THE IMPACT OF RETAIL STORE OWNERSHIP ON MULTI-CHANNEL DISTRIBUTION SYSTEMS

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ABSTRACT

In order to meet different customer segments' needs, manufacturers use multiple distribution channels. In this paper, we will study two of the most popular multi-channel structures. Under Structure 1, the supply chain includes a manufacturer, its online store and its owned retail store, like GAP’s business model. Under Structure 2, the supply chain includes a manufacturer, its online store and an independent retail store, like Dell’s business model. We obtain optimal decision variables for each structure and compare these two structures. We develop a number of managerial guidelines and identify future research topics.

Keywords: multi-channel, equal-pricing, channel integration, retail store ownership, online sale
1. INTRODUCTION

Emerging technologies are rapidly changing the structure of distribution channels. Companies need to figure out the best market structure to serve the customers. In order to meet different customer segments’ needs, more and more manufacturers use a multi-channel distribution structure which includes a manufacturer direct online channel, a manufacturer owned retail store, and/or an independent retail store.

The retail stores can help manufacturers to build brand awareness, gather market information, and provide product consulting and return, and other services. So manufacturers tend to pursue a multi-channel strategy, including online channels and retail stores. This channel conflict (Frazier, 1999) is the biggest deterrent for the manufacturer to go ahead with the mixed channel business model. There are a number of ways to alleviate the channel conflict, like adding value-added activities on the base products to different channels (Mukhopadhyay et al 2008 and Cattani et al 2006). The same products should be charged at the same price regardless of channels.

We will use the equal-pricing policy to study two of the most popular multi-channel structures. Under Structure 1, the supply chain includes a manufacturer, its online store and its owned retail store. Under Structure 2, the supply chain includes a manufacturer, its online store and an independent retail store. In this research, we will find the optimum decision variables for each structure and compare these two business structures.

2. LITERATURE SURVEY

There are several research related to strategic multi-channel structure. Chiang et al (2003) states that the direct marketing could be used for strategic channel control purposes. They find that the manufacturer is more profitable even if no sales occur in the direct channel. Yao and Liu (2003) study diffusion of customers between two channels and find that, under certain conditions, both channels would enjoy stable demand.

One of the concerns of multi-channel distributions is the channel conflict. One way of eliminating the possibility of this channel conflict includes offering differential product at different channels, like Fay (1999), Cohen et al (1995), Mukhopadhyay et al (2008). Viswanathan (2000) studies the multi-channel issue from the product differentiation point of view and conclude that the more different the product is in the two channels, the more the benefit for the channels. The other way to mitigate channel conflict is by matching the retail price among different channels. This is the most popular business practice in the real world now as we mentioned before. Although the equal-pricing policy has been extensively used in our everyday life, relatively few academic quantitative researches have done in this field. Our research will focus on studying two different types of retailer ownership under the equal-pricing policy.
3. THE MODEL SCENARIO

In this research, we will consider two of the most popular supply chain structures. Under Structure 1, the supply chain includes a manufacturer, its online store and its owned retail store. The decision variables for the manufacturer are retail price and level of value added at its retail store. Under Structure 2, the supply chain includes a manufacturer, its online store and an independent retail store. The decision variables for the manufacturer are retail price and wholesale price and level of value added by the independent retail store.

Let $p$ denote the retail price charged to a potential customer and let $w$ denote the wholesale price. Let $v$ denote the value added services by the retailer when it sells the product to the customer. $v_{mr}$ is the level of value added service from the manufacturer owned retail store under Structure 1. $v_r$ is the level of value added service from the independent retail store under Structure 2. The cost to the retailer for adding a value $v$ is $k_i * v$ per unit. $k_{mr}$ and $k_r$ are cost efficiency parameters for the manufacturer owned retailer and independent retailer to provide the value added services.

We follow the lead of Cotterill & Putsis (2001), Mukhopadhyay et al (2008), and others using the similar linear demand function. There will be a migration of potential customers among different channels due to the level of value added services. Then the demand of the two channels under Structure 1 would be:

The manufacturer online channel: $d_{1m} = (a_1 - bp_1) - \theta_1 v_{mr} + \theta_1 v_{mr}$

The manufacturer owned retail store: $d_{1mr} = (a_2 - bp_1) + \beta_{mr} v_{2mr} + \theta_1 v_{mr} - \theta_2 v_{mr}$

Where $\theta_1$ and $\theta_2$ are the migration effectiveness. $\theta_1$ indicates the migration effectiveness from online channel to retail store, and $\theta_2$ indicates the migration effectiveness from retail store to online channel.

To maintain analytical tractability, we assume that $a_1 = a_2 = a$, $\beta_{mr}$ and $b$ to 1.

The manufacturer online channel: $d_{1m} = (a - p_1) - \theta_1 v_{mr} + \theta_2 v_{mr}$

The manufacturer owned retail store: $d_{1mr} = (a - p_1) + \beta_{mr} v_{2mr} + \theta_1 v_{mr} - \theta_2 v_{mr}$

We also assume that $\theta_1 = \theta_2 = \theta$. $a$ and $\theta$ are common knowledge. Therefore, the demand function is as follows.

The manufacturer online channel: $d_{1m} = a - p_1$ (1a)

The manufacturer owned retail store: $d_{1mr} = (a - p_1) + v_{mr}$ (1b)

Using the similar analysis, we can get the demand functions under Structure 2:

The manufacturer online channel: $d_{2m} = a - p_2$ (2a)

The independent retail store: $d_{2r} = (a - p_2) + v_r$ (2b)

The manufacturer and the independent retailer’s profit functions under two structures are:

Structure 1:

The manufacturer’s profit function: $\pi_{im} = p_1 d_{1m} + (p_1 - k_{mr} v_{mr}) d_{1mr}$ (3)
The manufacturer’s profit comes from two channels: online channel and its retail store.

Structure 2:
The manufacturer’s profit function: \( \pi_{2m} = p_2 d_{2m} + w_2 d_{2r} \)  
(4a)
The retailer’s profit function: \( \pi_{2r} = (p_2 - w_2 - k_r v_r) d_{2r} \)  
(4b)
Where \( d_{1m} \), \( d_{1mr} \), \( d_{2m} \), and \( d_{2r} \) are given by Equations (1a), (1b), (2a) and (2b). \( p_1 \) and \( p_2 \) are the retail prices under Structure 1 and Structure 2. To maintain analytical tractability, we further assume there are no marginal costs incurred by the manufacturer for selling through direct channel.

4. The Games

In this section, we will derive the optimal decision variables for each party under two different distribution structures.

4.1 Structure 1 or channel integration

Under Structure 1, the manufacture sells products through its online direct sell channel and its own retail store. These two channels are vertically integrated. The manufacturer will have the total profit from these two channels. The manufacturer will decide its retail price and the value added service at its retail store by maximizing its total profit, as in equation (3).

\[
\text{Max } \pi_{1m} = p_1 d_{1m} + (p_1 - k_{mr} v_{mr}) d_{1mr} = p_1 (a - p_1) + (p_1 - k_{mr} v_{mr}) [(a - p_1) + v_{mr}]
\]

The optimal retail price \( p \) and the level of value added service \( v_{mr} \) can be derived by taking the first order condition with respect to \( p_1 \) and \( v_{mr} \), and solve them simultaneously.

Proofs of all results are shown in the Appendix, unless stated otherwise.

Proposition 1: The optimal retail price and level of value added service under Structure 1 (or channel integration) are given by:

\[
p_1^* = \frac{a k_{mr} (-3 + k_{mr})}{-6 k_{mr} + 1 + k_{mr}^2}
\]

\[
v_{mr}^* = \frac{2 a (-1 + k_{mr})}{-6 k_{mr} + 1 + k_{mr}^2}
\]

Corollary 1.1: The optimal total profit for the manufacturer under Structure 1 is given by:

\[
\pi_{1m}^* = -\frac{2 a^2 k_{mr}}{-6 k_{mr} + 1 + k_{mr}^2}
\]

Corollary 1.2: The ratio of value added and retail price under Structure 1 is given by:
From the Proposition 1, we can see that the retail price is increasing with the base demand \( a \). It is interesting to note that from the Corollary 1.2., the ratio of value added and retail price does not depend on the base demand, only depend on cost efficiency factors and migration factors.

4.2 Structure 2

Under Structure 2, the manufacture sells products through its online direct sell channel and an independent retail store. The moves of the manufacturer and the independent retail store follow a Stackelberg game: the manufacturer is the leader, announcing the retail price \( p_2 \) and wholesale price \( w_2 \) first; the retailer is the follower, announcing the level of value added service \( v_r \) after that.

Before the first stage of the game where the manufacturer announces the values of its decision variables \( p_2 \) and \( w_2 \), the retailer’s best response function, as functions of the manufacturer’s variables, needs to be determined. This is done by maximizing the independent retail store’s profit function \( \pi_{2r} \) (as the equation 4b) with respect to its decision variables \( v_r \). Then the manufacturer derives the optimal retail price \( p_2 \) and \( w_2 \) by maximizing its own profit \( \pi_{2m} \), given in Equation (4a).

**Proposition 2**: The optimal retail price, wholesale price and the level of value added service under Structure 2 are given by:

\[
\begin{align*}
    p_2^* &= \frac{k_r a (k_r - 5)}{1 + k_r^2 - 10 k_r} \\
    w_2^* &= -\frac{2 k_r a (k_r + 1)}{1 + k_r^2 - 10 k_r} \\
    v_r^* &= \frac{2 (2 k_r - 1) a}{1 + k_r^2 - 10 k_r}
\end{align*}
\]

**Corollary 2.1**: The optimal profits for the manufacturer and the independent retailer under Structure 2 are given by:

\[
\begin{align*}
    \pi_{2m}^* &= -\frac{3 k_r a^2}{1 + k_r^2 - 10 k_r} \\
    \pi_{2r}^* &= \frac{k_r a^2 (k_r + 1)^2}{(1 + k_r^2 - 10 k_r)^2}
\end{align*}
\]
\[ \pi_{2m}^* + \pi_{2r}^* = -\frac{2k_r a^2 (1 + k_r^2 - 16 k_r)}{(1 + k_r^2 - 10 k_r)^2} \]

**Corollary 2.2:** The level of value added service is increasing with the retail price and decreasing with the wholesale price under Structure 2.

Corollary 2.2 can be easily seen from the independent retailer’s best response function, equation (5). We can conclude that the independent retailer tend to provide more value added service for the high price product or low wholesale price produce.

Next, we will study several special cases for these two types of supply chain structures. We will generate a number of insights into those cases and develop significant guidelines for decision making.

5. **COMPARING TWO STRUCTURES**

To maintain analytical tractability, we assume that the cost efficiency parameters are same for the manufacturer owned retail store and the independent retail store, like \( k_{m} = k_r = k \). We also assume \( a = 10 \). We will also briefly report the results of our numerical experimentation. We conduct the experiment for two main reasons. One is to verify some of the analytical findings. The other is to gain more insights into the optimal policies, and thereby get some useful managerial guidelines.

**Proposition 3**

Comparing Structure 1 to Structure 2, we see that

(i) The retail price is higher under Structure 1 than under Structure 2.

(ii) The manufacturer’s profit is higher under Structure 1 than under Structure 2.

(iii) The supply chain profit higher under Structure 1 than under Structure 2.

From the Proposition 3 (i), as showed in Figure 2.1, we see that the retail price is higher at Structure 1 than Structure 2 when \( 3 - 2\sqrt{2} < k < 1 \). With the entry of the independent retail store, the retail price will get lower. From the customer’s standing point, Structure 2 is preferred. From the Figure 1, we also see that the retail price under Structure 1 is decreasing with \( k \). The less efficient (higher value of \( k \)) to offer the value added service, the lower is the retail price. We also find that the retail price under Structure 1 is more sensitive to \( k \) than under Structure 2.

From the Proposition 3 (ii), we see that the manufacturer’s profit is higher under Structure 1 than under Structure 2. It is interesting to see that supply chain coordination is achieved under the Structure 1, from the Proposition 3(iii), as showed in Figure 2. Under Structure 1, manufacturer
gets the whole supply chain’s profit. Manufacturer sets the retail price by maximizing its total profit from two channels, direct online channel and its retail store. It makes the channel integrated. Under Structure 2, supply chain’s total profit includes the profit from manufacturer’s online sale and independent retailer’s store sale. Manufacturer and independent retailer need to play the Stackelberg game to set the retail price. Each party, the manufacturer and the independent retailer, only maximizes its own profit. The profit realized under supply chain coordination is always higher than the sum of the retailer’s and the manufacturer’s profits without such coordination.

FIGURE 1. VARIATION OF THE RETAIL PRICE UNDER STRUCTURE 1 AND STRUCTURE 2 FOR VARIOUS K.

FIGURE 2. VARIATION OF TOTAL SUPPLY CHAIN PROFITS UNDER STRUCTURE 1 AND STRUCTURE 2 FOR VARIOUS K.
6. CONCLUSIONS

In this paper, we study an important aspect of supply chain structures in the Internet era. Increasingly, manufacturers are offering direct online channels and bricks-and-mortar type of retail stores to maximum possible number of potential customers.

We studied two types of multi-channel distribution structure. Structure 1 includes a manufacturer online store and manufacturer owned retail store. Structure 2 includes a manufacture online store and an independent retail store. It is interesting to find that the retail price is higher if the store is owned by the manufacturer rather than the independent retailer. We also find that the level of value added service offered by the independent retailer is increasing with the retail price and decreasing with the wholesale price, but not related to the base demand. We confirm a general finding in the supply chain management, that the profit realized under supply chain coordination (Structure 1) is always higher than the sum of the retailer’s and the manufacturer’s profits without such coordination (Structure 2).

APPENDIX

Proof of Proposition 1
From equation (3), (1a) and (1b), we get
\[ \pi_{1m} = p_1d_{1m} + (p_1 - k_m v_{mr})d_{1mr} = p_1[(a - p_1)] + (p_1 - k_m v_{mr})[(a - p_1) + v_{mr}] \]
Then we take first order condition with respect to \( p_1 \) and \( v_{mr} \) and set them equal to zero, respectively. After that, solving these three equations simultaneously, we can get the desired result.

Proof of Proposition 2
Bring the best response function into (4a), and then we take first order condition with respect to \( p_2 \) and \( w \) and set them equal to zero, respectively. After that, solving these three equations simultaneously, we can get the desired result.

Proof of Proposition 3
It is easy to get the 3(i), (ii) and (iii) within the valid range of \( k, (3 - 2\sqrt{2} < k < 1) \), using Maple or other software. We skip the details.
REFERENCES


