1 = $35,000 or more; 0 = otherwise
MAINBUY	Main shopper or not	1 = yes; 0 = no
	Variable of purchasing behavior	
SIGN	Paying attention or not to the labels of rice content on packages	1 = yes; 0 = no

3. Estimation Results

Under the framework of random utility models, several sets of estimation results are performed by using NLOGIT version 5 [68]. Since the MNL results are similar to those from the RPL models, the parameter estimates and their corresponding WTPs are available upon request to save the space. Estimation results from both the RPL and the LC models are reported here for comparison purposes.

3.1. The RPL Results

Table 5 lists the RPL estimates for both coefficients and their standard errors. If the standard error of a variable is statistically significant, there exists heterogeneous preferences among participants for the variable. Our empirical results show that the standard errors are statistically significant for *ASC* and *PRNs* before the tasting test but for *PRNs* and *ADD* after the experiment, revealing heterogeneity only in some attributes in the experiment. In addition, the estimated coefficients using the RPL model also show that the variables of *ASC*, *PRNs*, *ADD*, and *PRICE* were statistically significant both before and after the tasting tests, whereas *DoO* was significant only before the experiment.

Table 5 also lists marginal WTP calculations for each significant attribute level. The marginal WTP for the intercept was −114.12 NTD before the experiment and increased to −86.01 NTD after the experiment. Before the experiment, the participants' marginal WTP for PRNs was 52.54 NTD and almost doubled to 106.25 NTD afterwards, indicating that the taste test had the effect of strengthening participant preferences and increasing their WTP for pure rice noodles. In addition, the participants' marginal WTP for products without food additives was 31.54 NTD before the experiment but increased to 55.16 NTD after the experiment, which indicates again that the taste test had the effect on increasing the participants' WTP for rice noodle products that do not use food additives.

For interaction terms, none of the standard error estimates was statistically significant, showing no heterogeneous preferences about prices in terms of the consumer' gender, age, level of education, income, whether the participant is the primary household shopper, or whether the consumer usually pays attention to the rice content labeling on packages. As for the pre-experiment results, four terms were statistically significant, including *PRICE*EDU*, *PRICE*INCOME*, *PRICE*MAINBUY*, and *PRICE*SIGN*, indicating that, before the experiment, four types of participants would prefer to choose a new product profile. Their demographic characteristics are (1) possessing higher incomes; (2) paying attention to the rice content labeling; (3) achieving higher levels of education; and (4) the primary household shopper. However, only the interaction terms *PRICE*MALE* and *PRICE*SIGN* were statistically significant, indicating that only two types of participants, including both females and those who usually pay attention to the rice content labeling on packages, would prefer to choose a new product profile after the experiment.

Table 5. Estimation results of the random parameter logit models for pre- and post-experiment conditions.

Variable	Pre-Experiment					Post-Experiment				
	Coefficient	*t-value*	s.e.	*t-value*	WTP	Coefficient	*t-value*	s.e.	*t-value*	WTP
ASC	−3.943 **	−2.32	2.447 **	2.08	−144.12	−21.502 *	−1.68	4.590	0.36	−86.01
PRNs	1.437 ***	3.41	1.090 **	2.18	52.54	26.562 **	2.05	27.432 **	2.06	106.25
BRNs	−0.123	−0.79	0.015	0.04		0.680	0.35	0.226	0.03	
ADD	−0.863 ***	−2.95	0.518	0.95	−31.54	−13.789 **	−2.06	11.307 *	1.91	−55.16
DoO	0.786 ***	5.18	0.105	0.18	28.72	3.170	1.40	5.151	1.22	
PRICE	−0.027 ***	−3.47				−0.250 **	−1.96			
Intersection term										
*PRICE*MALE*	−0.003	−1.13	0.001	0.04		−0.055 *	−1.68	0.083	0.75	
*PRICE*AGE*	−0.002	−0.75	0.012	1.08		−0.034	−1.01	0.001	0.01	
*PRICE*EDU*	−0.006 **	−2.08	0.010	0.84		−0.059	−1.57	0.060	0.61	
*PRICE*INCOME*	0.010 ***	2.59	0.004	0.28		0.081	1.62	0.038	0.36	
*PRICE*MAINBUY*	−0.007 **	−2.22	0.009	0.58		−0.050	−1.38	0.079	0.89	
*PRICE*SIGN*	0.005 *	1.85	0.002	0.14		0.074 *	1.86	0.034	0.38	
Sample size	547					548				
Log likelihood	−337.677					−324.785				
Pseudo R^2	0.438					0.461				

Note: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$, respectively.

3.2. The LC Results

In addition to using RPL models to observe differences in participant preferences for attribute levels before and after the taste test, we used LC models to perform market segmentation analyses. Participants were divided into classes based on socioeconomic and behavioral variables. We tested several group configurations to optimize the number of classes for our sample, resulting in two classes for both the pre- and post-experiment conditions. Tables 6 and 7 list the LC estimation results for the pre- and post-experiment conditions, respectively. The chi-squared test statistics for both pre- and post-experiment conditions show that the LC model was appropriate.

For the pre-experiment condition, the two classes of participants, grouped by market segmentation, exhibited disparate preferences for rice noodle products. The first class of participants preferred pure rice noodles that did not use food additives, included a designation of origin, and were cheap. In contrast, the second class of participants preferred rice noodle products that included a designation of origin and were cheap. Furthermore, compared to the first class, the second class showed a substantially greater preference for products with a designation of origin.

The first class comprised 53.1% of the samples; the second class comprised 46.9% of the samples. Comparing the socioeconomic and behavior variables of the first class to those of the second class, all variables (i.e., gender, age, level of education, personal monthly income, primary household shopper, and pays attention to the rice content labeling on packages) were statistically significant, indicating that, comparing the first class to the second class, members of the first class with significant preferences were mostly females who were 42 years old or younger, had a high school, vocational high school, or lower level of education, were not the primary household shopper, had an income of 35,000 NTD or higher, and usually paid attention to the rice content labeling on packages when purchasing rice noodle products.

Table 7 shows the post-experiment estimation results of the LC models. The two classes of participants were again segmented to exhibit disparate preferences for rice noodle products. The first class of participants preferred pure rice noodles that did not use food additives, included a designation of origin, and were cheap. The second class of participants preferred cheap products and did not prefer the basic product profile. In addition, compared to the first class, the second class showed a substantially greater preference for cheap products. The first class comprised 69% of the samples; the second class comprised 31% of the samples. Comparing the socioeconomic and behavior variables of the first class to those of the second class, the variables of both personal monthly income and paying attention to the rice content labeling on packages were significant. This indicated that, comparing the first class to the second class, members of the first class with significant preferences were mostly participants who had an income of 35,000 NTD or higher and who usually paid attention to the rice content labeling on packages when purchasing rice noodle products.

Table 8 lists the marginal WTP, both before and after the experiment, calculated using the values from Tables 6 and 7. Because the pre- and post-experiment class characteristics were different, we could not compare WTPs before and after the experiment. Before the experiment, the first class was willing to pay 172.34 NTD for pure rice noodles, 93.51 NTD for no food additives, and 104.32 NTD for a designation of origin, but the second class was willing to pay 76.99 NTD for replacing the basic profile in Table 3 and 15.98 NTD for a designation of origin. After the experiment, the first class was willing to pay 233.09 NTD for pure rice noodles, 64.96 NTD for no food additives, and 52.90 NTD for a designation of origin, whereas the second class was willing to pay 65.03 NTD for replacing the basic profile in our experiment.

Table 6. Estimation results of the latent class model for the pre-experiment condition.

Attribute	Class 1		Class 2	
	Coefficient	**s.e.**	**Coefficient**	**s.e.**
ASC	−1.10338	1.30637	−2.17492 **	0.85069
PRNs	1.84056 ***	0.58378	0.43669	0.3471
BRNs	−0.21684	0.24353	−0.06721	0.22606
ADD	−0.99871 ***	0.3644	−0.51032	0.32955
DoO	1.11415 ***	0.25825	0.45131 ***	0.15201
PRICE	−0.01068 *	0.00557	−0.02825 ***	0.0068
Coefficient estimates of class 1 relative to class 2				
Constant term	0.15794	0.48658		
MALE	−0.55803 **	0.27726		
AGE	−0.47865 *	0.28657		
EDU	−0.57399 **	0.27461		
INCOME	1.50486 ***	0.39884		
MAINBUY	−1.05075 ***	0.29928		
SIGN	1.03744 ***	0.33226		
Sample proportion	0.531		0.469	
Sample size	547			
AIC/N	1.269			
Log likelihood	−328.14026			
Chi-squared statistic	545.60133 ***			
Pseudo R^2	0.4539559			

Note: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Table 7. Estimation results of the latent class model for the post-experiment condition.

Attribute	Class 1		Class 2	
	Coefficient	s.e.	Coefficient	s.e.
ASC	−30.6596	5.382×10^6	−2.52768 **	1.28790
PRNs	3.61983 ***	0.82813	0.25281	0.51289
BRNs	−0.5002	0.31160	0.53203	0.36652
ADD	−1.00887 ***	0.25235	−0.45921	0.47144
DoO	0.82161 ***	0.26407	−0.03830	0.25863
PRICE	−0.01553 ***	0.00574	−0.03887 ***	0.01104
Coefficient estimates of class 1 relative to class 2				
Constant term	0.79090 ***	0.24841		
MALE	−0.08007	0.15105		
AGE	0.10178	0.16156		
EDU	−0.26509	0.16239		
INCOME	0.43091 **	0.18221		
MAINBUY	−0.12452	0.16395		
SIGN	0.26830 *	0.16244		
Sample proportion	0.688		0.312	
Sample size	548			
AIC/N	1.263			
Log likelihood	−327.19300			
Chi-squared statistic	549.69306 ***			
Pseudo R^2	0.4565257			

Note: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Table 8. Estimated marginal willingness to pay using the latent class models.

	Pre-Experiment		Post-Experiment	
Attribute	Class 1	Class 2	Class 1	Class 2
ASC		−76.99		−65.03
PRNs	172.34		233.09	
BRNs				
ADD	−93.51		−64.96	
DoO	104.32	15.98	52.90	

The variables that were significant in the MNL, RPL, and LC models are summarized in Table 9. We found that both before and after taste testing, variables that were significant in all three models had the same positive or negative effect on utility in all models. This indicated that in all three models, these attribute level variables had consistent effects on participants' preferences.

Table 9. Sign of the statistically significant variables among models.

	Pre-Experiment				Post-Experiment			
Attribute	MNL	RPL	LC_1	LC_2	MNL	RPL	LC_1	LC_2
ASC	−			−	−	−		−
PRNs	+	+	+		+	+	+	
BRNs								
ADD	−	−	−		−	−	−	
DoO	+	+	+	+	+		+	
PRICE	−	−	−	−	−	−	−	−

4. Discussion

Labeling proper information about food products is extensively studied in food economics [69,70]. Ambiguous or misleading food labels may bias consumers' decisions [8]. This study attempts to investigate factors affecting consumers' WTP for rice noodles in Taiwan. Our econometric results from employing MNL, RPL, and LC models reveal several important findings about food labels.

First, in terms of the WTP estimates, information about rice contents plays the most important role among the selected attributes in our experiment. Compared with the SRNs of less than 50% rice content and BRNs of at least 50% but less than 100% rice content, PRNs contain 100% rice. As we reported earlier, consumers' marginal WTP for PRNs dramatically increases from 52.54 NTD in the pre-experiment condition to 106.25 NTD in the post-experiment condition. After classifying two groups using LC models, the estimated values of PRNs are substantially higher: 172.34 NTD and 233.09 NTD, respectively. Similar to the study on organic foods by Batte et al. [71], our results reinforce the finding that consumers are willing to pay more for 100% natural food ingredients.

Second, consumers are unwilling to pay more for added food additives [72]. Our estimated WTP from both models are all negative, indicating that consumers appreciate additive-free food instead of food with additives. In particular, the estimated marginal WTP for no food additives rises slightly from 31.54 NTD to 55.16 NTD in the RPL models (Table 5). The findings of this study are consistent with Radam et al. [73], who studied food products with no added Monosodium Glutamate (MSG), and with Chou and Chen [74], who show that Taiwanese consumers are most concerned about the effects of food additives on physical health and are willing to pay a premium for food products without additives.

Finally, the RPL model also shows that consumers exhibit heterogeneous preferences for pure rice noodles in the pre-experiment condition, but their preferences for pure rice noodles and food additives are heterogeneous in the post-experiment condition. In addition, the group analysis with the LCM model indicates that two consumer groups report significant differences in preferences for attribute levels in the pre-experiment condition. The first group largely comprises women who are aged 42 years or younger; have received a senior high school, vocational, or a lower level of education; are not the main buyers in the household; report a monthly income of 35,000 NTD or more; and generally pay attention to the rice content mentioned on labels when purchasing the products. This group prefers to buy pure rice noodle products that have a local name and no additives. The second group, by contrast, prefers products with local names but at lower prices.

5. Conclusions and Implications

Rice is the most important staple food in Taiwan and is representative of the country's food culture. Processed food products, such as rice noodles, can promote various uses of rice. Most consumers, especially the younger generation, in Taiwan have never eaten pure rice noodles and some may mistakenly treat corn starch-based rice noodles as PRNs. The purpose of this study is to elicit consumers' WTP for PRNs using DC models with a blind taste experiment to understand consumers' ability to identify PRNs with varying rice content on the basis of their appearance and taste. Collecting data from the Taipei metropolitan area, our DC experimental results of both pre- and post-experiment conditions show that Taiwanese consumers do prefer PRNs and their WTP for PRNs was strengthened. A latent class model highlights that attribute preferences tend to be heterogeneous.

This study suggests that consumers are generally concerned about whether rice noodles are in fact made from rice and prefer pure rice noodles rather than steamed ones, indicating that pure rice noodles still have market potential. Tasting experiments strengthened consumers' preference for pure rice noodles with no food additives. Therefore, producers marketing and promoting pure rice noodles should hold tasting events to help consumers understand products with different rice content ratios and strengthen their preference and WTP for pure rice noodles. In addition, a "no food additives" label on the packaging may increase consumers' WTP.

Consumer groups tend to differ in their preferences. Using the LC models, heterogeneous preferences are detected and some consumers are less concerned about the rice content in the rice noodles and may prefer the SRNs instead of the PRNs. This finding suggests that, while there is value in promoting pure rice noodles, there remains a market for the more affordable corn starch-based rice noodles. Thus, it seems imperative to establish labeling guidelines for rice noodles to eliminate ambiguities in the market that can mislead consumers and to ensure the preferences of various consumer groups are satisfied. The guidelines should also clearly distinguish between pure rice noodles and corn starch-based rice noodles.

According to Food and Drug Administration regulations, only products with 100% rice content can be called pure rice noodles or rice noodles. Producers can also mention the rice content and local names on their packaging. However, the Food and Drug Administration intends to relax its regulation for "rice noodle" labeling [75]. This study confirms that the use of local names positively influences consumers' preference and WTP for products. Thus, if the government relaxes its labeling regulations, it should adopt complementary measures to prevent consumer misinterpretations; for example, a "rice noodle" label may not necessarily mean "pure rice noodles." In addition, it should set a reasonable lower limit for rice content ratio and clearly prescribe the position and size of packaging labels for rice content ratio. The government may also assess the impact of these measures on actual producers of pure rice noodles and, accordingly, offer subsidies or issue certification marks prior to the relaxation to mitigate the impact on the producers of pure rice noodles.

Since our participants were recruited in the Taipei metropolitan area, the WTP for pure rice noodles may be overestimated if we target Taiwan as the population for making inferences. Further research may also pay attention to the confounding effects of both food ingredients and food additives, the two major components in processed food products.

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Appendix A

Table A1. Socio-economic profiles of participants.

Category	Item	Frequency (Person)	Percentage (%)
Gender	Male	57	44.53
	Female	71	55.47
Age (years)	20–29	29	22.66
	30–39	28	21.88
	40–49	24	18.75
	50–59	28	21.88
	60 and above	19	14.84
	Average (years)	43.01	
Education	Primary school	2	1.56
	Junior high school	9	7.03
	Senior high school	38	29.69
	College	22	17.19
	University	40	31.25
	Graduate school	17	13.28
	Average (years)	14.43 [1]	
Marriage status	Unmarried	70	54.69
	Married	48	37.50
	Other [2]	10	7.81
Primary household shopper	Yes	87	67.97
	No	41	32.03
Personal pre-tax monthly income (NTD)	Less than 10,000	5	3.91
	10,000–19,999	15	11.72
	20,000–49,999	71	55.47
	50,000–79,999	19	14.84
	80,000 and above	6	4.69
	No income	12	9.38
	Average (NTD)	35,664.06	
Household weekly food expenditure (NTD)	Less than 1000	9	7.03
	1000–1999	36	28.13
	2000–2999	31	24.22
	3000–3999	24	18.75
	4000–4999	14	10.94
	5000 and above	14	10.94
	Average (NTD)	2792.97	
Sample size		128	

Note: [1.] Average of educational years is calculated according to the following school years: 6 years for primary school, 9 years for junior high school, 12 years for high school, 16 years for college and university, and 18 years for graduate school. [2.] "Other" in marriage status includes divorce and widowhood.

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