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Pricing Game of Retailers Based on Certain Consumer Buying Model and Preference

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Abstract: Online shopping became more and more prevalent. The pricing decision under traditional and online shopping patterns based on different consumer demand type is worthy to be discussed. A pricing game in a supply chain was discussed in this study. A traditional retailer and an internet retailer were considered. Competiveness exists between them. Consumers have certain buying mode and preference. Three types of consumers were concluded in the model. A Stackelberg game model was considered. The manufacturer is the leader, while the retailer is the follower. The manufacturer decides the optimal wholesale price and the two retailers decide the optimal retail price. The equilibrium solution was obtained. At last the effect of the parameters on the solution was discussed. It was concluded that the negative impact factor ratio of retail price on sales between the traditional retailer and the online retailer and the customers' loyalty are decisive to the optimal decision-making.

Key words: Stackelberg game, game model, multi-channel, manufacture leading, consumer loyalty

INTRODUCTION

The convenience and popularity of the network has gradually formed two consumer shopping patterns which are online shopping and traditional shopping. Based on a purchase decision involving shop-choosing and multi-retail-channel, IBM announced a survey on shopping behaviors, preferences and expectations of nearly a thousand consumers in America and Britain. The survey showed that in 2007 the cross-channel shopping reached 510 billion dollars which accounted for 20% of total retail sales. In China, the proportion of multi-channel shoppers also showed a rapid growth which has intensified the competition between network retailers and traditional retailers.

The multi-channel supply chain price decision has been a hot issue of academic research in recent years (Chiang *et al*., 2003; Liu and Zhang, 2006; Xu and Dan, 2012; Li and Zhang, 2012; Chen and Cao, 2012; Cai, 2010; Guo and Zhao, 2008; Chen *et al*., 2009; Raju and Zhang, 2005). Applying the consumer utility theory (Guo and Zhao, 2008) established the function of demand in dual channel to use game theory to analyze the pricing strategy. They concluded that with dual-channel manufacturer can expand market demand and induce traditional retailer to reduce prices so that the profits of manufacturer and supply chain can both increase. A coordination mechanism also was designed to achieve the dual channels coordination. As to traditional retailing and online direct marketing under e-commerce environment, (Chen *et al*., 2009) formulated the model to compare the optimal promotion investment, the promotion compensation investment and pricing strategies of the supply chain under the centralized and decentralized decision-making modes, respectively. They also investigated the contract design to coordinate dual-channel under the conditions of promotion-price sensitive demand and promotion compensation incentives.

The pricing decision was explored in all the above mention literatures assuming that suppliers adopted both electronic channel and traditional channel without considering consumers' shopping patterns and preferences. In practice, however, some companies don't have the online direct marketing networks like DELL or HP, so consumers' shopping patterns tend to be buying goods from local retailers or from online retailers such as Joyo and Taobao. By now there is no research on competitive pricing decision of traditional retailers and online retailers while considering consumer' shopping patterns and preferences. In this article the situation with two competitive retailers which are traditional retailer like Parkson and online retailer like Joyo is investigated. Based on the shopping patterns and preferences, the consumers were divided into three groups. Group 1 are the ones with complete loyalty to traditional shopping patterns. Group 2 are the ones with complete loyalty to online channels. Group 3 are the ones who don't have any loyalty to either channel and buy goods by comparing the prices through both channels. A supply chain pricing decision based on Stackelberg game theory was explored.

MATERIALS AND METHODS

Model assumption: It's assumed that there are two competitive retailers which are traditional retailer and online retailer both selling a single product. Parameter D denotes the potential total demand of the market. Based on the shopping patterns and preferences, the consumers are divided into three groups. Group 1 are the ones with complete loyalty to traditional shopping patterns. Group 2 are the ones with complete loyalty to online channels. Group 3 are the ones who don't have any loyalty to either channel and buy goods by comparing the prices through both channels. Parameter α denotes both the proportion of the consumers with complete loyalty to traditional retailer and the extent of the loyalty. Parameter β denotes both the proportion of the consumers with complete loyalty to online retailers and the extent of the loyalty. Also, Parameter γ denotes proportion of the consumers without any loyalty to either channel who buy goods by comparing the prices of both channels and $\alpha+\beta+\gamma = 1$. It means that regardless of the price the number of the consumers to choose traditional retailers is $D\alpha$, the number of the consumers to choose online retailers is $D\beta$, the number of the consumers to choose either of both retailers is $D\gamma$. For convenience, hereby "1" indicates the traditional retailers, "2" indicates online retailers. Parameter P_0 is assumed to be the benchmark price. If P_0 is the manufacturer's suggested retail price, then d_1P_0, d_2P_0 are, respectively the retail price of traditional retailer and the one of online retailer. d_1, $d_2>0$, the extent of retailers' raising price on the basis of P_0 is indicated by d_1 and the extent of reducing price is indicated by d_2. Assuming that it is linear between the actual demand (Tsay and Agrawal, 2000; Raju *et al*., 1995) and that the price has a negative impact on the actual demand of the product, S_1, S_2, ($S_1 \neq S_2$), respectively indicate the factors of negative impact of price on traditional retailer and online retailer. If $d_1>d_2$, the actual demands of the above mention three types of consumers are $D\alpha-S_1d_1P_0$, $D\beta-S_2d_2P_0$, $D\gamma-S_2d_2P_0$, respectively. If $d_1<d_2$, the actual demands of the above mention three types of consumers are $D\alpha-S_1d_1P_0$, $D\beta-S_2d_2P_0$, $D\gamma-S_1d_1P_0$, respectively.

A two-stage Stackelberg game model involving a manufacturer as dominator and two retailers as followers was established. The manufacturer determines the optimal wholesale price, the two retailers determine the optimal retail price coefficient d_1, d_2.

Optimal decision of the retailers: The optimal d_1, d_2 were determined by the back stepping method. From the assumption, the retailers' profit expression when $d_1>d_2$ is different from the one when $d_1<d_2$. Therefore, the models are established separately in both two cases and the manufacturer's optimal wholesale prices are assumed to be w', w'', respectively in both two cases. As the followers in the game, retailers will make the optimal decisions according to the manufacturer's optimal wholesale price.

$d_1>d_2$: When $d_1>d_2$, traditional retailer, online retailer and manufacturers' profits are expressed, respectively as follows:

$$\pi_{R1}' = (d_1P_0-w')\,(Da-S_1d_1P_0) \tag{1}$$

$$\pi_{R2}' = (d_2P_0-w')\,(D\beta-S_2d_2P_0)+(d_2P_0-w')\,[D(1-\alpha-\beta)-S_2d_2P_0] \tag{2}$$

$$\pi_M' = w'\,[D-S_1d_1P_0-2S_2d_2P_0] \tag{3}$$

The second-order derivative Eq. 1 and 2 of d_1, d_2, respectively were solved:

$$\frac{\partial \pi_{R1}'}{\partial d_1} = -2S_1P_0^2 < 0,\ \frac{\partial \pi_{R2}'}{\partial d_2} = -4S_2P_0^2 < 0$$

Therefore, The first-order derivative Eq. 1 and 2 of d_1, d_2, respectively were solved:

$$\frac{\partial \pi_{R1}'}{\partial d_1} = P_0\,(D\alpha - S_1d_1P_0) + (d_1P_0 - w')(-S_1P_0)$$

$$\frac{\partial \pi_{R2}'}{\partial d_2} = P_0\,[D(1-\alpha) - 2S_2d_2P_0] + (d_1P_0 - w')(-2S_2P_0)$$

Let:

$$\frac{\partial \pi_{R1}'}{\partial d_1},\ \frac{\partial \pi_{R2}'}{\partial d_2} = 0$$

then:

$$d_1' = \frac{D\alpha + w'S_1}{2S_1P_0} \tag{4}$$

$$d_2' = \frac{D(1-\alpha) + 2w'S_2}{4S_2P_0} \tag{5}$$

Assuming that the manufacturer as the dominator has known the optimal responses of the retailers, it decides the optimal w' by back stepping on the basis of d_1', d_2' which are the optimal responses of the retailers, respectively. The first-order derivative Eq. 3 of w' was solved by substituting Eq. 4 and 5 into Eq. 3. Let the first-order derivative Eq. 3 of w' be 0, then:

$$w' = \frac{D}{2(S_1 + 2S_2)} \tag{6}$$

Assuming $d_1 > d_2$, $d_1 > d_2$ can only exist when $d_1' > d_2'$ and Eq. 6 was simplified into:

$$\alpha > \frac{S_1}{S_1 + 2S_2}$$

Substituting Eq. 6 into Eq. 4 and 5, then:

$$d_1' = \frac{D\alpha}{2S_1P_0} + \frac{D}{4(S_1 + 2S_2)P_0} \tag{7}$$

$$d_2' = \frac{D(1-\alpha)}{4S_2P_0} + \frac{D}{4(S_1 + 2S_2)P_0} \tag{8}$$

$d_1 < d_2$: The traditional retailer's profit expression can be turned into the online retailer's profit expression by replacing α with β, S_1 with $d_1' = d_2''$ S_2, respectively. Therefore, in Eq. 4 by replacing α with β, S_1 with S_2. Similarly, $d_2' = d_1''$ in Eq. 5 by replacing β with α, S_2 with S_1, respectively. Then the optimal solution when $d_1 < d_2$ can be given:

$$w'' = \frac{D}{2(S_2 + 2S_1)} \tag{9}$$

$$d_1'' = \frac{D(1-\beta)}{4S_1P_0} + \frac{D}{4(S_1 + 2S_2)P_0} \tag{10}$$

$$d_2'' = \frac{D\beta}{2S_2P_0} + \frac{D}{4(S_1 + 2S_2)P_0} \tag{11}$$

Theorem 1: The more negative impact on the sales of products the retail price has, the lower the manufacturer's optimal wholesale price and the retailers' retail price all will be. One of the two retailers will raise its retail price when the consumers have higher loyalty to it but the other retailer will lower its own retail price.

Theorem 1 can be proved as follows:

$$\frac{\partial w'}{\partial S_1} = \frac{-1}{2(S_1 + 2S_2)^2} < 0, \quad \frac{\partial w'}{\partial S_2} = \frac{-1}{(S_1 + 2S_2)^2} < 0$$

$$\frac{\partial d_1'}{\partial S_1} = \frac{-2}{4P_0S_1^2} + \frac{-1}{4P_0(S_1 + 2S_2)^2} < 0$$

$$\frac{\partial d_1'}{\partial S_2} = \frac{-1}{2P_0(S_1 + 2S_2)^2} < 0$$

$$\frac{\partial d_1'}{\partial \alpha} = \frac{D}{2S_1P_0} > 0, \quad \frac{\partial d_2'}{\partial \alpha} = \frac{-D}{4S_1P_0} < 0$$

Likewise:

$$\frac{\partial w''}{\partial S_1} < 0, \frac{\partial w''}{\partial S_2} < 0, \frac{\partial d_1''}{\partial S_1} < 0, \frac{\partial d_2''}{\partial S_2} < 0, \frac{\partial d_1''}{\partial \beta} < 0, \frac{\partial d_2''}{\partial \beta} > 0$$

can be given.

Optimal decision of the manufacturer: The optimal decision w* of the manufacturer is discussed as follows.

Theorem 2: If:

$$\frac{S_2}{S_1} > \max\left(\frac{1}{2}\left(\frac{1}{\alpha} - 1\right), \frac{2}{\left(\frac{1}{\beta} - 1\right)}\right), \quad w^* = w' = \frac{D}{2(S_1 + 2S_2)}$$

Theorem 2 also can be expressed as that as opposed to the traditional retailer if the online retailers' retail price has more negative effect which is greater than a certain value on sales, the manufacturer tends to choose $w^* = w'$.

Theorem 1 can be proved as follows. If $d_1 < d_2$,

$$\beta > \frac{S_2}{S_2 + 2S_1}$$

can be given. Then:

$$w' = \frac{D}{2(S_2 + 2S_1)}$$

If:

$$\beta < \frac{S_2}{S_2 + 2S_1}$$

it is contradicted with $d_1 < d_2$. Therefore, in this situation the optimal decision of the retailers doesn't exist.

$$\alpha > \frac{S_1}{S_1 + 2S_2}$$

can be obtained by $d_1 > d_2$. If:

$$\alpha > \frac{S_1}{S_1 + 2S_2}$$

and:

$$\beta < \frac{S_2}{S_2 + 2S_1}$$

which is also:

$$\frac{S_2}{S_1} > \max\left(\frac{1}{2}\left(\frac{1}{\alpha}-1\right), \frac{2}{\left(\frac{1}{\beta}-1\right)}\right)$$

the optimal decision of the retailers only exists only under the situation of $d_1>d_2$. When the manufacturer as dominator assumes that the retailers have made the optimal responses, the optimal wholesale price decision is:

$$w^* = w' = \frac{D}{2(S_1+2S_2)}$$

In this situation $d_1^* = d_1'$, $d_2^* = d_2'$.

Theorem 3: If:

$$\frac{S_2}{S_1} < \min\left(\frac{1}{2}\left(\frac{1}{\alpha}-1\right), \frac{2}{\left(\frac{1}{\beta}-1\right)}\right), \; w^* = w'' = \frac{D}{2(S_2+2S_1)}$$

Theorem 3 also can be expressed as that as opposed to the traditional retailer if the online retailers' retail price has less negative effect which is less than a certain value on sales, the manufacturer tends to choose $w^* = w''$.

Theorem 3 can be proved as follows. If $d_1>d_2$:

$$\alpha > \frac{S_1}{S_1+2S_2}$$

can be given. If:

$$\alpha < \frac{S_1}{S_1+2S_2}$$

it is contradicted with $d_1>d_2$. Therefore, in this situation the optimal decision of the retailers doesn't exist. If $d_1<d_2$ then:

$$\beta > \frac{S_2}{S_2+2S_1}$$

and:

$$w' = \frac{D}{2(S_2+2S_1)}$$

If:

$$\beta > \frac{S_2}{S_2+2S_1}$$

and:

$$\alpha < \frac{S_1}{S_1+2S_2}$$

which is:

$$\frac{S_2}{S_1} < \min\left(\frac{1}{2}\left(\frac{1}{\alpha}-1\right), \frac{2}{\left(\frac{1}{\beta}-1\right)}\right)$$

the optimal decision of the retailers only exists only under the situation of $d_1<d_2$. When the manufacturer as dominator assumes that the retailers have made the optimal responses, the optimal wholesale price decision is:

$$w^* = w'' = \frac{D}{2(S_2+2S_1)}$$

In this situation $d_1^* = d_1''$, $d_2^* = d_2''$.

Inference 1: When the negative impacts the online retailer's retail price and the traditional retailer's retail price, respectively have on their sales are large enough:

$$\frac{S_2}{S_1} > \max\left(\frac{1}{2}\left(\frac{1}{\alpha}-1\right), \frac{2}{\left(\frac{1}{\beta}-1\right)}\right)$$

or small enough:

$$\frac{S_2}{S_1} < \min\left(\frac{1}{2}\left(\frac{1}{\alpha}-1\right), \frac{2}{\left(\frac{1}{\beta}-1\right)}\right)$$

the retailer whose price has less impact on sales tends to raise its own retail price as opposed to the other one.

Inference 1 can be proved as follows. From theorem 2, If:

$$\frac{S_2}{S_1} > \max\left(\frac{1}{2}\left(\frac{1}{\alpha}-1\right), \frac{2}{\left(\frac{1}{\beta}-1\right)}\right)$$

then:

$$w^* = w' = \frac{D}{2(S_1+2S_2)}$$

The best responses of the retailers are, respectively d_1', d_2' in which $d_1'>d_2'$. Likewise, if:

$$\frac{S_2}{S_1} < \min\left(\frac{1}{2}\left(\frac{1}{\alpha}-1\right), \frac{2}{\left(\frac{1}{\beta}-1\right)}\right)$$

the best responses of the retailers are, respectively in which $d_1''>d_2''$.

Theorem 4: If:

$$\frac{1}{2}(\frac{1}{\alpha}-1)<\frac{S_2}{S_1}<\frac{2}{(\frac{1}{\beta}-1)}$$

and:

$$(\frac{1}{\alpha}-1)(\frac{1}{\beta}-1)<4$$

when $S_1>S_2$:

$$w^*=w'=\frac{D}{2(S_1+2S_2)}$$

when $S_1<S_2$ and:

$$w^*=w''=\frac{D}{2(S_2+2S_1)}$$

Theorem 4 can be proved as follows. If:

$$\alpha>\frac{S_1}{S_1+2S_2}$$

and:

$$\beta>\frac{S_2}{S_2+2S_1}$$

then $d_1>d_2$ and $d_1<d_2$ can be both obtained. In this situation:

$$\frac{1}{\alpha}<1+\frac{2S_2}{S_1}$$

and:

$$\frac{1}{\beta}<1+\frac{2S_1}{S_2}$$

can be integrated into:

$$\frac{1}{2}(\frac{1}{\alpha}-1)<\frac{S_2}{S_1}<\frac{2}{(\frac{1}{\beta}-1)}$$

which must meet:

$$\frac{1}{2}(\frac{1}{\alpha}-1)<\frac{2}{(\frac{1}{\beta}-1)}$$

then:

$$(\frac{1}{\alpha}-1)(\frac{1}{\beta}-1)<4$$

can be given.

The retailers decide the retail price coefficient based on the manufacturer's optimal wholesale price which is decided by the comparison of profits in the two cases as follows:

$$\pi_M'=\frac{D}{2(S_1+2S_2)}\left[D-\frac{D\alpha+\frac{DS_1}{2(S_1+2S_2)}}{2}-\frac{D(1-\alpha)+\frac{S_2D}{(S_1+2S_2)}}{2}\right]=\frac{D^2}{8(S_1+2S_2)}$$

$$\pi_M''=\frac{D}{2(S_2+2S_1)}\left[D-\frac{D\beta+\frac{DS_1}{2(S_2+2S_1)}}{2}-\frac{D(1-\beta)+\frac{S_2D}{(S_2+2S_1)}}{2}\right]=\frac{D^2}{8(S_2+2S_1)}$$

If $S_1>S_2$, $S_1+2S_2<S_2+2S_1$, then $\pi_M'>\pi_M''$

In this case the manufacturer will choose:

$$w^*=w'=\frac{D}{2(S_1+2S_2)}$$

Then the decisions of the retailers can be expressed, respectively by Eq. 7 and 8 which are substituted, respectively into Eq. 2 and 3.

$$\pi_{R1}'=\left[\frac{D\alpha}{2S_1}-\frac{D}{4(S_1+2S_2)}\right](\frac{D\alpha}{2}-\frac{S_1D}{4(S_1+2S_2)})$$

$$\pi_{R2}'=\left[\frac{D(1-\alpha)}{4S_2}-\frac{D}{4(S_1+2S_2)}\right]\left[\frac{D(1-\alpha)}{2}-\frac{S_2D}{2(S_1+2S_2)})\right]$$

Apparently, if $S_1<2S_2$, $\alpha>1-\alpha$, then $\pi_{R1}'>\pi_{R2}'$, if $S_1>2S_2$, $\alpha<1-\alpha$ then $\pi_{R1}'<\pi_{R2}'$.

When $S_1 = 2S_2$, $\alpha = 1-\alpha$, the two retailers have the same amount of profits. If $S_1>2S_2$, $\alpha = 1-\alpha$, then $\pi_{R1}'<\pi_{R2}'$ and if $S_1>2S_2$, $\alpha>1-\alpha$ then $\pi_{R1}'<\pi_{R2}'$. It indicates that when the loyalty value of the traditional retailer is $\frac{1}{2}$ and the ratio of negative impact factor of the traditional retailer's retail price on its own sales to the one of the online retailer's is more than 2, the traditional retailer's profit is lower than the online retailer's. When the loyalty value of the traditional retailer is more than $\frac{1}{2}$ and the ratio of negative impact factor of the traditional retailer's retail price on its own sales to the one of the online retailer's is 2, the traditional retailer's profit is higher than the online retailer's profit. In this condition, the traditional retailer has the relative potence on customer loyalty (2) If $S_1<S_2$, then $S_1+2S_2>S_2+2S_1$ and $\pi_M'<\pi_M''$ can be obtained. In this case the manufacturer's optimal wholesale price decision is:

$$w^* = w'' = \frac{D}{2(S_2 + 2S_1)}$$

Then the retailers' decisions are as follows:

$$\pi_{R1}'' = \left[\frac{D(1-\beta)}{4S_1} - \frac{D}{4(S_2+2S_1)}\right]\left[\frac{D(1-\beta)}{2} - \frac{S_1 D}{2(S_2+2S_1)})\right]$$

$$\pi_{R2}'' = \left[\frac{D\beta}{2S_2} - \frac{D}{4(S_2+2S_1)}\right](\frac{D\beta}{2} - \frac{S_2 D}{4(S_2+2S_1)})$$

$$S_2 < 2S_1, \beta > 1-\beta, \pi_{R2}'' > \pi_{R1}''$$

$$S_2 > 2S_1, \beta < 1-\beta, \pi_{R2}'' < \pi_{R1}''$$

Likewise, when $S_2 = 2S_1$, $\beta = 1-\beta$ the retailers have the same amount of profits.

Inference 2: If the impact ratio of price on sales is within a certain range which is:

$$\frac{1}{2}(\frac{1}{\alpha} - 1) < \frac{S_2}{S_1} < \frac{2}{(\frac{1}{\beta} - 1)}$$

the retailer whose price has more impact on sales tends to raise its own retail price as opposed to the other one.

Inference 2 can be proved as follows. From theorem 4, if:

$$\frac{1}{2}(\frac{1}{\alpha} - 1) < \frac{S_2}{S_1} < \frac{2}{(\frac{1}{\beta} - 1)}$$

and:

$$(\frac{1}{\alpha} - 1)(\frac{1}{\beta} - 1) < 4$$

when $S_1 > S_2$, the optimal decision of the manufacturer is:

$$w^* = w' = \frac{D}{2(S_1 + 2S_2)}$$

the best responses of the retailers are, respectively d_1', d_2' In which $d_1' > d_2'$. When $S_1 < S_2$, the optimal decision of the manufacturer is:

$$w^* = w'' = \frac{D}{2(S_2 + 2S_1)}$$

the best responses of the retailers are, respectively d_1'', d_2'' in which $d_1'' < d_2''$.

RESULTS AND DISCUSSION

Sensitivity analysis: Assuming that the traditional retailer is Parkson and the online retailer is Joyo, who both sell the high-end jewelry. The impacts of variations of parameter combinations (S_1, S_2), (α, β, γ) on decision variables, the manufacturer's profit and retailers' profits are analyzed in Table 1.

Abbreviations and symbols used in Table 1. (S_1, S_2): The factors of negative impact of price on traditional retailer and online retailer; (α, β, γ): α indicates the proportion of the consumers with complete loyalty to online retailers and the extent of the loyalty, β indicates the proportion of the consumers with complete loyalty to online retailers and the extend of the loyalty, γ indicates the proportion of the consumers without any loyalty to either channel who buy goods by comparing the prices of both channels. $\alpha+\beta+\gamma = 1$; (w^*, d^*_1, d^*_2) decision variables, w^* indicates the manufacturer's optimal wholesale price; (d^*_1, d^*_2) indicate the extent of retailer's optimal raising or reducing price on the basis of the benchmark price; π^*_M : The manufacturer's optimal profit; (π^*_{S1}, π^*_{S2}): The retailers' optimal profit.

In this study a supply chain price game in which the consumers are divided into three categories based on their shopping patterns and preference is investigated and also a Stackelberg game model with the manufacturer as the dominator is established. Stackelberg game is often used in dual channel coordination study and some scholars use it in the study, such as Xu and Dan (2012) and Cai (2010). However, the pricing decision that was made in all the former literatures assumes that suppliers adopted two channels-electronic and traditional, ignoring the consumers' shopping patterns and preferences. Some scholars discussed the supply chain model only under dual-channel situation, such as Guo and Zhao (2008) and Chen *et al.* (2009), the conclusion only can indicate the influence of dual-channel to pricing decision and profit. They didn't consider the difference of the consumers. Few scholars studied competitive pricing decision of traditional and online retailers under this complex back ground till now, which is common in the real world. This

Table 1: The impacts of variations of parameter combinations (S_1, S_2) and (α, β, γ) on price and profit

S_1	S_2	(α, β, γ)	(w^*, d_1^*, d_2^*)	π_M^*	(π_{S1}^*, π_{S2}^*)
0.40	0.30	(1/2,1/4,1/4)	(750.00, 0.66, 0.50)	281250	126560, 37500
		(1/3,1/3,1/3)	(681.82, 0.50, 0.60)	255680	64566, 72744
		(1/6,1/2,1/3)	(681.82, 0.42, 0.81)	255680	13075, 247930
	0.50	(1/2,1/4,1/4)	(535.71, 0.60, 0.32)	200890	179370, 11480
		(1/3,1/3,1/3)	(576.92, 0.45, 0.39)	216350	90607, 22374
		(1/6,1/2,1/3)	(576.92, 0.37, 0.51)	216350	26003, 106510

study is much nearer to the practice than the former studies, adding the two important factors-shopping patterns and preferences into the model. In this study, the conclusion adds the influence of a few new parameters to pricing decision and profit, with dividing the consumers into several groups.

CONCLUSION

Conclusion is more persuasive than any former study. The impact of parameter variations on the equilibrium solution is discussed. It can be concluded that the negative impact factor ratio of retail price on sales between the traditional retailer and the online retailer and the customers' loyalty are decisive to the optimal decision-making, which shows a certain significance in the practical price decision-making of enterprises. And a three-stage decision-making involving suppliers and the impact of advertisement on demand can be further explored.

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