Research on pricing of gourd handicrafts based on game theory

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Keywords: game theory, gourd handicrafts, pricing

Abstract: Research on pricing model of calabash handicrafts based on game theory.This part combines the game theory analysis method with the consumer utility theory effectively, and USES the data collected from the questionnaire survey to preliminarily give the pricing formula of different types of gourd handicrafts.

1. Introduction

This paper is mainly based on game theory and the model of consumer utility, among them, the game theory mainly studies the formulation of the interaction between the incentive structure, is the study of struggle or mathematical theories and methods of the competitive nature of the phenomenon, while the consumer utility model is put the selling price of a commodity, travel costs, consumer preferences into the model, such as building a quantifiable utility expression, make consumers to maximize its own utility as a target for consumer choice. On the basis of the effective combination of the two, the pricing formula of consumers is given.

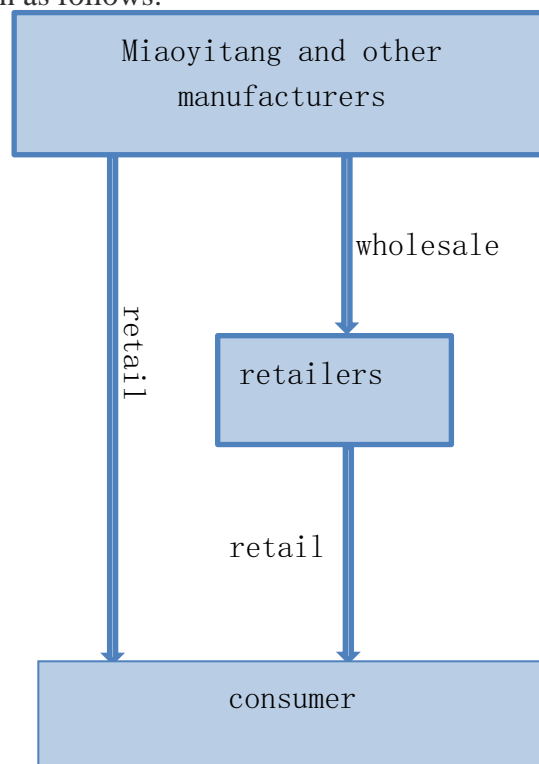The game process is shown as follows:

Figure 1. Product sales channel circulation chart

2. Model assumptions

(1).Assume that the manufacturer's retail channel and the wholesaler's retail channel are completely independent;(2).Assume that the goods sold by the manufacturer and wholesaler are undifferentiated;(3) Assume that the manufacturer and its subordinate retailers are completely rational and take profit maximization as the business objective;(4) Assume that manufacturers and wholesalers will set prices according to the business objectives of maximizing the cost and profit of handicrafts;(5) Assume that the market information of traditional handicrafts is complete and there is no information asymmetry;(6) Assume fair competition between all retailers and producers;(7) Not taking into account the impact of external factors such as inflation, fluctuation of income level and rising prices of handicrafts;(8) Assume that consumers are risk-neutral and weigh the size of gains and losses to choose specific consumption channels;(9) According to the minimum wage standard, the labor cost is assumed to be 20 yuan per hour.

3. Symbol description

π_1: The total profit of the manufacturer; π_2: The total profit of the wholesaler; π_{11}: for the profit of gourd handicraft manufacturers under 30cm; π_{12}: for the profit of gourd handicraft manufacturers under 30cm-60cm; π_{13}: For the profit of gourd handicraft manufacturers above 60cm; π_{21}: The profit of gourd handicraft wholesaler below 30cm; π_{22}: The profit of gourd handicraft wholesalers under 30cm-60cm; π_{23}: Targeted at the profits of gourd handicraft wholesalers over 60cm; S: Consumer surplus; P_{11}: wholesale price for gourd handicraft manufacturers under 30cm; P_{12}: wholesale price for 30cm~60cm gourd handicraft manufacturers; P_{13}: wholesale price for gourd handicraft manufacturers over 60cm; P_{21}: retail price for gourd handicraft manufacturers under 30cm; P_{22}: for 30cm~60cm gourd handicraft manufacturers retail price; P_{23}: retail price for gourd handicraft manufacturers over 60cm; P_{31}: retail price for gourd handicraft wholesalers under 30cm; P_{32}: for 30cm~60cm gourd handicraft wholesaler retail price; P_{33}: retail price for gourd handicraft wholesalers over 60cm; ω_1 : proportion of sales of gourd handicrafts below 30cm; ω_2 : proportion of 30cm~60cm gourd handicrafts sales; ω_3: proportion of sales of gourd handicrafts above 60cm; Q_1: manufacturer's retail sales; Q_2: retail sales by wholesalers; C_1: production cost of unit product of gourd handicrafts manufactured by the manufacturer under 30cm; C_2: production cost of unit product of 30cm~60cm gourd handicraft manufactured by the manufacturer; C_3: production cost of the manufacturer's unit product of gourd handicraft over 60cm; T: market share of calabash handicraft in traditional handicraft; R: Consumer channel risk; q: The probability that consumers think the value of gourd handicrafts is higher than the price.

4. Model

In the process of price game between manufacturers and retailers, consumers first choose purchase channels. The market share of calabash crafts in traditional handicrafts is T, and the risk of consumer channels is R.Ignoring other factors and only considering the market share of calabash art, consumer channel risk and residual value, the consumer utility value purchased through wholesalers and retailers is as follows:

$F_2(S) = S - TR - P_{2i})$ (manufacturer's retail)， $F_3((S) = R - (1-T)R - P_{3i}$ (wholesaler retail)

Whe $F_2(S) > F_3(S)$, choose to buy from the manufacturer; When $F_2(S) < F_3(S)$, choose to buy from wholesalers, when $F_2(S) = F_3(S)$, there is no obvious difference between the two sales channels.

$$Q_1 = q[F_2(S) - P_{2i}] + (1-q)0 \; , \quad Q_2 = q[F_3(S) - P_{3i}] + (1-q)0 \; ; \quad \pi_{11} = (P_{21} - C_1)q[F_2(S) - P_{21}] \; ;$$

$$\pi_{12} = (P_{22} - C_2)q[F_2(S) - P_{22}] \; ; \quad \pi_{13} = (P_{23} - C_3)q[F_2(S) - P_{23}] \; , \quad \pi_1 = \omega_1\pi_{11} + \omega_2\pi_{12} + \omega_3\pi_{13} \; ;$$

$$\pi_{21} = (P_{31} - P_{11})q[F_3(S) - P_{31}] \; , \quad \pi_{22} = (P_{32} - P_{12})q[F_3(S) - P_{32}]$$

$$\pi_{23} = (P_{33} - P_{13})q[F_3(S) - P_{33}] \; , \quad \pi_2 = \omega_1\pi_{21} + \omega_2\pi_{22} + \omega_3\pi_{23}$$

According to the inquiry of the merchants, the material cost of making gourd handicrafts below 30cm is 1.5 yuan, and the manufacturing time is about 10 minutes. The total cost is about RMB $23/6$ yuan.The material cost for manufacturing the gourd handicraft of 30cm~60cm is 5 yuan, and the manufacturing time is about 4 hours. The total cost calculated is about 85 yuan.The material cost for manufacturing gourd handicrafts over 60cm is 20 yuan, and the manufacturing time is about 7 hours. The total cost calculated is about 160 yuan. The manufacturer's wholesale price, or wholesaler's cost, is 6 yuan each.90 yuan, 200 yuan. The daily sales volume of gourd handicrafts below 30cm is 50;The daily sales volume of gourd handicrafts of 30cm~60cm is 10, and the daily sales volume of gourd handicrafts of over 60cm is 5, so the weights of three gourd handicrafts of different sizes are calculated as $\frac{10}{13}, \frac{2}{13}, \frac{1}{13}$.

Substitute the above known conditions into the equations and get the pricing of three kinds of gourd handicrafts according to profit maximization as follows:

$$P_{21} = \frac{29}{12} + \frac{F_2(S)}{6} \; ; \quad P_{21} = \frac{85}{2} + \frac{F_2(S)}{2} \; ; \quad P_{23} = 80 + \frac{F_2(S)}{2}$$

$$P_{31} = 3 + \frac{F_3(S)}{2} \; ; \quad P_{32} = 45 + \frac{F_3(S)}{2} \; ; \quad P_{33} = 100 + \frac{F_3(S)}{2}$$

As can be seen from the above formula, to get the specific pricing formula and $F_i(S)$ are related. Moreover, it is mainly affected by three factors: consumer surplus, market share of gourd handicrafts and consumer channel risk.

Among them, the estimated market share of consumer surplus and gourd handicrafts can be obtained through the data of our questionnaire survey. For example in the questionnaire, we according to different size of bottle gourd crafts investigating consumers can accept the highest price, according to the proportion to be weighted, 30 cm respectively calculated and below the gourd crafts can accept the highest price of 117.76 yuan, 30 ~ 60 cm gourd handicrafts can accept the highest price of 171.24 yuan, more than 60 cm gourd crafts can accept the highest price of 213.35 yuan, consumers corresponding value is the actual price paid 6 yuan, 50 yuan, 200 yuan,And consumer surplus = the highest price consumers are willing to pay - the actual price consumers pay, so we can add and calculate the consumer surplus is 111.76 yuan, 121.24 yuan and 13.35 yuan respectively. According to the market share of gourd handicrafts consumers, we can calculate that the market share of gourd handicrafts is about 6.83% according to the "types of traditional folk handicrafts you know" in the questionnaire.

Consumer utility value is the important factors that affect consumers to choose channel, its main is determined by consumer channels risk and surplus value, different individuals have different criteria, human capital and the cost of raw materials cost is a major production cost, on this basis, the operators from the perspective of profit maximization, for different channels, different specifications of the gourd crafts pricing for:

$$P_{21} = \frac{29}{12} + \frac{F_2(S)}{6} \; ; \; P_{22} = \frac{85}{2} + \frac{F_3(S)}{2} \; ; \; P_{23} = 80 + \frac{F_3(S)}{2}$$

$$P_{31} = 3 + \frac{F_3(S)}{2} \; ; \; P_{32} = 45 + \frac{F_3(S)}{2} \; ; \; P_{33} = 100 + \frac{F_3(S)}{2}$$

According to the data provided by the questionnaire, the final calculation shows that the highest price acceptable for gourd handicrafts of 30cm and below is 117.76 yuan, the highest price acceptable for gourd handicrafts of 30-60cm is 171.24 yuan, and the highest price acceptable for gourd handicrafts of 60cm and above is 213.35 yuan.The corresponding value of the actual price paid by consumers is 6 yuan, 50 yuan and 200 yuan, and consumer surplus = the highest price that consumers are willing to pay -- the actual price paid by consumers. Therefore, we can add and calculate that the consumer surplus is 111.76 yuan, 121.24 yuan and 13.35 yuan respectively. According to the market share of gourd handicrafts consumers, we can calculate that the market share of gourd handicrafts is about 6.83% according to the "types of traditional folk handicrafts you know" in the questionnaire.

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