

Research on Game between Retailer's Own Brand and Manufacturer's Direct Distribution Channel

Xianfeng Wu, Hanmeng Tan

School of Economics and Management, Chongqing University of Posts and Telecommunications, PR. China.

18883282718@163.com

Abstract

In current market environment, there is a growing trend that retailers start building their own brands, and manufacturers are establishing direct distribution channels. Based on it, this paper studies the game between retailer and manufacturer in four different situations: whether the retailer chooses to establish its own brand or whether the manufacturer chooses to set up the direct distribution channel. Furthermore, it researches the relationship between the loyal consumers' proportion of manufacturer's brand / the quality level of manufacturer's direct channel/ perceived value of the retailer's own brand and the profit. The results find that the continuous increase in the loyal consumers' proportion of manufacturer's brand can even damage the manufacturer's profit which is different from common idea; high perceived value of retailer's own brand can not guarantee to raise the retailer's profit; the improving level of direct distribution channel of manufacturer does not always have a positive effect on total supply chain profit.

Keywords

Retailer's own brand; manufacturer's direct distribution channel; loyal consumers; game theory.

1. Introduction

With market competition becoming fiercer, retailers start building their own brands in order to enhance competitiveness and increase varieties. This behavior has existed for a long time abroad: Walmart has been developing its own brand as an important global strategy. Its sales of Great Value brand in 2017 accounted for a continuous increase of 30%. Manufacturers set up direct distribution channels to reduce the dependence on retailers and make direct contact with consumers. Dell has established this way where customers can get customized personal computers, lowering inventory costs heavily meanwhile getting better customer satisfaction.

One kind of literature is related to retailer's own brand: there is a well-accepted definition about it, "it is owned by the retailer, but the distribution channel is non-exclusive" (Koskinen 1999[1]). The reasons why retailers choose to establish own brands, Caprice's [2] opinion was for retailer to improve negotiating power to gain higher profit ratio with manufacture; Chen Ruiyi[3] further studied on it, finding out that not only the quality of the retailer's own brand products, but also the profit distribution ratio in the whole supply chain would change with the negotiating power of retailer. Retailer can also increase its profit and supply chain profit by founding own brand whether selling these products directly or not(Li Kai[4]). And compared with the unified wholesale pricing mechanism, retailer has a higher incentive to introduce its own brand under the flexible pricing mechanism(Yannan Jin[5]); this strategy aims at a more competitive advantage among retailers in the same industry horizontally, and intended to limit the charging ability of the manufacturer vertically(Li Hui[6]); To consider the current Internet

environment, online retailer has more significant advantages in building its own brands than traditional retailer (Yang Fanjing[7]).

Another is related to the manufacturer's direct distribution channels. In the aspect of manufacturer, when it has a cost disadvantage, direct distribution channels cannot increase its own profit if manufacturer does not rely on original equipment manufacturer (OEM) distribution of famous brands (Li Lin[8]). In the aspects of multiple parties, when manufacturer mixes direct and indirect distribution channels, both its own profit and the supply chain profit increase. However at this time it will reduce the profit of retailer (Park and Keh t[9]). To mitigate the conflict between retail channels and direct distribution channels, manufacturer can adjust the quality of products in direct distribution channels or ensure distribution productivity (Albert[10]), Andy and Narendra[11]). In addition, when the retailer's shareholding ratio is moderate, manufacturer can establish direct distribution channels to achieve a win-win situation between retailer and manufacturer. But after the ratio has increased to a level, a good choice is not to establish direct distribution channels and lower wholesale prices (Nie Jiajia[12]). Dumrongsiri[13] stood on the perspective of performance, concluding that opening up direct distribution channels has a positive impact of every unit in supply chain when the overall supply chain was coordinated. Zhao Lianxia[14] pointed out that when the compensation rate reaches a certain value, manufacturers are more inclined to establish direct distribution channels, which would improve the performance of the entire supply chain too.

Unfortunately, little research results have been reported at this aspect when the retailer and the manufacturer both take actions simultaneously instead of just analyzing one participant action. Moreover, it is difficult to obtain satisfied reports about how the ratio of manufacturers' loyal consumers influences the upshot, and rarely discuss the direct distribution channel of manufacturer and the consumers' perceived value of retailer's own brand on the impact of supply chain profits.

This paper will focus on retailer's and manufacturer's actions at the same time, and then establish a game model based on profit maximization in the four situations where retailer does not establish/establish its own brands and manufacturer does not establish/establish direct distribution channels. Furthermore consider the impact of manufacturer's direct channel costs, retailer's own brands perceived value, and the proportion of manufacturers' brand loyal customers.

2. Research Hypotheses and Model Establishment

In this study, SB refers to the retailer's own brand, MB refers to the manufacturer's brand. What retailer is facing is whether to establish SB, and manufacturer is faced with whether to establish direct distribution channel to sell MB products.

2.1. Research Hypotheses

2.1.1. Hypotheses about Retailer

When the retailer chooses an edge manufacturer to manufacture SB products, the retailer's own brand production cost is 0 because the edge manufacturers are in a completely competitive market environment. [15]

2.1.2. Hypotheses about Manufacture

The manufacturer's production cost for MB products is considered as 0, and the unit cost for manufacturer's direct distribution channel is c . Previous studies have demonstrated that this assumption can simplify the calculation results without affecting the nature of the main conclusions. [16] [17]

Table 1. Parameters and explanation of retailer’s hypotheses

Parameter	Explanation
ω	Wholesale price for buying unit MB product from leading manufacturer
p_s	Unit price of SB product
q_s	Quantity of SB products
π_s	Retailer’s profit

Table 2. Parameters and explanation of manufacturer’s hypotheses

Parameter	Explanation
p_m	Unit price of MB product ($p_m > p_s$)
q_m	Total quantity of MB products ($q_m = q_{m1} + q_{m2}$)
q_{m1}	Quantity of MB products purchased by the retailer
q_{m2}	Quantity of MB products in direct distribution channel
π_m	Manufacture’s profit
π	Supply chain’s profit ($\pi = \pi_s + \pi_m$)

2.1.3. Hypotheses about Consumers

- (1) Each consumer can only buy one product at most;
- (2) From Tirole’s analysis of longitudinal differential model, utility function is $U_i = \theta v_i - p_i$:

Table 3. Parameters and explanation of consumers’ hypotheses

Parameter	Explanation
U_i	The utility of i product for the consumer(i can be SB or MB product)
θ	Consumer willingness to pay for i product, subject to [0,1] distribution
v_i	The perceived value of the i product for consumer. $v_m = 1, 0 < v_s < 1$

(3) Consumers are divided into loyal to MB and disloyal to MB style, respectively the ratio is r , $1 - r$. The MB loyal consumers always choose MB product. The MB disloyal consumers choose the higher utility one from SB product and MB product whose utility is not less than 0.

Only MB exists: MB loyal consumers will definitely choose to buy MB products; MB disloyal consumers will purchase MB products when the utility of purchasing MB products is not less than 0. That is, $U_m = \theta v_m - p_m \geq 0$, the probability is $1 - F(\theta) = 1 - \frac{p_m}{v_m} = 1 - p_m$. So the MB product

demand function is $q_m = r + (1 - r)(1 - p_m)$.

MB and SB exist: MB loyal consumers make the same decision; MB disloyal consumers will only purchase MB when $U_m \geq U_s$, that is $\theta v_m - p_m \geq \theta v_s - p_s$, the probability is

$1 - F(\theta) = 1 - \frac{P_m - P_s}{v_m - v_s} = 1 - \frac{P_m - P_s}{1 - v_s}$. Otherwise consumers choose the SB products whose utility is not less than 0, ie $U_s = \theta v_s - p_s \geq 0$, the probability is $1 - F(\theta) = 1 - \frac{P_s}{v_s}$. Therefore, MB product and SB product demand functions are $q_m = r + (1 - r)(1 - \frac{P_m - P_s}{1 - v_s})$, $q_s = (1 - r)(\frac{P_m - P_s}{1 - v_s} - \frac{P_s}{v_s})$.

Table 4. Products demand functions

	Demand Function
Only MB	$q_m = r + (1 - r)(1 - p_m)$
SB and MB	$q_m = r + (1 - r)(1 - \frac{P_m - P_s}{1 - v_s})$ $q_s = (1 - r)(\frac{P_m - P_s}{1 - v_s} - \frac{P_s}{v_s})$

2.2. Model Establishment

2.2.1. Situation 1: No Establishing SB While No Establishing Direct Distribution Channel

In this case, there is only MB products, the demand function is $q_m^I = r + (1 - r)(1 - p_m^I)$.

The order of game playing: first step, the manufacturer decides the wholesale price ω^I ; secondly, the retailer decides the quantity of MB products purchased from manufacture q_m^I . Use the reverse order deduction method to solve.

Retailer’s profit $\pi_s^I = (p_m^I - \omega^I)q_m^I$, take derivation of q_m^I , and make the formula is equal to 0, figure out $q_m^I = \frac{1 - \omega^I + r\omega^I}{2}$.

Manufacturer’s profit $\pi_m^I = \omega^I q_m^I$, take derivation of ω^I , and make the formula is equal to 0, figure out $\omega^I = \frac{1}{2 - 2r}$, further $q_m^I = \frac{1}{4}$.

Saving $\frac{\partial^2 \pi_s^I}{\partial q_m^{I2}} < 0$, $\frac{\partial^2 \pi_m^I}{\partial \omega^{I2}} < 0$, therefore, the maximum exists, then get results

$$\pi_s^I = (p_m^I - \omega^I)q_m^I = \frac{1}{16 - 16r}; \pi_m^I = \omega^I q_m^I = \frac{1}{8 - 8r}; \pi^I = \pi_m^I + \pi_s^I = \frac{3}{16 - 16r}.$$

2.2.2. Situation 2: Establishing SB While No Establishing Direct Distribution Channel

There are two kinds of brands, so the demand functions are $q_m^{II} = r + (1 - r)(1 - \frac{P_m^{II} - P_s^{II}}{1 - v_s})$,

$$q_s^{II} = (1 - r)(\frac{P_m^{II} - P_s^{II}}{1 - v_s} - \frac{P_s^{II}}{v_s}), \text{ further } p_m^{II} = \frac{1 - q_m^{II} - q_s^{II} v_s}{1 - r}, \text{ } p_s^{II} = \frac{v_s(1 - q_m^{II} - q_s^{II})}{1 - r}, \text{ so}$$

$$\pi_s^{II} = (p_m^{II} - \omega^{II})q_m^{II} + p_s^{II} q_s^{II}, \pi_m^{II} = \omega^{II} q_m^{II}.$$

The game sequence: the manufacturer decides the wholesale price ω^{II} ; then the retailer decides q_m^{II} and the output of SB products q_s^{II} . Use the reverse order deduction method to solve (the specific process is similar, not described in detail).

Get results that are $\omega^{\text{II}} = \frac{v_s - 1}{2(r-1)}$, $q_m^{\text{II}} = \frac{1}{4}$, $q_s^{\text{II}} = \frac{1}{4}$. Saving $\frac{\partial^2 \pi_s^{\text{II}}}{\partial q_m^{\text{II}2}} < 0$, $\frac{\partial^2 \pi_s^{\text{II}}}{\partial q_s^{\text{II}2}} < 0$, $\frac{\partial^2 \pi_m^{\text{II}}}{\partial \omega^{\text{II}2}} < 0$, the maximum exists, $\pi_s^{\text{II}} = (p_m^{\text{II}} - \omega^{\text{II}})q_m^{\text{II}} + p_s^{\text{II}}q_s^{\text{II}} = \frac{3v_s + 1}{16(1-r)}$; $\pi_m^{\text{II}} = \omega^{\text{II}}q_m^{\text{II}} = \frac{v_s - 1}{8(r-1)}$; $\pi^{\text{II}} = \pi_m^{\text{II}} + \pi_s^{\text{II}} = \frac{3 + v_s}{16 - 16r}$.

2.2.3. Situation 3: No Establishing SB While Establishing Direct Distribution Channel

In this case, demand function is $q_m^{\text{III}} = r + (1-r)(1 - p_m^{\text{III}})$.

The game sequence: equally, the manufacturer chooses the wholesale price ω^{III} ; the retailer decides q_m^{III} ; finally, the manufacturer decides quality of MB products in direct distribution channel q_{m2}^{III} . Use the reverse order deduction method to solve (the specific process is similar, not described in detail).

The results are $\omega^{\text{III}} = \frac{3 - c(1-r)}{6(1-r)}$, $q_{m1}^{\text{III}} = \frac{2c(1-r)}{3}$, $q_{m2}^{\text{III}} = \frac{3 - 7c(1-r)}{6}$.

Saving $\frac{\partial^2 \pi_s^{\text{III}}}{\partial q_{m1}^{\text{III}2}} < 0$, $\frac{\partial^2 \pi_m^{\text{III}}}{\partial q_{m2}^{\text{III}2}} < 0$, $\frac{\partial^2 \pi_m^{\text{III}}}{\partial \omega^{\text{III}2}} < 0$, we can get $\pi_s^{\text{III}} = (p_m^{\text{III}} - \omega^{\text{III}})q_{m1}^{\text{III}} = \frac{2c^2(1-r)}{9}$; $\pi_m^{\text{III}} = \omega^{\text{III}}q_{m1}^{\text{III}} + (p_m^{\text{III}} - c)q_{m2}^{\text{III}} = \frac{3 - 6c(1-r) + 7c^2(1-r)^2}{12(1-r)}$; $\pi^{\text{III}} = \pi_m^{\text{III}} + \pi_s^{\text{III}} = \frac{9 - 18c(1-r) + 29c^2(1-r)^2}{36(1-r)}$.

2.2.4. Situation 4: Establishing SB While Establishing Direct Distribution Channel

Demand functions are $q_m^{\text{IV}} = r + (1-r)(1 - \frac{p_m^{\text{IV}} - p_s^{\text{IV}}}{1 - v_s})$, $q_s^{\text{IV}} = (1-r)(\frac{p_m^{\text{IV}} - p_s^{\text{IV}}}{1 - v_s} - \frac{p_s^{\text{IV}}}{v_s})$, leading to

$$p_m^{\text{IV}} = \frac{1 - q_m^{\text{IV}} - q_s^{\text{IV}}v_s}{1 - r}, p_s^{\text{IV}} = \frac{v_s(1 - q_m^{\text{IV}} - q_s^{\text{IV}})}{1 - r}. \pi_s^{\text{IV}} = (p_m^{\text{IV}} - \omega^{\text{IV}})q_{m1}^{\text{IV}} + p_s^{\text{IV}}q_s^{\text{IV}},$$

$$\pi_m^{\text{IV}} = \omega^{\text{IV}}q_{m1}^{\text{IV}} + (p_m^{\text{IV}} - c)q_{m2}^{\text{IV}}.$$

The order of game: the manufacturer resolves ω^{IV} ; second step, the retailer decides q_{m1}^{IV} and q_s^{IV} ; last, the manufacture figure out q_{m2}^{IV} , Use the reverse order deduction method to solve (the specific process is similar, not described in detail).

Get $\omega^{\text{IV}} = \frac{[3 - c(1-r)](1 - v_s)}{2(1-r)(3 - v_s)}$, $q_{m1}^{\text{IV}} = \frac{v_s - c(1-r)(3v_s - 8)}{4(3 - v_s)}$, $q_{m2}^{\text{IV}} = \frac{3 - 2v_s + c(1-r)(2v_s - 5)}{2(3 - v_s)}$,

$$q_s^{\text{IV}} = \frac{3 - c + cr}{12 - 4v_s}.$$

Considering $\frac{\partial^2 \pi_s^{\text{IV}}}{\partial q_{m1}^{\text{IV}2}} < 0$, $\frac{\partial^2 \pi_s^{\text{IV}}}{\partial q_s^{\text{IV}2}} < 0$, $\frac{\partial^2 \pi_m^{\text{IV}}}{\partial q_{m2}^{\text{IV}2}} < 0$, $\frac{\partial^2 \pi_m^{\text{IV}}}{\partial \omega^{\text{IV}2}} < 0$, the maximum value exists which are

$$\pi_s^{\text{IV}} = (p_m^{\text{IV}} - \omega^{\text{IV}})q_{m1}^{\text{IV}} + p_s^{\text{IV}}q_s^{\text{IV}} = \frac{v_s(v_s - 9) - 2cv_s(r-1)(5v_s - 13) - c^2(1-r)^2(32 - 31v_s + 7v_s^2)}{16(r-1)(v_s - 3)^2};$$

$$\pi_m^{\text{IV}} = \omega^{\text{IV}}q_{m1}^{\text{IV}} + (p_m^{\text{IV}} - c)q_{m2}^{\text{IV}} = \frac{6c(r-1)(v_s - 2) + 5v_s + c^2(r-1)^2(5v_s - 14)}{8(1-r)(v_s - 3)};$$

$$\pi^{\text{IV}} = \pi_m^{\text{IV}} + \pi_s^{\text{IV}} = \frac{36 - 33v_s + 9v_s^2 + 2c(r-1)(36 - 43v_s + v_s^2) + c^2(r-1)^2(116 - 89v_s + 17v_s^2)}{16(1-r)(v_s - 3)^2}.$$

3. Equilibrium Analysis

Theorem 1: (a) $\omega^I > \omega^{II}$; (b) $\omega^I > \omega^{III}$; (c) $\omega^I > \omega^{IV}$; (d) The ranking of ω^{II} , ω^{III} , ω^{IV} depends on the situation: if $\frac{3v_s}{1-r} < c < \frac{3}{1-r}$, $\omega^{II} > \omega^{III} > \omega^{IV}$; $c > \frac{3}{1-r}$, $\omega^{II} > \omega^{IV} > \omega^{III}$; $\frac{v_s}{1-r} < c < \frac{3v_s}{1-r}$, $\omega^{III} > \omega^{II} > \omega^{IV}$; $c < \frac{v_s}{1-r}$, $\omega^{III} > \omega^{IV} > \omega^{II}$.

We can get a conclusion that the wholesale price is highest when manufacture and retailer both do not change the origin situation. Either creating direct distribution channel or store's brands will decrease it. Developing with improving the level of direct distribution channel, the cost for it keeps decreasing and the lowest wholesale price appears in from situation 3 to situation 2.

Theorem 2: (a) $\pi_m^{III} > \pi_m^I > \pi_m^{II}$; (b) $\pi_m^{III} > \pi_m^{IV}$, and $\frac{\partial(\pi_m^{III} - \pi_m^{IV})}{\partial r} > 0$ if $r > 1 - 3\sqrt{\frac{2+v_s}{v_s c^2}}$ ($c > 3\sqrt{3}$, $v_s > \frac{18}{c^2 - 9}$); (c) $\pi_m^{II} > \pi_m^{IV}$ is right especially when $c \geq \frac{1+\sqrt{6}}{3}$ and $r > \frac{6-14c-3v_s+5cv_s+\sqrt{78-37v_s+18v_s^2-5v_s^3}}{c(14-5v_s)}$ are met.

When considering the profit of manufacturer, under any circumstances, the retailer's establishment of its own brand will lead to a decline in the profit of the manufacturer, and the decline rate is related to the proportion of loyal consumers of the manufacturer brand. The manufacturer can establish direct distribution channel to increase their profits when a retailer does not establish its own brand.

Theorem 3: (a) $\pi_s^I < \pi_s^{II}$; (b) $\pi_s^{III} > \pi_s^{IV}$ is tenable when $r < 1 - \frac{3}{c}$; (c) $\pi_s^I < \pi_s^{III}$ sets up When $c > \frac{3\sqrt{2}}{8}$ and $r < 1 - \frac{3\sqrt{2}}{8c}$ are agreed; (d) when $r < \frac{13v_s - 5v_s^2 - \sqrt{288 + 105v_s - 652v_s^2 + 546v_s^3 - 180v_s^4 + 21v_s^5}}{-c(32 - 31v_s + 7v_s^2)} + 1$, $\pi_s^{II} < \pi_s^{IV}$ exists.

On the one hand, the retailer can get higher profit by creating own brand all the time when the manufacturer does not establish direct distribution channel. On the other hand, when the proportion of loyal consumers for manufacturers' brand or the level of direct distribution channel is respectively low, the retailer also improve profit regardless of its own brand.

Theorem 4: (a) $\pi^I < \pi^{II}$; (b) $\pi^{III} < \pi^{IV}$; (c) $\pi^I < \pi^{III}$ is reasonable when $c \leq \frac{3(6-\sqrt{7})}{58}$; (d) when $c > \frac{36-43v_s+11v_s^2-\sqrt{2(-1497v_s-64v_s^2+438v_s^3-156v_s^4+17v_s^5+1692)}}{(1-r)(116-89v_s+17v_s^2)}$, we get $\pi^{II} < \pi^{IV}$.

Certainly, retailer's establishment of its own brand has a positive effect on supply chain profits under any circumstances. And the higher the proportion of loyal manufacturer's brand consumers, the more positive the retailer's effect will be. In the condition where the unit cost of direct distribution channel is low, the retailer has not its own brand also can play a good role to supply chain's profit.

4. Conclusion

Considering the increasingly obvious commercial trend in the market, this article provides methods and opinions to study it about four different scenarios. The research in this article provides an efficient analysis to explain why a commercial activity happens and puts forward useful suggestions for retailers to establish own brands and manufacturers to set up direct distribution channels.

In conclusion, (1) the wholesale price is the highest when neither of them change original situation, any change will decline the wholesale price and the degree of declining has a positive correlation with perceived value of the retailer's own brand.

(2) Once the retailer chooses to have its own brand, it will lead to a positive effect on supply chain's profit, but negative effect on manufacturer's profit. Additionally, the higher the proportion of manufacturer's brand loyal consumers is, the more obvious of negative effect appears.

(3) Facing the fact that manufacturer has developed direct distribution channel, the retailer should relate the level of direct channel and the proportion of manufacturer's brand loyal consumers to make a decision. Only when both of them are low, establishing a store's brand can improve its profit. Otherwise, it is better not to construct own brand.

In later studies, we plan to keep thinking the degree of acceptance of products which are sold through different channels for consumers is different and the market unit price of the manufacturer's brand products through direct distribution channels and retailer channels may not be the same.

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