

## RESEARCH LETTER

# How product attributes and consumer attitudes affect purchase prices of japonica rice in China

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**ABSTRACT**

This study focuses on japonica rice (*Oryza sativa* L. ssp. *japonica*) and examines how product attributes, consumer attitudes, consumer demographics, and regional differences influence different categories of the daily purchase prices of japonica rice in China. Online questionnaires were distributed to 492 respondents from the inland, coastal, and northern regions of China. The study applied an ordered logit regression and a multinomial logit regression to analyze the survey data and understand the differences among various categories based on purchase prices. Consumers with high income and educational levels, who are more concerned with the environment and their health and have greater trust in government supervision of rice quality, as well as inland consumers, are more likely to purchase high-priced japonica rice, whereas the price factor has a negative relationship with such purchases. The results provide sufficient information to the japonica rice industry to expand its market and improve its profitability.

## 1 | INTRODUCTION

Rice (*Oryza sativa* L. ssp. *indica* and *japonica*) is among the most important staple foods worldwide. More than 60% of the population of China consumes rice, with japonica rice accounting for 30% of rice consumption. Normally, the low price elasticity of rice ensures that its price is not highly volatile. However, income growth, convenience, marketization, and urbanization have significantly changed the rice consumption structure (Aoyagi, 2012; Wu, Wu, Yin, & Chien, 2020). In particular, more and more consumers in the north of China prefer to consume japonica rice instead of wheat (*Triticum aestivum* L.), and an increasing number of consumers in the south purchase japonica rice instead of indica rice. Another significant change is in the quality of rice; increasing numbers of consumers favor natural, safe, healthy, environmentally friendly, functional (e.g., low protein), and

organic high-quality rice. Consequently, the market share of japonica rice is continually growing, and the price range of rice has been fluctuating wildly. For example, the average market price for normal japonica rice is approximately CNY 8 (yuan [CNY]) kg<sup>-1</sup>, but for certain japonica rice varieties it can reach up to CNY 80 kg<sup>-1</sup> (Zeng & Xu, 2014).

Previous studies examined the influence of awareness and knowledge on the purchasing behavior or willingness to pay for rice; however, there is limited research on japonica rice (Wu, Zhou, & Chien, 2019; Xu, Su, & Lone, 2018; Zhou, Liu, Mao, & Yu, 2017). Until now, consumer perceptions have remained a largely unexplored mechanism for empirically understanding price structures in the japonica rice market. Clarifying the preference and characteristics of consumers who purchase high-priced agricultural products can provide useful information to producers and enable product differentiation. This study examines how product attributes, consumer

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attitudes, consumer demographics, and regional differences influence different categories of the daily purchase prices of japonica rice in China.

## 2 | DATA AND METHODS

Given the existence of regional differences in the Chinese rice market, our survey randomly selected three different regions across 10 provinces (Beijing, Shanghai, Yunnan, Sichuan, Guangdong, Jiangsu, Hubei, Fujian, Liaoning, and Heilongjiang) and targeted respondents who consume japonica rice as their main staple food. The main data collection method was an online questionnaire, conducted November–December 2017. A third-party platform database agency (Baidu) was used to distribute questionnaires to potential respondents (>24 years old). All other procedures (e.g., survey design and data analysis) were performed by the authors.

The questionnaire focused on four components: consumer demographics (age, gender, education, and household income), product attributes (brand and place of production), consumer attitudes (price, environment, health, and supervision), and purchase prices of japonica rice. Forms used a five-point rating scale. Product attributes and consumer attitudes (price) were measured from very unimportant (1) to very important (5) by the answer to the question “To what extent do you think the brand, place of production (place) or price of japonica rice are important?” Consumer attitudes regarding environment and health were measured from not concerned (1) to very concerned (5) by the answer to the question “To what extent are you concerned about environmental impact or health effect while purchasing japonica rice?” Consumer attitude of supervision was measured from no trust (1) to very high trust (5) by the answer to the question: “To what extent do you trust the food supervision system?” The purchase price of japonica rice was measured using the question “What is your daily purchase price of japonica rice (yuan/kg)?”; respondents were given choices of purchase prices (four ordered categories) (Table 1 gives details for each category).

The final set of respondents consisted of 492 randomly selected respondents: 150, 187, and 155 respondents from the inland (region I: Hubei, Yunnan, and Sichuan), coastal (region C: Guangdong, Shanghai, Jiangsu, and Fujian), and northern (region N: Beijing, Liaoning, and Heilongjiang) regions, respectively.

To measure the ordinary dependent variables, we used an ordered logit regression (Model 1) and multinomial logit regression (Model 2). The ordered logit regression is based on the following formula:

$$P(Y \leq k) = p_1 + p_2 + \dots + p_k = \frac{\exp(\alpha_k + X\beta)}{1 + \exp(\alpha_k + X\beta)} \quad (1)$$

### Core Ideas

- Product attributes and consumer attitudes influence japonica rice prices in China.
- Consumers concerned about the environment are more likely to purchase high-priced japonica rice.
- Consumers with more trust in the supervision system are more likely to purchase high-priced japonica rice.
- High-income, highly educated consumers are also more likely to purchase high-priced japonica rice.
- Price has a negative relationship with purchase of high-priced japonica rice.

where  $k = 1, 2, \dots, k$  (the outcome category),  $X$  indicates the matrix of independent variables,  $\alpha_k$  and  $\beta$  are the parameters to be estimated,  $P(Y \leq k)$  is the probability of  $Y$  falling at or below a given  $k$ , and  $p_1, p_2, p_k$  are the probabilities of  $Y$  (an ordinal response). The ordered logit regression in the logit form is as follows:

$$\begin{aligned} \text{Logit}[P(Y \leq k)] &= \log \left[ \frac{P(Y \leq k)}{1 - P(Y \leq k)} \right] \\ &= \log \left[ \frac{p_1 + p_2 + \dots + p_k}{p_{k+1} + p_{k+2} + \dots + p_k} \right] \\ &= \alpha_k + X\beta \end{aligned} \quad (2)$$

where  $\beta$  indexes the effect of  $p$  independent variables on the logit,  $\alpha_k$  is not used to interpret the results and is only related to the out category, and  $X = (X_1, X_2, X_3, \dots, X_{12})$  is a set of exploratory variables.

For the multinomial logistic regression, the dependent variable contains four categories (A, B, C, and D). Choosing category A as a baseline, the equations of each category are as follows:

$$g_b(x) = \log \frac{P(Y = B)}{P(Y = A)} = \beta_{10} + \beta_{10}x_1 + \dots + \beta_{1p}x_p \quad (3)$$

$$g_c(x) = \log \frac{P(Y = C)}{P(Y = A)} = \beta_{20} + \beta_{20}x_1 + \dots + \beta_{2p}x_p \quad (4)$$

$$g_d(x) = \log \frac{P(Y = D)}{P(Y = A)} = \beta_{30} + \beta_{30}x_1 + \dots + \beta_{3p}x_p \quad (5)$$

where  $\beta_{10}, \beta_{11}, \beta_{12}, \dots, \beta_{3p}$  are the parameters to be estimated, and  $X = (X_1, X_2, X_3, \dots, X_{12})$  is a set of exploratory variables. Table 2 presents a detailed description of the variables and a summary of sample statistics used in Models 1 and 2.

TABLE 1 Distribution of four purchase-price categories

Purchase price	Frequency	Percentage	Cumulative	Category
	Sample numbers			
<CNY 5.00 kg <sup>-1</sup>	122	24.80	24.80	A
CNY 5.00–9.99 kg <sup>-1</sup>	270	54.88	79.67	B
CNY 10.00–14.99 kg <sup>-1</sup>	60	12.20	91.87	C
≥CNY 15.00 kg <sup>-1</sup>	40	8.13	100	D
Total sample	492	100	–	–

Note. Data from the authors' survey.

TABLE 2 Definition of variables and sample statistics

Variables	Description	Mean	Median	Range	
Demographic factors					
$X_1$	Age	Age of respondents (yr)	34.20 (8.01)	32	45
$X_2$	Gender	Female = 1; Male = 0;	0.41 (0.49)	0	1
$X_3$	Education	1 = primary education or below; 2 = lower secondary education; 3 = upper secondary education or equivalent level; 4 = bachelor's degree or equivalent level; 5 = master's level or above	3.75 (0.80)	4	4
$X_4$	Household income (monthly)	1 = <CNY 3,000; 2 = CNY 3,001–5,000; 3 = CNY 5,001–8,000; 4 = CNY 8,001–10,000; 5 = CNY 10,001–20,000; 6 = CNY 20,001–30,000; 7 = CNY 30,001–50,000; 8 = >CNY 50,000	4.33 (1.66)	4	7
Product attributes					
$X_5$	Brand	Scores range from 1 = very unimportant to 5 = very important	3.26 (1.11)	3	4
$X_6$	Place	Scores range from 1 = very unimportant to 5 = very important	3.26 (1.24)	3	4
Consumer attitudes					
$X_7$	Price	Scores range from 1 = very unimportant to 5 = very important	3.42 (1.18)	3	4
$X_8$	Environment	Scores range from 1 = not concerned to 5 = very concerned	4.13 (1.15)	5	4
$X_9$	Health	Scores range from 1 = not concerned to 5 = very concerned	3.98 (1.14)	4	4
$X_{10}$	Supervision	Scores range from 1 = no trust to 5 = very high trust	3.46 (1.27)	4	4
Regional factors					
$X_{11}$	Region C	Coastal region = 1, inland and northern region = 0	0.38 (0.49)	0	1
$X_{12}$	Region I	Inland region = 1, northern and coastal region = 0	0.30 (0.46)	0	1

Note. Parentheses indicate standard errors.

TABLE 3 Estimated results of Model 1

Variables	Coefficient	Odds ratio
Demographic factors		
Age	0.0178 (0.0117)	1.0179 (1.0118)
Gender	-0.0902 (0.1816)	0.9137 (1.1991)
Education	0.3222 (0.1246) **	1.3802 (1.1327) **
Household income	0.1715 (0.0588) **	1.1871 (1.0606) **
Product attributes		
Brand	0.0786 (0.0862)	1.0818 (1.0900)
Place	0.0681 (0.0834)	1.0704 (1.0870)
Consumer attitudes		
Price	-0.1985 (0.0827) *	0.8199 (1.0862) *
Environment	0.2422 (0.1003) *	1.2740 (1.1055) *
Health	0.2064 (0.1042) *	1.2293 (1.1098) *
Supervision	0.1583 (0.0799) *	1.1715 (1.0832) *
Regional factors		
Region C	0.1100 (0.2142)	1.1163 (1.2389)
Region I	0.1583 (0.0799) *	2.1337 (1.0832) *
AlB intercept	1.7457 (0.8792) *	5.7299 (2.4090) *
B/C intercept	4.4408 (0.9011) ***	84.8428 (2.4623) ***
C/D intercept	5.5585 (0.9156) ***	259.4334 (2.4983) ***

Note. Pseudo  $R^2$ : 0.1117; Akaike information criterion: 1095.5748; Bayesian information criterion: 1158.5520; log likelihood: -532.7874; LR  $\chi^2$ : 51.97\*\*\*; Prob ( $>\chi^2$ ): 0.0000; parentheses indicate standard errors.

\*Significant at the .05 probability level.

\*\*Significant at the .01 probability level.

\*\*\*Significant at the .001 probability level.

### 3 | RESULTS

Table 3 presents the results of the ordered logit regression. The results of Model 1 were proved to be robust and statistically significant by examining the Brant test and their variance inflation factors (Brant, 1990). Education; household income; consumer attitudes toward the environment, health, and supervision; and region I were positive and statistically significant, whereas price was negative and statistically significant.

Regarding consumer attitudes, if consumers consider price an important factor, they are less likely to buy higher-priced japonica rice. For every one-unit increase in product attribute (price), the odds of being more likely (category B, C, or D vs. category A) to buy was 18.01% lower, holding all other variables constant. Consumers are more likely to purchase high-priced japonica rice if they focus on environment and health when making purchase decisions. In addition, if consumers have greater trust in government supervision of rice quality, they are more likely to buy higher-priced japonica rice. For every one-unit increase in consumer attitudes (environment, health, and supervision), the odds of being more likely to buy was multiplied 1.27, 1.23, and 1.17 times, respectively (i.e.,

increased by 27.40, 22.93, and 17.15%, respectively), holding all other variables constant.

Consumers from inland areas were more likely to purchase higher-priced japonica rice; their odds of purchasing was 2.13 times that of consumers in the coastal or northern regions, holding all other variables constant. One possible explanation is that inland consumers face higher logistic costs; this is because the inland region only produces a small amount of japonica rice compared with coastal or northern regions. Among demographic factors, if consumers have a high education level or high household income, they are more likely to purchase high-priced japonica rice. For every one-unit increase in consumers' education level, the odds of being more likely to buy was multiplied 1.38 times (i.e., increased by 38.02%), holding all other variables constant. And for every one-unit increase in consumers' household income, the odds of being more likely to buy was multiplied 1.19 times (i.e., increased by 18.71%).

Table 4 shows the results of the multinomial logit regression regarding the specific differences between the reference category A and categories B, C, or D. Category A is the reference group compared with category B (Case 1), category C (Case 2), and category D (Case 3), respectively. Case 1 shows that category A and category B have similar values, and only the environment and supervision factors were statistically significant. This is because price differences were not large in Case 1. The results of Case 2 and Case 3 were very similar to Model 1. However, Case 3 shows that the age factor has statistical significance; that is, older consumers were more likely to buy high-priced japonica rice. Finally, consumer attitude toward supervision was not significant.

### 4 | CONCLUSION

The Chinese agriculture market is facing the issue of agricultural product similarity, partly because producers often ignore consumer demand. Analyzing consumer preferences and regional characteristics could contribute to developing a product differentiation strategy for producers. This study focused on japonica rice, examining how product attributes, consumer attitudes, consumer demographics, and regional differences influence different categories of the daily purchase prices of japonica rice. Consumers with high income and educational levels, who are more concerned with the environment and their health, and have greater trust in government supervision over rice quality, as well as older consumers and inland consumers, are more likely to purchase high-priced japonica rice. These results not only provide an insight into the food market but also provide sufficient information to the japonica rice industry to expand its market and improve its profitability. More important, the results could contribute to the

TABLE 4 Estimated results of Model 2

Variables	Case 1 (Category A vs. B)		Case 2 (Category A vs. C)		Case 3 (Category A vs. D)	
	Coefficient	Odds ratio	Coefficient	Odds ratio	Coefficient	Odds ratio
<b>Demographic factors</b>						
Age	0.0145 (0.0153)	1.0146 (1.0154)	0.0018 (0.0234)	1.0018 (1.0237)	0.0455 (0.0238) *	1.0466 (1.0241) *
Gender	0.0527 (0.2334)	1.0542 (1.2629)	-0.3338 (0.3509)	0.7162 (1.4204)	-0.1250 (0.3979)	0.8825 (1.4887)
Education	0.2234 (0.1533)	1.2504 (1.1657)	0.4047 (0.2532) *	1.4988 (1.2882) *	0.7655 (0.3077) *	2.1500 (1.3603) ***
Household income	0.0937 (0.0748)	1.0982 (1.0777)	0.2634 (0.1109) ***	1.3013 (1.1173) ***	0.3262 (0.1313) ***	1.3857 (1.1403) ***
<b>Product attributes</b>						
Brand	-0.0019 (0.1108)	0.9981 (1.1172)	0.1620 (0.1632)	1.1759 (1.1772)	0.1033 (0.1874)	1.1088 (1.2061)
Place	-0.0451 (0.1060)	0.9559 (1.1118)	0.0745 (0.1563)	1.0773 (1.1691)	0.1772 (0.1826)	1.1939 (1.2003)
<b>Consumer attitudes</b>						
Price	-0.0611 (0.1057)	0.9407 (1.1114)	-0.3454 (0.1543) *	0.7080 (1.1668) **	-0.3142 (0.1779) *	0.7304 (1.1947) **
Environment	0.3274 (0.1403) ***	1.3874 (1.1507) ***	0.4251 (0.2276) **	1.5298 (1.2556) **	0.3697 (0.2276) *	1.4473 (1.2556) *
Health	0.0340 (0.1363)	1.0346 (1.1461)	0.3164 (0.2371) *	1.3722 (1.2675) *	0.4545 (0.2371) *	1.5753 (1.2675) **
Supervision	0.2213 (0.0993) **	1.2477 (1.1044) **	0.3349 (0.1700) **	1.3977 (1.1853) **	0.1019 (0.1700)	1.1073 (1.1853)
<b>Regional factors</b>						
Region C	0.1115 (0.2636)	1.1180 (1.3016)	0.3174 (0.4831)	1.3735 (1.6211)	0.0851 (0.4831)	1.0888 (1.6211)
Region I	0.4166 (0.2968)	1.5168 (1.3456)	1.2631 (0.4895) *	3.5362 (1.6315) ***	1.1968 (0.4895) *	3.3097 (1.6315) ***
Intercept	-0.2288 (1.1313)	0.7955 (3.0997)	-4.1405 (1.7417) ***	0.0159 (5.7070) ***	-7.9673 (1.9975) ***	0.0003 (7.3706) ***

Note: Pseudo  $R^2$ : 0.1538; Akaike information criterion: 1122.5340; Bayesian information criterion: 1286.2750; log likelihood: -522.2672; LR  $\chi^2$ : 73.01\*\*\*; Prob ( $>\chi^2$ ): 0.0000; parentheses indicate standard errors.

\* Significant at the .05 probability level.

\*\* Significant at the .01 probability level.

\*\*\* Significant at the .001 probability level.

development of agricultural product differentiation and improve its producer price.

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## AUTHOR CONTRIBUTIONS

Wenhao Wu: Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Software; Writing-original draft; Writing-review & editing. Lin Zhou: Methodology; Project administration; Resources; Software; Supervision. Hsiaoping Chien: Conceptualization; Methodology; Project administration; Resources; Supervision; Visualization; Writing-review & editing.

## CONFLICT OF INTEREST

The authors declare no conflicts of interest

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