

Price Competition between a Dual-Channel Retailer and a Pure Online Retailer

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Abstract

Price competition between dual-channel and pure online retailers frequently occurs in reality, but the result is too complex to foresee. Pricing strategy and management advices are given in this paper to help enterprises solve problems of price competition. Focused on the price competition between a dual-channel retailer and a pure online retailer, and the uniform pricing strategy was adopted by the dual-channel retailer to avoid channel conflicts. A linear demand model which contained the substitution effect was adopted to characterize the competition between different channels and a non-cooperative game model was built to obtain the pricing equilibrium. Several specific scenarios were set to compare the pricing strategies of retailers. From the findings it can be concluded that whether the dual-channel retailer has an advantage over the pure online retailer in competition depends on the relative size of online market to the traditional channel market and the dual-channel retailer's main sales channel should be gradually shifted from the offline to online, and the traditional channel will be a complementary channel of online channel to improve the user experience. When the dual-channel retailer has no obvious advantage on market size, the pure online retailer will benefit more from price competition.

Keywords: dual-channel retailer; pure online retailer; uniform pricing; price competition.

INTRODUCTION

Online shopping has become an important way for shopping. The traditional retailers are facing the loss of customers and profits. In order to cope with the impact of internet sales, some traditional retailers try to open online channels to expand sale channels, and we define this kind of retailers as "dual-channel retailer". For the dual-channel retailer, the opening of online channel will bring pricing conflicts between different channels. But the pure online retailer has no channel conflicts. Price war between dual-channel and pure online retailers frequently occurs in China. For instance, the price war between "Jingdong"(a famous e-tailer in China) and "Suning" (a famous dual-channel retailer in China) on August 14,2012. Uniform pricing strategy was adopted by "Suning" to achieve advantage in competition. The price war has ended, but the impact of uniform price policy on both sides is still unclear. While in practice, pricing is one of the most important decisions for retailers, therefore, research on price competition between the dual-channel and pure online retailers has practical significance.

Widespread attention has been paid to price competition and coordination of online retail in recent years. There were three types of research: (1) Conflicts and coordination of online direct retail and traditional retail. For example Chiang et al. (2003) studied the impact of consumer acceptance on price

competition. Yao and Liu(2005) studied the traditional retailer added value for the product. Lin et al. (2005) studied the price strategy which based on the assumption that consumers' reservation price exponentially declined with time. Yan et al. (2007) studied the price competition and coordination of channels under the condition of price-service sensitive demands. (2) Price Competition of independent online and traditional retailer. Brynjolfsson et al. (2000) found that the prices are 9–16% lower on the Internet than in conventional outlets. Cai et al. (2001) modeled the price competition of retailers with game theory and information economics. Chen et al. (2006,2008) studied the impact of e-commerce implementation level on retailers. (3) Price competition of dual-channel and pure online retailers. Friberg et al. (2000, 2001) did some empirical studies using the data of books and music CDs which indicated the pure online retailer's price is lower than the dual-channel retailer. Pan et al. (2002) built a Hotelling model and through simulation they pointed out the pure online retailer's price generally lower than the dual-channel retailer.

Although extensive and in-depth research has been done by previous studies, fully answers are still not be given upon the price competition between the dual-channel and pure online retailers. In the (1) research, same products were sold in two different

channels by a manufacturer, but the impact of other retailers on pricing was not considered. In the (2) research, the two retailers only sold products in a certain channel, and one party might be a dual-channel retailer was not considered. In the (3) research, main conclusions were drawn by empirical research lacking of theoretical analysis, and the impact of uniform pricing strategy on the pricing competition was not analyzed deeply.

For this reason, this paper studies the pricing competition between the dual-channel and online retailers under the uniform pricing strategy. Considering the uniform pricing strategy has been taken by more and more dual-channel retailers in practice, and this assumption was made in past research(e.g., Pan et al.(2002)), so this assumption is also followed in this paper.

MODEL

Price

Same merchandises are sold by dual-channel and pure online retailers. p_1 and p_{ol} is the dual-channel retailer's traditional and online channel price. p_2 is the pure online retailer's price. To avoid channel conflicts and preserve channel integrity, uniform pricing strategy is adopted by the dual-channel retailer, i.e., $p_1 = p_{ol}$. This is supported by anecdotal evidence of the retail markets that shows a lot of dual-channel retailers have the same prices at the two channels (e.g., Estee Lauder, Best Buy, Circuit City, CompUSA, and Suning etc.).

Demand

The demand of each channel is affected by its own price and rival channels price. d_t is the dual-channel retailer's demand on traditional channel, and it is affected by its own price p_1 , as well as affected by the rival channels price p_{ol} and p_2 :

$$d_t = a_1 - b_1 p_1 + n p_{ol} + n p_2 \quad (1)$$

(1) means that substitution effect exists between different channels, and when the price in a channel increases, consumers will shift to other channels, leading to price increasing of rival channels. Greater n stronger substitution effect means more intense competition of different stores.

Analogously, the online channel demand of dual-channel retailer d_{ol} , total demand of dual-channel retailer d_1 and demand of pure online retailer d_2 are given in the following equations.

$$d_{ol} = a_1 - b_1 p_{ol} + n p_1 + n p_2 \quad (2)$$

$$d_1 = d_t + d_{ol} \quad (3)$$

$$d_2 = (1-t)a_2 - b_2 p_2 + n p_{ol} + n p_1 \quad (4)$$

The meanings of related symbols are described as below:

a_1 : Maximal potential demand size of traditional channel

a_2 : Maximal potential demand size of online channel

t : Proportion of dual-channel retailer's online potential demand

b_1 : Price sensitivity coefficient of traditional channel

b_2 : Price sensitivity coefficient of online channel

n : Substitution effect coefficient of rival stores

In general, parity is easier in online environment, so consumers are more sensitive to price changes in this condition. In addition, channel demands are affected more greatly by its own channel than rival channels, so this paper assumes: $b_2 > b_1 > 2n$.

Revenue

According to both retailers' price and demands, the two retailers' revenue are as follows:

$$\pi_1 = (p_1 - c_1)d_t + (p_{ol} - c_2)d_{ol} \quad (5)$$

$$\pi_2 = (p_2 - c_3)d_2 \quad (6)$$

π_1 、 π_2 are the dual channel retailer and pure online retailer's total revenue. c_1 , c_2 , c_3 are the unit sale cost of traditional channels, online channel of dual-channel retailer and online channel of pure online retailer.

Model Solution and Analysis

It is assumed in this paper that all the retailers can perfectly foresee the final outcome, in accordance with the literature where it is called fulfilled expectation. Dual-channel and pure online retailers simultaneously make decisions to maximize their own revenue respectively. The decision-making process is non-cooperative static game and the equilibrium can be characterized by the Nash equilibrium. The result is given by proposition 1.

Proposition 1: If $p_{ol} = p_1$, dual-channel and pure online retailers' equilibrium prices are given as follows:

$$p_1^* = \frac{1}{L} \{ (n + b_2 t - n) a_2 + b_2 a_1 - b_2 [(c_1 + c_2 - c_3) n - b_1 c_1 - b_2 c_2] \} \quad (7)$$

$$p_2^* = \frac{1}{L} \{ (c_1 + c_2) n^2 + [(2c_3 - c_2) b_2 + (2 - 3t) a_2 - a_1 - b_1 c_1] n + (b_1 + b_2) [(t - 1) a_2 - b_2 c_3] \} \quad (8)$$

$$\text{Where, } L = 2b_2^2 - 4b_2 n + 2b_1 b_2 - 2n^2$$

Proof: The best-response functions can be obtained from the first order conditions: $\frac{\partial \pi_1}{\partial p_1} = 0, \frac{\partial \pi_2}{\partial p_2} = 0$:

$$p_1(p_2) = \frac{a_1 + ta_2 + b_1c_1 + b_2c_2 + (2p_2 - c_1 - c_2)n}{2b_1 + 2b_2 - 4n} \quad (9)$$

$$p_2(p_1) = \frac{c_3}{2} + \frac{(1-t)a_2 + 2np_1}{2b_2} \quad (10)$$

Concavity of the revenue function is not difficult to be verified, so the first order conditions are necessary and sufficient.

p_1^*, p_2^* can be obtained from consisting of equations (9) and (10).

$$\text{Corollary 1: } \frac{\partial p_1^*}{\partial c_i} > 0, \frac{\partial p_2^*}{\partial c_i} > 0 \quad (i = 1, 2, 3)$$

Proof: $\frac{\partial p_1^*}{\partial c_1} = \frac{b_2(b_1 - n)}{L} > 0$

$$\frac{\partial p_1^*}{\partial c_2} = \frac{b_2(b_2 - n)}{L} > 0, \frac{\partial p_1^*}{\partial c_3} = \frac{b_2n}{L} > 0 \quad (11)$$

$$\frac{\partial p_2^*}{\partial c_1} = \frac{n(b_1 - n)}{L} > 0, \frac{\partial p_2^*}{\partial c_2} = \frac{n(b_2 - n)}{L} > 0$$

$$\frac{\partial p_2^*}{\partial c_3} = \frac{n^2}{L} + \frac{1}{2} > 0 \quad (12)$$

The effect of cost on pricing is showed in Corollary 1. It is easy to find the pricing of retailer is affected by its own costs as well as the rival costs: both retailers' prices will be risen no matter either retailer's costs increase. The high cost of traditional channel is the dual-channel retailer's weakness in competition, and it is very easy to be attacked in a price war. For dual-channel retailer, the strength of traditional channel should be fully used to reduce the overall cost. For instance, logistics and distribution strengths of traditional channel are shared with online channel to cope with the price war.

Pricing Strategy Analysis

In order to analyze and compare the retailer's pricing strategy, it is necessary to simplify the model. Assumes that the two retailers have the same cost, specially, $c_1 = c_2 = c_3 = 0$. When the pricing strategies are compared, the effect of cost is excluded under this assumption. In other words, the impact of cost structure on the pricing strategy is not considered in section 4. In order to avoid excessive border situation discussion, a_1, a_2 are large enough.

Under the above assumptions, the reaction functions (9) and (10) become:

$$p_1 = \beta_1 + \beta_2 p_2 \quad (13)$$

$$p_2 = \frac{(1-t)a_2 + 2np_1}{2b_2} \quad (14)$$

Where:

$$\beta_1 = \frac{a_1 + a_2 t}{2b_1 + 2b_2 - 4n}, \beta_2 = \frac{n}{b_1 + b_2 - 2n}$$

The two retailers' equilibrium price equations (7) and (8) becomes:

$$p_1 = \frac{(b_2 - n)ta_2 + na_2 + b_2a_1}{L}$$

$$=$$

$$p_2 = \frac{na_1 + (b_1 + b_2 - 2n)a_2 + (3n - b_1 - b_2)ta_2}{L}$$

The form of equilibrium is still complicated in this situation. The equilibrium is affected by the price sensitivity. Meanwhile, the potential size of the market is also an important factor. Considering the strength of retailer's market position is reflected by its potential market size, two special scenarios are set to analyze the impact of market position on the competition.

Situation 1: the two retailers have the same potential online market size. In this situation, the pure online retailer already has a certain market position, but the total potential market size is still too small compared with the dual-channel retailer.

Situation 2: the two retailers have the same total potential market size. In this situation, the pure online retailer has a strong enough position in the online market, and the dual-channel retailer is not in a dominant position in either channel.

Situation 1 may be more in line with current market conditions. For example, some e-tailers already have a certain market size, but their market sizes are far from the traditional retailers, e.g. compared with the retail giants "Suning".

Situation 1: Same Potential Online Market Size

Considering the two retailers have the same potential online market size, then the main factors affecting pricing is the potential traditional market size. The main problem we are concerned about is how the market price and market structure are affected by the traditional market size. In the following, the superscript I is used to refer this case.

When $t = \frac{1}{2}$, the two retailers have the same potential online market size. In this situation, position 2 is obtained as follows:

Position 2: If $t = \frac{1}{2}$: when

$$\frac{a_1}{a_2} \in \left(0, k - \frac{1}{2}\right), p_1^I < p_2^I, \pi_1^I < \pi_2^I;$$

$$\text{when } \frac{a_1}{a_2} \in \left[k - \frac{1}{2}, L_1\right), p_1^I < p_2^I, \pi_1^I \geq \pi_2^I;$$

$$\text{when } \frac{a_1}{a_2} \in [L_1, L_2), p_1^I \geq p_2^I, \pi_1^I > \pi_2^I;$$

$$\text{when } \frac{a_1}{a_2} \in [L_2, \infty), d_1^I > 0, d_{o1}^I = 0.$$

$$\text{Where, } k = \sqrt{\frac{b_1 + b_2 - 2n}{4b_2}} \quad ($$

$$\frac{1}{2} < k < 1), L_1 = \frac{b_1 - 2n}{2(b_2 - n)},$$

$$L_2 = \frac{2b_1 + b_2 - 3n}{2(b_2 - n)}, \text{ and}$$

$$k - \frac{1}{2} < L_1 < L_2$$

Proof: If $t = \frac{1}{2}$, from (1) and (2), we know:

$$\text{when } \frac{a_1}{a_2} < L_2 = \frac{2b_1 + b_2 - 3n}{2(b_2 - n)}: d_1^I > 0,$$

$d_{o1}^I > 0$; At this time, traditional and online channel will be opened by the dual-channel retailer. Relevant decision variables can be obtained through

substituting $t = \frac{1}{2}$ into (13) and (14).

$$p_1^I = \frac{2b_2 a_1 + (b_2 + n)a_2}{2L},$$

$$p_2^I = \frac{2na_1 + (b_1 + b_2 - n)a_2}{2L} \quad (17)$$

$$\pi_1^I = \frac{(b_1 + b_2 - 2n)[2b_2 a_1 + (b_2 + n)a_2]^2}{16(b_2^2 - 2b_2 n + b_1 b_2 - n^2)^2},$$

$$\pi_2^I = \frac{b_2[2na_1 + (b_1 + b_2 - n)a_2]^2}{16(b_2^2 - 2b_2 n + b_1 b_2 - n^2)^2} \quad (18)$$

$$\Delta p = p_1^I - p_2^I = \frac{2(b_2 - n)a_1 - (b_1 - 2n)a_2}{2L} \quad (19)$$

$$\Delta \pi = \pi_1^I - \pi_2^I = \frac{a_2^2}{8L^2} \left(4b_2 \frac{a_1^2}{a_2^2} + 4b_2 \frac{a_1}{a_2} - b_1 + 2n \right) \quad (20)$$

$$\text{When } \frac{a_1}{a_2} = \frac{b_1 - 2n}{2(b_2 - n)} = L_1, \Delta p = 0;$$

When $\frac{a_1}{a_2} = k - \frac{1}{2} \in (0, L_1)$, $\Delta \pi = 0$ (Zero

value theorem)

Easy to be proved $L_1 < L_2$, thus:

$$\text{When } \frac{a_1}{a_2} \in \left(0, k - \frac{1}{2}\right), \Delta p < 0, \Delta \pi < 0,$$

thus $p_1^I < p_2^I, \pi_1^I < \pi_2^I$;

When

$$\frac{a_1}{a_2} \in \left[k - \frac{1}{2}, L_1\right), \Delta p < 0, \Delta \pi \geq 0, \text{ thus}$$

$$p_1^I < p_2^I, \pi_1^I \geq \pi_2^I;$$

$$\text{When } \frac{a_1}{a_2} \in [L_1, L_2), \Delta p \geq 0, \Delta \pi > 0, \text{ thus}$$

$$p_1^I \geq p_2^I, \pi_1^I > \pi_2^I;$$

$$\text{When } \frac{a_1}{a_2} \in [L_2, \infty), \text{ it can be proved}$$

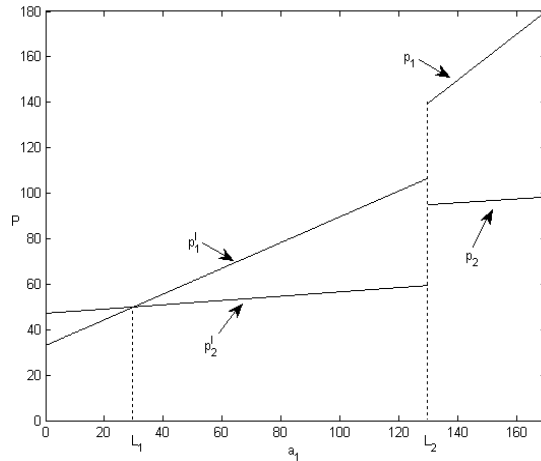
that $d_1^I > 0, d_{o1}^I = 0$ from (1) and (2).

From Theorem 2, with the increase of traditional market size with respect to the online market size, four competition stages appear. In the first stage, the dual-channel retailer's pricing space and revenue are limited by the small traditional market size, and the traditional channel should be reserved carefully. In the second stage, the dual-channel retailer's revenue exceeds the pure online retailer, and the traditional channel should be remained. The traditional market size of the dual-channel retailer should be further expanded through driving the traditional channel by the online channel to increase revenue. In the third stage, the price and revenue of pure online retailer are exceeded by the dual-channel retailer. In this situation, the strength of traditional channel should be used fully through driving online channel by the traditional channel to achieve the best price and income. With further increase of the traditional market size, the fourth stage appears. At this point, the online channel is given up by the dual-channel retailer, because its pricing space is limited by the small online market size and the low price persecution from the pure online retailer.

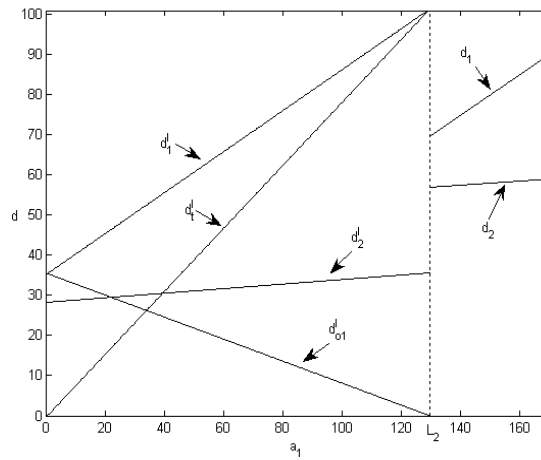
To make it easier to intuitively understand the position 2, a numerical example is given below.

Under the assumptions, $t = \frac{1}{2}, a_2 = 100$,

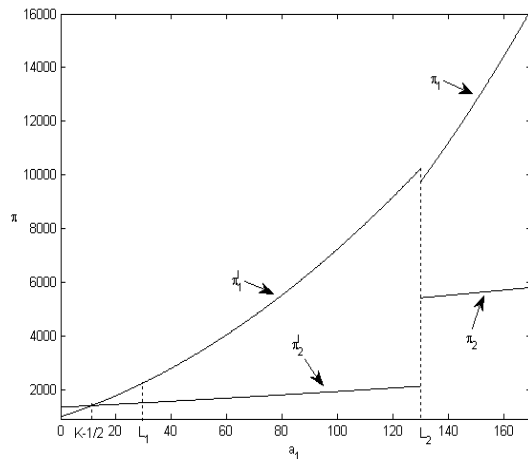
$b_1 = 0.5, b_2 = 0.6, n = 0.1$ are given. With the change of a_1 , the change of price, demand and revenue are showed in the Figure 1.



(a) Price change of two retailers



(b) Demand change of two retailers



(c) Revenue change of two retailers

Figure 1 Price, demand and revenue change with a_1

The changes of price, demand and revenue with a_1 are described in Figure 1. The figure on the left of L_2 describes the situation that traditional channel and online channel are opened by the dual-channel retailer, and the figure on the right of L_2 describes

the situation that the online channel is given up by the dual-channel retailer. We can see from Figure 1:

(1) Figure (b) shows that the total sales of dual-channel retailer is always higher than the pure online retailer. It also supports the dual-channel retailer's demand is higher than the pure online retailer in real life. For instance, the sale of "Suning" is higher than "Jingdong" no matter whether "Suning" opens the dual-channel.

(2) Figure (b) also shows that when $a_1 < 50$ (the dual-channel retailer's online market size is 50), the online sale of dual-channel retailer has been exceeded by its traditional channel. It reflects that the traditional channel has the natural advantage of driving sales with respect to the online channel.

(3) After the online channel is given up by the dual-channel retailer (figure on the right of L_2), the pure online retailer benefits more: its price, demand and revenue all improve greatly than before. This also explains why "Jingdong" has no rest to force "Suning" to exit the online channel through price war.

Situation 2: Same Total Potential Market Size

In situation 1, the two retailers have the same potential online market size, and the total potential market size of the dual-channel retailer is larger than the pure online retailer. With the development and expansion of the pure online retailers, the two retailers may have same total potential market size. In the following, the superscript II is used to refer this case. In this situation, position 3 is obtained as follows:

Position 3: when $a_1 + ta_2 = (1-t)a_2$, then $p_1^{II} < p_2^{II}$, $\pi_1^{II} < \pi_2^{II}$.

Proof: When $a_1 + ta_2 = (1-t)a_2$, then $t = \frac{a_2 - a_1}{2a_2}$ can be obtained. Substitute t into (15) and (16), thus:

$$\begin{aligned} p_1^{II} &= \frac{(a_1 + a_2)(b_2 + n)}{2L}, \\ p_2^{II} &= \frac{(a_1 + a_2)(b_1 + b_2 + n)}{2L}. \end{aligned} \quad (21)$$

Other decision variables can be obtained according to p_1^{II} and p_2^{II} :

$$\pi_1^{II} = \frac{(a_1 + a_2)^2 (b_2 + n)^2 (b_1 + b_2 - 2n)}{(2L)^2} \quad (22)$$

$$\pi_2^{II} = \frac{b_2 (a_1 + a_2)^2 (b_1 + b_2 - n)^2}{(2L)^2} \quad (23)$$

$$\Delta p = p_1^{II} - p_2^{II} = -\frac{(b_1 - 2n)(a_1 + a_2)}{2L} < 0,$$

thus $p_1^{II} < p_2^{II}$

$$\Delta\pi = \pi_1'' - \pi_2'' = -\frac{(a_1 + a_2)^2(b_1 - 2n)}{8L} < 0, \quad \text{thus} \quad \pi_1'' < \pi_2''.$$

Position 3 shows that when the two retailers have the same total potential market size, the pure online retailer is not in dominant in the competition: its price and revenue both are lower than the dual-channel retailer. This explains why “Suning” dares to claim its price is lower 5% than “Jingdong” in face of the price war and “Suning” did so in practice. In fact, when the dual-channel retailer faces such a situation, something can be done to deal with it. From the expression of t and $\Delta\pi$, the online market size of the dual-channel retailer can be increased by reducing a_1 , as well as the gap of price and revenue can be narrowed simultaneously. can see by the, reducing the size of the market can increase the network's two-channel retailers and narrow the income gap between the price and pure online retailers. Therefore, in this situation, a_1 should be reduced and its online market size should be expanded. While reducing a_1 is not simply to reduce the traditional market size, its main sales channel should be gradually shifted from the offline to online, and the traditional channel will be a complementary channel of online channel to meet all kinds of demands of online market.

Next, what causes the dual-channel retailer is not in dominant will be explored. Let p_{11}, p_{12}, p_{13} denote the price of the dual-channel retailer when opening the dual-channel simultaneously, only opening the traditional channel and only opening the online channel, respectively. Position 4 is obtained as follow:

Position 4: When $a_1 + ta_2 = (1-t)a_2$, thus $p_{11} < p_{12}, p_{11} < p_{13}$

Proof: The two retailers' total potential market size both are A . The dual-channel retailer's online and traditional market size are $\varphi A, (1-\varphi)A$, respectively. For a given p_2 , the method of seeking reaction function in position 1 is used here to solve the reaction functions under different conditions.

When the traditional and online channels are opened simultaneously by the dual-channel retailer, the reaction function of p_1 with respect to p_2 is:

$$p_{11} = \frac{A + 2np_2}{2(b_1 + b_2 - 2n)}. \quad (24)$$

When only the traditional channel is opened by the dual-channel retailer, i.e. when $\varphi \rightarrow 0$, the reaction function of p_1 with respect to p_2 is:

$$p_{12} = \frac{(1-\varphi)A + np_2}{2(b_1 - n)}. \quad (25)$$

When only the online channel is opened by the dual-channel retailer, i.e. when $\varphi \rightarrow 1$, the reaction function of p_1 with respect to p_2 is:

$$p_{13} = \frac{\varphi A + np_2}{2(b_2 - n)}. \quad (26)$$

$$\lim_{\varphi \rightarrow 0} (p_{12} - p_{11}) = \frac{((1-t)(b_2 - n) - t(b_1 - n))A + np_2(b_2 - b_1)}{2(b_1 + b_2 - 2n)(b_1 - n)} > 0$$

Thus, $p_{11} < p_{12}$;

$$\lim_{\varphi \rightarrow 1} (p_{13} - p_{11}) = \frac{(b_1 - n)(A - \frac{n(b_2 - b_1)}{b_1 - n} p_2)}{2(b_1 + b_2 - 2n)(b_2 - n)} > \frac{(b_1 - n)(A - b_2 p_2)}{2(b_1 + b_2 - 2n)(b_2 - n)} > 0$$

Thus, $p_{11} < p_{13}$.

From position 4, it can be learned that the price of opening two channels is higher than only opening one channel for the dual-channel retailer. Thus, the price will be reduced if a single-channel retailer changes into a dual-channel retailer. More and more traditional retailers realize the prospect of the online market, and begin to expand the online channel. However, some traditional retailers do not fully understand the risks of opening the online channel, and blindly opening the online channel leads to fall into the dilemma plight. Here, the risk for the traditional retailers who want to expand the online channel is warned: be ready to withstand the impact of low-price risk.

From position 4, the preliminary reason of the dual-channel retailer's low price is found. Further analysis will be done to explore the more in-depth reason. Next, what causes the dual-channel retailer is not in dominant will be explored. Let $\varepsilon_1, \varepsilon_2, \varepsilon_3$ denote the price elasticity of the dual-channel retailer when opening the dual-channel simultaneously, only opening the traditional channel and only opening the online channel, respectively. Position 5 is obtained as follow:

Position 5: When $a_1 + ta_2 = (1-t)a_2$, thus $\varepsilon_1 > \varepsilon_2, \varepsilon_1 > \varepsilon_3$

Proof:

$$\varepsilon_1 = \frac{d_{d_1} / d_1}{d_{p_1} / p_1} = \frac{(b_1 + b_2 - 2n)p_1}{A + 2np_2 - (b_1 + b_2 - 2n)p_1}.$$

Similarly, ε_2 and ε_3 can be obtained.

$$\varepsilon_2 = \frac{(b_1 - n)p_1}{(1-\varphi)A + np_2 - (b_1 - n)p_1}. \quad (27)$$

$$\varepsilon_3 = \frac{(b_2 - n)p_1}{\varphi A + np_2 - (b_2 - n)p_1} \quad (28)$$

$$\varepsilon_1 - \varepsilon_2 > \frac{(b_1 - n)p_1}{(1 - \varphi)A + 2np_2 - (b_1 + b_2 - 2n)p_1} - \frac{(b_1 - n)p_1}{A + np_2 - (b_1 - n)p_1} > \frac{(b_1 - n)p_1}{A + np_2 - (b_1 - n)p_1} - \frac{(b_1 - n)p_1}{A + np_2 - (b_1 - n)p_1} = 0$$

Thus, $\varepsilon_1 > \varepsilon_2$;

$$\varepsilon_1 - \varepsilon_3 = \frac{(b_1 + b_2 - 2n)p_1}{A + 2np_2 - (b_1 + b_2 - 2n)p_1} - \frac{(b_2 - n)p_1}{\varphi A + np_2 - (b_2 - n)p_1} > 0$$

Thus, $\varepsilon_1 > \varepsilon_3$.

From position 5, it can be learned that the price elasticity of opening two channels is higher than only opening one channel for the dual-channel retailer. When only one channel is opened by the dual-channel retailer, reducing one unit price will lead to only one channel sales increase. While for the dual-channel retailer, reducing one unit price will lead to two channels sales increase. Therefore, the dual-channel retailer have higher price elasticity when opening two channels simultaneously which leads to a lower price than only opening one channel. If the dual-channel retailer wants the price elasticity to be reduced, he must make full use of his platform advantage. For example, more product differentiation and exclusive brands sales can be introduced, and the scope of customized products is expanded to meet the individual needs better. All of this will help to reduce the price elasticity.

CONCLUSIONS AND LIMITATIONS

Considering the dual-channel retailer in face of pricing conflicts, the pricing competitive between the dual-channel and pure online retailers under the uniform pricing strategy is studied in this paper. The research finds: both retailers' prices will be risen no matter either retailer's costs increase. The strength of traditional channel should be fully used by the dual-channel retailer to reduce the overall cost. Several specific scenarios were set to compare the price strategies of retailers. □ When the two retailers have the same potential online market size, then the potential traditional market size is the main factor affecting pricing. When the potential traditional market size is much smaller, the dual-channel retailer's pricing space and revenue is limited by it. With the increasing of the potential traditional market size, this restriction becomes smaller. When the traditional market size is roughly equal to the online market, the advantages of dual-channel retailer gradually reflects, and the pure online retailer's price and revenue are gradually exceeded by the dual-channel retailer. However, when the traditional market size is much larger than the online market, the dual-channel retailer's pricing space is limited by the online market size. At this time, it's better for the dual-channel retailer to give up the online market.

With the development and expansion of the pure online retailers, the two retailers may have same total potential market size. In this situation, the dual-channel retailer's price and revenue are lower than the pure online retailer. Further analysis finds that the dual-channel retailer's low price is caused by its high price elasticity. On the one hand, this explains why "Suning" dares to set its price lower than "Jingdong"; On the other hand, an idea is provided for the dual-channel retailer to change its retailing model, i.e. its main sales channel should be gradually shifted from the offline to online, and the traditional channel will be a complementary channel of online channel to meet all kinds of demands of online market.

This paper still has some limitations. For example, to simplify the analysis, same costs of all channels are assumed. Different costs of different channels could be studied to make the competition research more in line with the reality. In addition, the random demand is not considered in this paper, and this could be extended in the future study, etc.

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REFERENCES

- Bakos J Y. 1997. Reducing buyer search costs: implications for electronic marketplaces [J]. *Management science*, 43(12): 1676-1692.
- Brynjolfsson E, Smith M D. 2000. Frictionless commerce? A comparison of Internet and conventional retailers [J]. *Management Science*, 46(4): 563-585.
- Cai J, Zhang Z H. 2001. The pricing competition model between electronic retailer and traditional retailer[J]. *Journal of University of Shanghai for Science and Technology*, 23(1): 71-74.
- Chen P Y, Hitt L M. 2004. A model of price dispersion in Internet-enabled markets[J]. *Graduate School of Industrial Administration, Carnegie Mellon University*.
- Chen Y, Wang H C, Shen H Z. 2006. Study on the Price Competition between E-commerce Retailer and Conventional Retailer[J]. *Systems Engineering Theory and Practice*, 26(1): 35-41.
- Chen Y, Wang H C, Shen H Z. 2008. Study on the Pricing Strategy of Multi-channel Retailer in Internet Environment[J]. *Journal of Industrial Engineering and Engineering Management*, 22(1): 34-39.

Chiang W K, Chhajed D, Hess J D. 2003. Direct marketing, indirect profits: A strategic analysis of dual-channel supply-chain design[J]. *Management Science*, 49(1): 1-20.

Friberg R, Ganslandt M, Sandström M. 2000 E-commerce and Prices: Theory and Evidence[R]. SSE/EFI working paper series in Economics and Finance.

Friberg R, Ganslandt M, Sandström M. 2001. pricing Strategies in E-commerce: Bricks vs. Clicks[M]. IUI, the Research Institute of Industrial Economics.

Lal R, Sarvary M. 1999. When and how is the internet likely to decrease price competition?[J]. *Marketing Science*, 18(4): 485-503.

Lin Z B, Xu B G, Cai C. 2005. Hybrid Channels Model Analysis Based on Consumer Preference[J]. *Chinese Journal of Management Science*, 13(10): 431-434.

Pan X, Shankar V, Ratchford B T. 2002. Price competition between pure play versus bricks-and-clicks e-tailers: Analytical model and empirical analysis[J]. *Advances in Applied Microeconomics*, 11: 29-61.

Xiao T, Qi X. 2008. Price competition, cost and demand disruptions and coordination of a supply chain with one manufacturer and two competing retailers[J]. *Omega*, 36(5): 741-753.

Yan N N, Huang X Y, Liu B. 2007. Stackelberg Game Models of Supply Chain Dual-Channel Coordination in E-Markets[J]. *Chinese Journal of Management Science*, 15(3): 98-102.

Yao D Q, Liu J J. 2005. Competitive pricing of mixed retail and e-tail distribution channels[J]. *Omega*, 33(3): 235-247.