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Vertical cooperative advertising in a retailer duopoly ☆

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ABSTRACT

This paper focuses on optimal pricing and advertising decisions within a two-echelon distribution channel, which consists of one manufacturer and two competing retailers. Assuming an inter-echelon Stackelberg equilibrium, where the manufacturer obtains channel leadership, we compare two different forms of retailer behavior: non-cooperative (Horizontal Nash) and cooperative (Cooperation). While the consumer demand depends both on retail price and advertising, the manufacturer can offer a vertical cooperative advertising program to increase the advertising efforts of his retailers. In order to derive a logically consistent price demand function, we deduce our demand function from the consumers' utility function. Numerical examples lead to the following main findings: (i) consumers can benefit from retailer-competition, as it reduces retail price; (ii) the manufacturer's participation in retailers' advertising will be the highest when there is strong competition and no Cooperation; (iii) a Cooperation does not always yield higher profits for the retailers, but can also produce better results for the manufacturer.

1. Introduction

The interaction between different echelons of a distribution channel plays an important role in marketing and supply chain management literature. Herein, mathematical models and operations research methods are frequently used to support the decisions of the involved subjects. Our research focuses on manufacturer-retailer-interaction, where marketing has particular importance due to its objective of influencing competitors and customers. Thereby, we will concentrate on pricing and advertising decisions of both echelons, as these belong to the most important factors of consumer demand.

Depending on the executing echelon, advertising can have different characteristics and intentions: While manufacturer's advertising has a global character and often aims on the brand image itself, the advertising campaigns of retailers are more restricted to certain geographical regions and include information about special offers, etc. This implies that manufacturer's advertising tends more on long-term brand preferences of the customers, whereas the retailers' advertising directly causes consumption (Bergen & John, 1997). One will recognize that these complementary goals lead to a certain dependency of the manufacturer on the advertising of his retailers. If we now assume that the retailers are not able to (or are not disposed to) invest an adequate amount of money in their local advertising, this will have negative effects not only on retailers', but also on manufacturer's sales (Somers, Gupta, & Harriot, 1990; Yan, 2010). A solution to this problem is provided by a vertical cooperative advertising program, which is defined as the partial or complete payment of retailers' local advertising costs by the manufacturer (Bergen & John, 1997; Huang & Li, 2001; Tsou, Fang, Lo, & Huang, 2009). Thereby it is not an independent form of advertising on its own, but in fact a financial agreement about the division of advertising costs (Crimmins, 1984).

Cooperative advertising is a very common practice in the United States, where such programs involved about $15 billion in 2000 according to Nagler (2006), and even $50 billion in 2008 (He, Krishnamoorthy, Prasad, & Sethi, 2012). The participation rates of the manufacturers vary heavily from 25% at General Motors to 50% at IBM and 75% at Apple (Green, 2000; Xie & Wei, 2009). Two interbranch surveys of Dutta, Bergen, John, and Rao (1995) and Nagler (2006) however yielded that manufacturers often choose rates of 50% or 100%. These values suggest a certain arbitrariness in the determination of cooperative advertising participation rate rather than detailed analysis and underline the necessity of a theoretical examination.

Pricing and advertising decisions in manufacturer-retailer-interaction gained substantial attention in previous research, where often game-theoretical methods are used to analyze the interaction of different channel members. Due to the great number of papers dealing with pricing decisions, we limit our overview to few selected models, which include inner-echelon competition.

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E.g., Choi (1991) and Choi (1996) considers a distribution channel consisting of two manufacturers and one or two retailers and applies a Stackelberg game in order to model the channel leadership of either the manufacturers or the retailers. The inner-echelon power structure is assumed to be symmetrical and is calculated by means of a Nash equilibrium. Different inner-echelon power structures are taken into account by Yang and Zhou (2006), who examine an inter-echelon Stackelberg equilibrium with three different types of retailer behavior: non-cooperative and cooperative decision making as well as leadership of one retailer. Zhang, Liu, and Wang (2012) apply a demand based on consumers' utility function and study the differences of Manufacturer Stackelberg, Retailer Stackelberg and Vertical Nash game. Wu, Chen, and Hsieh (2012) extend these games by an inner-echelon Stackelberg game, but return to the widely-used linear demand function.

Detailed reviews of cooperative advertising literature can be found in Xie and Zhang (2011, chap. 9) and Aust and Buscher (2014). After some initial papers which concentrated solely on cooperative advertising (see, e.g., Jørgensen, Sigué, & Zaccour, 2000, 2001), research mostly passed on to analyze cooperative advertising and pricing simultaneously. Besides models of bilateral monopolies (see, e.g., Yue, Austin, Wang, & Huang, 2006; Xie & Neyret, 2009; Xie & Wei, 2009; Szmerekovsky & Zhang, 2009; Yan, 2010; SeyedEsfahani, Biazaran, & Gharakhani, 2011; Ahmadi-Javid & Hoseinpour, 2012; Aust & Buscher, 2012), among which one can find Vertical Nash, Manufacturer Stackelberg, Retailer Stackelberg games and Cooperation, only few authors propose approaches for retailer- and/or manufacturer-duopolies. E.g., He, Krishnamoorthy, Prasad, and Sethi (2011) develop a dynamic model, where one manufacturer obtains the Stackelberg leadership over two competing retailers and derive the retailers' optimal advertising decisions as well as the manufacturer's optimal subsidy rate, but do not include pricing into their consideration. In this regard, the studies of Chutani and Sethi (2012), Ghadimi, Szidarovszky, Farahani, and Khiabani (2013), He et al. (2012), Wang, Zhou, Min, and Zhong (2011) and Zhang and Xie (2012) are one step ahead, because they at least include the prices as exogenously determined parameters. The work closest to ours is the recent working paper by Aust and Buscher (2013), which also considers pricing and (cooperative) advertising decisions of a one-manufacturer two-retailer distribution channel in a static context. However, the focus of this work lies more on the effects of inter-echelon competition between the manufacturing- and the retailing-echelon. In contrast, we concentrate on intra-echelon competition, i.e., on the effects of competition between the two retailers on the resulting strategies.

Therefore, the remainder is organized as follows. Section 2 will describe the structure of the distribution channel and the demand functions on which our model bases on. In Section 3, we will introduce two game scenarios of retailer interaction with non-cooperative (Section 3.1) and cooperative (Section 3.2) retailer behavior. For each scenario, we will determine optimal pricing and advertising decisions for all channel members. The results will be compared in Section 4 and, by means numerical analysis, we will identify the effects of competition as well as the required framework, in which a Cooperation is advantageous for the retailers duopoly. Section 5 will finally summarize the main findings of our research.

2. Model formulation

We consider a two-echelon distribution channel consisting of one manufacturer and two symmetric retailers, who are competing for the same customers (see Fig. 1). Each retailer i can sell the quantity demanded D_i of a product, whereas the manufacturer serves as single supplier for both retailers with a total demand of $D_1 + D_2$. We assume that the manufacturer does not apply price discrimination, i.e., he charges the same wholesale price w of both retailers, while there may be individual retail prices p_i to the customers. Besides the retail prices, the customer demand is also influenced by the advertising expenditures of all channel members. Here we differentiate manufacturer's global advertising expenditures A and the local advertising expenditures a_i of retailer i. The manufacturer can furthermore decide to offer a vertical cooperative advertising program to his retailers, whereby he shares a part of the local advertising costs of each retailer with a fraction $0 \leqslant t < 1$. For the sake of simplicity, we assume that this participation rate is uniform for both retailers, as it can be understood as a general offer to all commercial partners (Wang et al., 2011). Apart from advertising costs, no further costs are examined. This yields a margin of w for the manufacturer and of $(p_i - w)$ for retailer i. The resulting profit functions of the manufacturer and of retailer i are as follows:

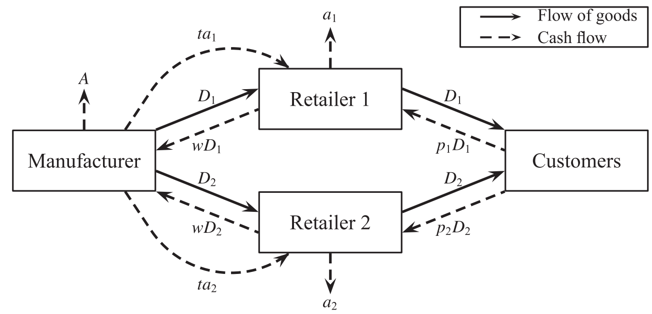

Fig. 1. Two-echelon distribution channel.

$$\Pi_m(w, A, t) = \sum_{j=1}^{2} wD_j - \sum_{j=1}^{2} ta_j - A \tag{1}$$

$$\Pi_{ri}(p_i, a_i) = (p_i - w)D_i - (1-t)a_i. \tag{2}$$

The quantity demanded by the customers D_i is determined by a demand function, which depends both on retail prices as well as on local and global advertising expenditures. Thereby, it is assumed that the price directly affects the consumers' utility, while advertising rather acts as a multiplicator of the price-induced demand without having direct effects on the consumers' utility. Hence, concerning the price demand g_i of retailer i, we follow (Ingene & Parry, 2004; Ingene & Parry, 2007; Zhang et al., 2012) and deduce the demand function from the consumers' utility function

$$U(g_1, g_2) = \sum_{j=1}^{2}\left(\Lambda g_j - \frac{Bg_j^2}{2}\right) - \Theta g_1 g_2 - \sum_{j=1}^{2} p_j g_j. \tag{3}$$

The positive parameter Λ denotes the initial base demand, whereas B (with $B > 0$) describes the intensity of the consumers' saturation effect, which occurs as a result of the already purchased quantity of product i. Lastly, parameter Θ with $0 \leqslant \Theta \leqslant 1$ is a measure of the channel substitutability, where $\Theta = 0$ can be interpreted as a market without competition between the two retailers and $\Theta = 1$ describes the situation of perfect substitutes and, accordingly, strong retailer competition. Obviously, we have to set $B > \Theta$.

By maximizing the consumers' utility with respect to the demand quantity, i.e., by setting the two partial first order derivatives $\partial U / \partial g_i$ to zero and solving the resulting system of equations, we get the following price demand function of retailer i

$$g_i(p_i, p_{3-i}) = [\Lambda(B - \Theta) + \Theta p_{3-i} - Bp_i]/(B^2 - \Theta^2), \tag{4}$$

which can be reformulated to the well-known linear demand function

$$g_i(p_i, p_{3-i}) = \alpha - \beta p_i + \epsilon p_{3-i}, \tag{5}$$