



Manufacturer's pricing strategy in a two-level supply chain with competing retailers and advertising cost dependent demand

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ABSTRACT

The paper studies a two-echelon supply chain comprising one manufacturer and two competing retailers with advertising cost dependent demand. The manufacturer acts as the Stackelberg leader who specifies wholesale price for each retailer. The two retailers compete with each other in advertising and they have different sales costs. The manufacturer uses one of the following two pricing strategies: (i) setting the same wholesale price for both the retailers irrespective of the difference in their sales costs; (ii) setting different wholesale prices for the retailers depending on their sales costs. Two models are developed. In the first model, the manufacturer shares a fraction of each retailer's advertising cost while in the second model, the manufacturer does not share any retailer's advertising expenses. In both the models, we derive the retailers' and manufacturer's optimal strategies. A numerical example is given to illustrate the theoretical results developed in each model. Computational results show that it is always beneficial for the manufacturer to adopt different wholesale pricing strategy for the retailers.

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1. Introduction

Rapid technological advancement, increasing expectation of customer and shortened product life-cycle have intensified competition and introduced new challenges in the market. To overcome the situation, companies should have good flexibility to respond and capability to adopt new strategies to utilize greater share of the market demand. More and more companies are resorted to depend on service and product quality in order to avoid traditional competition which focuses solely on price. Advertising is one way of promotional campaign used by many firms to provide customers the brand knowledge of their products and services and other specialties of their organizations. Depending upon the product type and market demand, either the manufacturer or the retailer or both participate in advertising. Two-tier advertising or co-operative (co-op) advertising is an interactive scheme in a manufacturer–retailer system in which the manufacturer pays a part of the advertising expenditure incurred by the retailer in local advertisement. For example, Small World Toys offers a 2% advertising on total net purchases (Small World Toys, 2007). In personal computer industry, IBM offers a 50–50 split of advertising costs with retailer while Apple Computer pays 75% of the media cost (Brennan, 1988). Manufacturer uses co-op advertising to strengthen the image of the brand and motivate immediate sales at the retail level while retailer uses local advertising to bring potential customers to the stage of buying. The sharing of local advertising cost by the manufacturer is intended to influence

retailers to spend more in local advertisement which in turn generates greater sales volume.

Berger (1972) was probably the first who discussed co-op advertising in a manufacturer–retailer channel. His work was subsequently extended by many authors (Berger and Magliozzi, 1992; Fulop, 1988; Somers et al., 1990) under different co-op advertising settings. Roslow et al. (1993) discussed co-op advertising under supply chain framework and demonstrated that cooperation in advertising investment could increase the profit of the whole supply chain. Khouja and Robbins (2003) studied the effect of advertising on the variance of demand under newsboy framework. However, the above studies are based on the assumption that demand at the retailer's end depends explicitly on retailer's local advertisement. Taking manufacturer's national level advertisement investment in addition to retailer's local advertising into consideration, Huang et al. (2002) and Li et al. (2002) independently developed manufacturer–retailer supply chain models under co-op advertising setting. Using game theory, Huang and Li (2001) further discussed the issue of co-op advertisement for supply chain with one manufacturer and one retailer. In their model, they showed that if the ratio of the manufacturer's and retailer's marginal profits is relatively high, the manufacturer offers a positive amount of advertising allowance to the retailer. In case the marginal profit ratio is relatively low, the manufacturer is reluctant to offer any advertising allowance. Szmerekovsky and Zhang (2009), Xie and Wei (2009) extended the model of Huang et al. (2002) assuming that customer demand is dependent on retail price as well as advertising efforts of channel members. Yue et al. (2006) also extended Huang et al. (2002) model assuming that the manufacturer directly offers a price discount to customers. To increase profits of the parties involved in the supply chain, they

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recommended that coordination in local and co-operative advertising with a partnership relation between manufacturer and retailer is the best solution.

In the context of co-operative advertising, Kunter (2012) analyzed a royalty payment contract for coordination of a manufacturer–retailer channel. Consumer demand was assumed to be simultaneously affected by the retail price and marketing efforts of manufacturer and retailer. Aust and Buscher (2012) addressed the optimal pricing and advertising decisions in a manufacturer–retailer supply chain where the consumer demand depends on the retail price as well as the channel members' advertising expenditures. Additionally, they considered a co-operative advertising program where the manufacturer can bear a fraction of retailer's advertising costs. Zhang et al. (2013) proposed a dynamic co-operative advertising model for a manufacturer–retailer supply chain taking into account the impact of advertising on the reference price and analyzed how the reference price would influence the decisions of all the channel members. Chen (2011) developed a model to study the combined effect of co-operative advertising, return policy and channel coordination for supply chain. Recently, Aust and Buscher (2014) made a comprehensive updated review of literature on co-operative advertising in supply chain management.

From the perspective of customer buying behavior, it is seen that besides price other factors such as promotional activity through advertising also influence customers' preferences and their purchasing decisions and hence market demand. Advertising is the most effective method of promotion and hence advertising investment plays a key role in a firm's marketing decisions. Through advertising the retailer gives the customers brand knowledge of the product, detailed description of the product as well as review of the product in the market. All these useful guidelines stimulate customers' purchasing decisions and thus bring potential customers to the stage of buying. Such attribute of market demand can be seen in insurance industries, departmental stores, supermarkets, news vendor products like fashion apparel, personal computers or supply chains with fixed retail price. Wang et al. (2010), Yan (2010) and Wang (2011) considered demand dependent on investment on advertising. For more literature concerning advertising sensitive demand, readers can be referred to articles contributed by Jorgensen et al. (2000), Karray and Zaccour (2006), Xie and Neyret (2009).

The primary interest of the present study is focused on the competitive behavior of manufacturer and retailers where mode of competition shifts from strategies that consider price differentiation to strategies that include differentiation in terms of advertising efforts. We consider a supply chain with one manufacturer and two competing retailers who face advertising cost dependent demand. In the proposed model, the effect of price is ignored; price remains fundamental as a basis for competition. However, it may not be the only means of determining competition. For instance, when different firms offer the same retail price for a product, the one which promotes the product more definitely has a better edge to consume greater market demand than the others through advertising done by the retailer. Viscolani and Zaccour (2009) examined a duopoly problem where each firm's current sales is proportional to its goods in stock, which is related to the firm's own advertising effort and negatively related to that of its competitor. The idea that one player's advertising effort may hamper competitor's sales can also be seen in the articles provided by Anderson and Renault (2009), Barigozzi et al. (2009). Viscolani (2012) proposed a model for two competing manufacturers selling substitutable products in a homogeneous market. Demand for each manufacturer is positively correlated with his own advertising effort and negatively correlated with advertising effort of his rival. Lu et al. (2011) modeled a game-theoretic problem considering two competing manufacturers and one common retailer, facing end consumers who are sensitive to both retail price and manufacturer service.

We investigate the effect of manufacturer's pricing strategy in the supply chain. The manufacturer who acts as Stackelberg leader specifies

wholesale prices to retailers. The manufacturer uses one of the following pricing strategies: (i) a common wholesale price for both the retailers while disregarding the difference of their sales costs (strategy 1) and (ii) different wholesale prices for two retailers according to their different sales costs (strategy 2). We determine optimal strategies of the manufacturer and retailers in response to manufacturer's different pricing strategies, effects of manufacturer's different pricing strategies on each member's performance and the whole supply chain's performance, the pricing strategy which is best suited to the manufacturer in response to different sales cost scenarios. Lau and Lau (1999) analyzed the pricing and return policies of a monopolistic manufacturer for single-period commodities. In our present study, we assume in Model I that the manufacturer takes part in co-op advertising and provides the retailers a fraction of local advertising costs incurred by the retailers while in Model II the manufacturer does not participate in co-op advertising. Both the models are developed under the framework of two pricing strategies set by the manufacturer. We investigate which strategy is beneficial for channel members as well as for the whole channel.

Among the existing literature on co-operative advertising, very few articles discussed a channel where a single manufacturer sells a product through two or more competing retailers. Related articles in this issue were presented by Wang et al. (2011) and He et al. (2011). This channel structure, however, represents numerous markets including those made up of specialty stores (e.g., consumer electronics, sporting goods, automobile parts, to name a few), departmental stores and supermarkets. The main contributions of our paper are the following. First, our paper extends the current literature on co-operative advertising to account for a supply chain with multiple retailers. Most of the previous research on co-operative advertising was done under the traditional setting of a bilateral monopoly model where one manufacturer sells through one retailer. Second, it takes into account the competitive behavior of two retailers in terms of advertising efforts, i.e. demand of each retailer is not only related to his own advertising investment but also on the other retailer's advertising expenditure. Third, it studies the effects of the manufacturer's pricing strategies in conjunction with retailers' gaming interaction, and discusses the related impact on supply chain's decisions and performance when all the channel members are affected by advertising investment dependent demand. This makes our contribution unique because no such analysis in connection with co-operative advertising has been done before.

The rest of the paper is organized as follows: Model description and assumptions are presented in the next section. Model I is formulated in Section 3 with co-operative advertising under different pricing strategies of the manufacturer. Section 4 describes Model II when the manufacturer does not participate in co-operative advertising. Section 5 is devoted to the discussion related to the effects of manufacturer's pricing strategies in Model II on retailers' and manufacturer's decision making. In Section 6, theoretical results are verified through a numerical example. Finally, the paper is concluded and scope of future research is suggested in Section 7.

2. Assumptions and model description

We consider a two-echelon supply chain comprising one manufacturer and two competing retailers for trading a single product. The manufacturer acts as the Stackelberg leader and sets wholesale price to two retailers. Suppose that the unit retail price of the product is p and unit production cost is c . The two retailers have different sales efficiencies and hence have different sales costs. Let the retailer i 's unit sales cost be s_i ($i = 1, 2$). Without any loss of generalization, we assume that $s_1 < s_2$.

We assume that the two retailers compete with each other on advertising and the market demand depends on their advertising expenses. Further, the price differentiation is negligible to the customers at the time of purchase and the demand is mainly influenced by the

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