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ABSTRACT

This paper presents a model for designing the pricing policies for the supply chain whose channel is integrated with retail and e-tail. In order to incentive the retailer, the manufacture in the supply chain adopts return policy promising that any unsold product can be returned to the manufacture for a partial refund in the end of the selling season. How can the manufacture coordinate the pricing policy between the retail and e-tail channel and what is the optimal pricing policy for the wholesale price and return policy which will make the supply chain's profit maximize are the central issue in the supply chain coordination. Pricing policies between retail and e-tail are researched under the Stackelberg price competition model firstly. Under the optimal competing pricing policies model, we further obtain the equilibrium pricing for the wholesale and return price that make the supply chain maximize through the expected profit analysis. Then further research dimensions are discussed in the end of the paper.

Keywords: pricing policy, supply chain, profit, electronic commerce

1. INTRODUCTION

In the past decade, rapid developments in information and telecommunication technology have substantially changed the landscape of organizational computing. Electronic commerce (E-commerce), including Web-based commerce, mobile commerce (M-commerce) and ubiquitous commerce (U-commerce), is based not only on developments pertaining to the Internet compound, but also on prior technological and organizational innovations arising from the combination of telecommunications and organizational computing[1]. As the most rapidly developing, e-commerce via the Internet (i.e., Web-based commerce) has substantially affected the business world since the commercialization of the internet and evolution of the dot.com in the early 1990' and it is commonly believe that the transactions volume via e-commerce will continue to grow in the coming years[2]. Different companies have different uses of the e-marketplace and different e-marketplaces take different roles. There is an increasingly number of company which takes e-marketplace as a distribution way which named as e-tail. By this way, many companies, such as dangdang.com in china, seems to make success possible. However, in most case, it turn out that the most workable solution is the way that is integrated with e-tail channel and traditional retail ones. By this hybrid channel, customer can have more than one way to purchase commodity by their attitude or convenience.

With the development of e-commerce, e-tail become as a crucial retail way in distribution channel more and more in practice and there is an increasingly number of research paper that is focus on the distribution channel which is integrated with e-tail and retail. For example, Dong-Qing and John J study the equilibrium pricing policy under the e-commerce [3]. Tsen-Ming Cha studied the return policy in supply which is integrated with e-marketplace [4]; Chen and Siems discusses the relationship between the B2B e-marketplace announcements and the shareholders response in the financial market [5]; Chiang studied the dual channel supply chain design for goods that do not provide a large service (value) such as books, CDs, etc. their results show the manufacturer can mitigate the profit loss by adding a direct channel [6]. Besides these researches, Iyer examined how manufacturers should coordinate distribution channels when two retailers compete under price and non-price attributes in supply chain earlier [7].

This paper focuses on providing an analytical pricing model for using both e-marketplace and retail as distribution channels in a supply chain instead of proposing a conceptual framework. We study a supply chain which is integrated by a return policy and the manufacture can distribute products by directly "on-line" (by e-Marketplace, referred to as e-tail) and traditional channel by which the manufacture wholesale the products to the retailer. Although, the mix of distribution with e-Marketplace has added a new dimension of competition to the firm's distribution channels, the manufacture faced with the problem how to design the pricing policy in the e-tail and regular retail channels in order to coordinate the distribution channels. Also the manufacture must decide the wholesales price and the returned price before the selling season in order to maximize mutual profit for manufacture and retailer. In fact, the analysis of return policy for channel coordination has been studied by Pasternack in the paper Optimal pricing and returns policies for perishable commodities which published in the marketing science literature in 1985 [8]. However, Pasternack's study didn't consider the impact of e-commerce on the commodities distribution because there is no e-commerce experience in that time. Cha study the optimal return policy under two undisturbed market [4]. Also, Hon-Shiang Lau studies the manufacture's pricing policy strategy and return policy for a single-period commodities in which the retail channel didn't integrate with e-marketplace [9]. However, with the emergency of e-commerce, more and more manufacture integrates e-marketplace as the aid way to distribute their products [10], such as gome in china. And the manufacture in supply chain is faced with the new problem how to coordinate the pricing policy among different distribution channels.

In this paper, we assume a two-echelon supply chain with a single manufacturer who supplies a single item to the retailer and the manufacture adopts both e-tail and regular retail channels to distribute products. Both the channels are designed for different customers respectively and the customer can acquire value-added service by regular retail channel which cannot receive from the e-tail channel; however, the price attached to e-tail would be lower. Under different types of retail channels and service level, what are the equilibrium pricing policies that manufacture should adopt for the e-tail and retail channels in order to coordinate the sales quantity and the profit in different channels? We will examine the pricing equilibriums between the e-tail channel and retail channel under the types of competitive pricing schemes: Stackelberg competition models. Under the Stackelberg model, the manufacture, as the leader of the market, announce the e-tail price before the selling season firstly. Also, the manufacture has considered the retailer's reaction prior to announce the e-tail price. As the follower in the market, the retailer reacts to the e-tail price by choosing retail price and the corresponding service level to maximize its own selling quantities and the profit.

As a result, we obtain the equilibrium prices between e-tail and retail channels. Because of promising in contracts, the retailer can return any unsold products to the manufacture for a partial re-fund products after the selling seasons which can incentive the retailer to order more quantities products and work harder for retailing, by this way, the manufacture shares the risk caused by demand uncertainly with the retailer by this way. Also, the retailer can acquire reasonable profit by different order quantity and the retail price. After we study the competing pricing policy between the e-tail and retail channels under the Stackelberg competing model before the selling season, the equilibrium pricing policy for wholesale price and return price is studied in the paper which can coordinate the profit and risk between the manufacture and retailer.

On the basis of the discussion, the paper is organized as follows: the quantity model that the supply chain is integrated with retail and e-tail channel is set up in section 2, and the Stackelberg competing pricing model is presented in successions; as a result, we obtain optimal pricing policy pertain to e-tail and retail channels under the discussion on the model. Furthermore, we derive the expected profits for all the parties in the supply chain under the wholesales price and returns policy in section2. After deducing, the optimal pricing policy for the wholesale price and returns policy is proposed in the same section. In the end, concluding remarks are presented.

2. MODEL

Based on the above discussion, we consider a supply chain inside which a single-product manufacturer-retailer system mixed with an e-tail distribution channel in addition to a regular retail channel where the manufacture sells the product to a retailer at a fixed market with a unit wholesale price of w_0 and the unit production cost at the manufacture is c. The retailer then sells the product to the customers in the lower echelon with price p_2. In the past, the manufacture can only distribute items by this way. However, with the development of e-commerce, the manufacture can select an e-tail channel to sell the products directly on-line at the same time in which the price is p_1. At the same time, the retailer competes against the on-line selling by adding value service via the traditional channel when distribute the product to lower echelon at a retail price p_2. The cost which is produced by value-added service defined as $c(v)$, such as speciously packing for books and CDs or properly maintain service for cars which are needed for some customers who are assumed to be heterogeneous and are able to purchase a product either from a retail channel or directly from an e-tail channel and some of the them would like to purchase directly from the manufacturer at a lower cost, while others are willing to pay more for the value added by the retailer that are unavailable in e-tail, on the contrary. Because of the value-added service, the retail price p_2 is typically expected to be higher than e-tail price p_1.

After the selling season the retailer can return any unsold products to the manufacture under the returns policy on the price w_1 which is promised in the contracts, so the manufacture shares the risk caused by demand uncertainly with the retailer by this way. As we discussed above, the retailer can acquire reasonable profit by different order quantity and the retail price p_2 either. In this paper, we assumed that the manufacture can sell any returned products by the e-marketplace faced with global and local markets and whose demand is assumed to be immensity. In the past, without the e-commerce, the manufacture would salvage the returned products at a price μ that more lower than p_1. However, any unsold products cost the retailer a unit holding cost h. In the past, there is an example of using both e-tail and traditional retail in china, such as eguo.com.

In this paper, we assume all information is common to both parties which mean that the retailer has complete information about manufacture (such as unit production cost, etc) and vice verse. With the above details, Fig 1 shows the structure of the supply chain with the use of the e-tail.

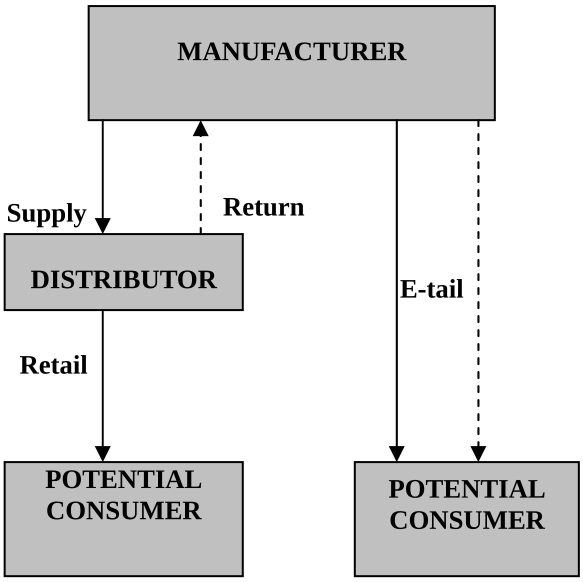

Fig.1. a supply chain mixed with e-tail and retail

Firstly, we have the following notation

π_1 Profit of the manufacture;

π_2 Profit of the retailer;

π Profit of the supply chain;

d_1 Demand via e-tail channel;

d_2 Demand via retail channel;

p_1 Unite price of the e-tail channel;

p_2 Unite price of the retail channel;

w_0 Unite wholesale price of the product;

w_1 Unite return price for the unsold product

v Cost of unit value-added service

q Quantity of product retail ordered from manufacture;

Under the Stackelberg model, the manufacture, as the market leader, firstly announced the unit e-tail price p_1 to maximize payoff π_1 on consideration the expect reaction price before the selling season; as the follower of the market, the retailer then reacts to the manufacture's price policy p_1 by adopting unit price p_2 and value-added service which unite cost is v to maximize its market share and own profit π_2.

So we can define the profit for manufacture, retailer and the supply chain as following:

$$\pi_1(p_1, p_2) = p_1 D_1(p_1, p_2, v) + wD_2(p_1, p_2, v) \qquad (1)$$

$$\pi_2(p_1, p_2) = (p_2 - c(v) - w) D_2(p_1, p_2, w) \qquad (2)$$

$$\pi(p_1, p_2) = \pi_1 + \pi_2 = p_1 D_1(p_1, p_2, v) + (p_2 - c(v)) D_2(p_1, p_2, v) \qquad (3)$$

We define the e-tail channel demands d_1 and retail demands d_2 as following which are similar to that in Tsay etal [11] and Choi [12]:

$$d_1 = D_1(p_1, p_2, v) = (a_1 - bp_1) + \lambda(p_2 - v - p_1) \qquad (4)$$

$$d_2 = D_2(p_1, p_2, v) = (a_2 - bp_2) + \gamma v + \lambda(p_1 + v - p_2) \qquad (5)$$

Where a_i is the market base through channel i (i = 1 for e-tail and i = 2 for retail), b_i represents the marginal channel demand per respective channel price, and γ measures the marginal retail demand per retail service value added. The parameter λ, termed discussion intensity, is adopted to describe the shift between the two channels with regards to the price and value.

We assume that before the selling seasons both the retail and the manufacture expect that the entire product q will be sold by either e-tail or retail, which will make their profit be maximized. Under this consideration, we can formulate the Stackelberg pricing equilibrium of p_1 and p_2. In the competing pricing model, we assumed that after the manufacture announced the e-tail price p_1 the best-reaction price that the retailer would adopt to maximize its profit is p_2 which make the following equation satisfy:

$$p_2(p_1) = \arg\max_{p_2} \pi_2(p_1, p_2) \qquad (6)$$

Anticipating against price p_2 that would be adopted by the retailer, the manufacture will select the best e-tail price p_1, which is given as:

$$\max_{p_1} \pi_1(p_1, p_2(p_1)) = p_1 d_1 + wd_2 \qquad (7)$$

Taking the derivative of (3) with respect to p_1 and let $\partial\pi/\partial p_1 = 0$ yields:

$$p_1 = \frac{2a_1 b + 2a_1\lambda + a_2\lambda + v\gamma\lambda + c(v)b\lambda}{4(b+\lambda)^2 - 2\lambda^2} + \frac{c(v)\lambda^2 + 2wb\lambda + 2w\lambda^2 - v\lambda^2 - wvb\lambda}{4(b+\lambda)^2 - 2\lambda^2} \qquad (8)$$

As the same way, we can obtain:

$$p_2 = \frac{\lambda p_1 + a_2 + (\lambda + \gamma)v + (c(v) + w)(b + \lambda)}{2(b+\lambda)} \qquad (9)$$

p_1 And p_2 is the competing equilibrium price that the manufacture and retailer decide by Stackelberg model before the selling seasons, which would make their profit maximize. Under the equilibrium pricing policy, they will contract the wholesale price w_0 and return price w_1 in order to share profit and risk in the cooperation process, So we define the $\pi_{r1}, \pi_{r2}, \pi_r$ as the real profit for manufacture, retail and supply chain end the selling season. Then we discussion the optimal wholesale price w_0 and return price w_1 in the following.

End the selling season, profit for the manufacture, retailer and supply chain are defined as following:

$$\pi_{r1} = (w_0 - c)q - (w_1 - p_1)L \quad (10)$$

$$\pi_{r2} = (p_2 - w_0)q - (p_2 + h + c(v) - w_1)L \quad (11)$$

$$\pi_r = \pi_{r1} + \pi_{r2} = (p_2 - c)q - (p_2 + c(v) + h - p_1)L \quad (12)$$

Where L shown the amount of returned items after the retail selling season and it is defined as:

$$L = max(0, q\text{-}x) \quad (13)$$

From the equation (10), (11) and (12), we can formulate the expect profit for the manufacture, retailer and supply chain as:

$$E[\pi_{r1}] = (w_0 - c)q - (p_2 + h - p_1)E[L] \quad (14)$$

$$E[\pi_{r2}] = (p_2 - w_0)q - (p_2 + h + c(v) - w_1)E[L] \quad (15)$$

$$E[\pi_r] = (p_2 - c)q - (p_2 + h + c(v) - p_1)E[L] \quad (16)$$

The expected returned products shown as following:

$$E[L] = \int_0^q (q - x) f(x) dx \quad (17)$$

Taking the derivative of (15) (16) with respect to q, we can show the result of the optimal product quantities for retailer and supply chain as:

$$\frac{dE[\pi_{r2}]}{dq} = (p_2 - w_0) - (p_2 + h + c(v) - w_1)\frac{dE[L]}{dq} \quad (18)$$

$$\frac{dE[\pi_r]}{dq} = (p_2 - c)q - (p_2 + h + c(v) - p_1)\frac{dE[L]}{dq} \quad (19)$$

Let (18) (19) equal to zero, we can acquire the optimal product quantities respectively for retailer and supply chain. It is obviously that there is only one solution for the optimal quantities in the supply chain. So we can obtain equation (20) from equation (18) (19) which are shown as:

$$\left(\frac{p_2 - c}{p_2 + h + c(v) - p_1}\right)w_1 - w_0 = \left((p_2 + h)\left(\frac{p_2 - c}{p_2 + h + c(v) - p_1}\right) - p_2\right) \quad (20)$$

The manufacture and the retailer have decided price p_1 and p_2 before the selling season, which we have explained by Stackelberg competing model shown in (8) and (9). From the equation (20), we can find that the wholesale price w_0 and return price w_1 are the variable which can the manufacture use as the way to share the profit and risk with retailer by different wholesale price w_0 and return price w_1. In order to make the profit of the supply chain maximize, price w_0 and w_1 must satisfy the equation (20).

3. CONCLUSION

This paper shows how a monopolistic manufacture of a single-period commodity could establish his pricing policies in a mixed e-tail and retail distribution channel in the supply chain under the e-commerce environment， in which the manufacture and retailer consider not only the wholesale price and return price, but also the competitive equilibrium pricing policy between the e-tail and retail firstly which we demonstrate by Stackelberg competition model. Also we obtained dynamic equilibrium equation between the optimal wholesale price and return price, which can make the supply chain's profit maximize and serve as a way for the manufacture and the retailer sharing the profit and the market risk.

In order to simplifier, we assumed that all returned product would be sold entirely by e-marketplace in this paper. However, as an extension, we can research the condition in which the returned products are still left in the e-tail in the end, which will make the research more complex. Also, we can also discuss the manufacture and the retailer announces the price simultaneity, so the price equilibrium can not be received by Stackelberg competition model. In more generally, we may further study equilibrium prices for different demand forms contrary to the linear demand which is assumed in this paper. Further study could be done how the incentive plan can be set to coordinate the manufacture and the retailer to make more contribution to the supply chain.

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