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Invited Review

Cooperative advertising models in supply chain management: A review

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ABSTRACT

This paper reviews articles on cooperative advertising, a topic which has gained substantial interest in the recent years. Thereby, we first briefly distinguish five different definitions of cooperative advertising which can be found in operations research literature. After that, we concentrate on vertical cooperative advertising, which is the most common object of investigation and is understood as a financial agreement where a manufacturer offers to pay a certain share of his retailer's advertising expenditures. In total, we identified 58 scientific papers considering mathematical modeling of vertical cooperative advertising. These articles are then analyzed with regard to their general model setting (e.g., the underlying supply chain structure and design of the cooperative advertising program). After that, we explain the different demand and cost functions that are employed, whereupon we distinguish between static and dynamic models. The last dimension of our review is dedicated to the game-theoretic concepts which are mostly used to reflect different forms of distribution of power within the channel.

1. Introduction

A steadily growing stream in operational research literature addresses the interaction of the various members of a supply chain. Thereby, the application of game theory is very common, because it allows to characterize different players' behavior or channel power during decision making. For a general overview of this field of research and methods in use, we refer the reader to Cachon and Netessine (2004, chap. 2) and Wang and Parlar (1989). Leng and Parlar (2005) identify four different classes of research: two classes referring to inventory games, a third one related to production and pricing competition, and a fourth category named "Games with other attributes", where one can find game-theoretic analyses of capacity, service, product quality, and advertising decisions. While research in the first categories has been conducted (and reviewed) extensively in the past decades, we want to turn the reader's attention to the latter. The scope of this paper is to give a review of studies which consider the mathematical modeling of cooperative advertising, a field which gained substantial interest in the recent years' operations research literature. However, existing surveys concentrate on reflecting only singular papers (see, e.g., Taboubi & Zaccour (2005, chap. 3.3 & 4.2), Leng & Parlar (2005, chap. 6.4), and, more recently, Xie & Zhang (2011, chap. 9)). Therefore, we intend to fill this gap and provide the reader with a broad summary and classification, which also contains recent studies missing in the aforementioned works.

To identify the relevant articles, we performed searches in the databases *ScienceDirect*, *Business Source Complete*, *Web of Knowledge*, and *Google scholar* related to the criteria "cooperative advertising" (and the common abbreviations "co-op advertising" respectively "co-op ad") as well as "advertising coordination". After screening the articles thus obtained, we furthermore used the bibliographic details given in order to complement our data set. Hence, we are confident that it comprehensively reflects the state of research concerning the mathematical modeling of cooperative advertising.

Through our investigation, we found 110 scientific articles, conference papers, and working papers of scientific institutions in English language dealing with cooperative advertising, with the major part published in academic journals. Though articles were published in altogether 51 Journals, Fig. 1 indicates that especially the *European Journal of Operational Research* is a popular platform for related publications, followed by *Journal of Optimization Theory and Applications* and *Marketing Letters*. The number of publications per year is depicted in Fig. 2 and clearly shows the increased interest in this research subject in the recent years.

We found five different meanings of the term cooperative advertising, which are briefly described in the following:

– *Vertical cooperative advertising*: This is the most common comprehension of cooperative advertising (used in 68 papers) and describes a financial agreement, where a manufacturer offers to share a certain percentage of his retailer's advertising expenditures (see, e.g., Bergen & John (1997)). To emphasize the fraction of articles following this understanding, we highlighted these by a black bar in Figs. 1 and 2, while the gray bars refer to all definitions found through the review process.

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– *Cooperative advertising in franchising*: A concept similar to the latter is also used in franchisor–franchisee relationships. However, advertising campaigns are mostly implemented by franchisors in order to guarantee uniformity between the different franchisees, who, for their part, participate in the resulting costs by an advertising fee, which is stipulated in the franchise contract. Related studies are, e.g., Bhattacharyya and Lafontaine (1995), Sen (1995), Dant and Berger (1996), Desai (1997), Rao and Srinivasan (2001), Michael (2002), Hempelmann (2006), and Sigué and Chintagunta (2009).
– *Horizontal cooperative/ generic advertising vs. brand advertising*: In contrast to the previous definitions, this group of articles considers collaboration in terms of advertising of firms belonging to the same echelon of the supply chain, which normally act as competitors. Generic advertising is meant as promoting a whole category of products instead of brand-related advertising of single manufacturers (see, e.g., Chakravarti & Janiszewski (2004)). Studies are mostly applied to farming and agricultural sector. See, e.g., Alston, Freebairn, and James (2001), Bass, Krishnamoorthy, Prasad, and Sethi (2005), Chakravarti and Janiszewski (2004), Crespi and James (2007), Depken, Kamerschen, and Snow (2002), Kinnucan (1997), Krishnamurthy (2001), Krishnamurthy (2000), LeVay (1981), Lu, Thompson, and Tu (2007), Miles, White, and Munilla (1997), Simonin and Ruth (1998), Varadarajan (1986), and Ward and Dixon (1989).
– *Cooperative advertising vs. predatory advertising*: Following the definition of Church and Ware (2000), cooperative advertising positively influences the own demand as well as the demand faced by the competitors, while predatory advertising detracts consumers from competitors in order to increase own demand. Studies referring to this definition are, e.g., Amrouche, Martín-Herrán, and Zaccour (2008), Depken and Snow (2008), Erickson (2009), Friedman (1983), Karray and Martín-Herrán (2008), Karray and Martín-Herrán (2009), Ma and Ulph (2012), Mariel and Sandonís (2004), Piga (1998), Slade (1995), Viscolani (2012), and Viscolani and Zaccour (2009).
– *Joint advertising decisions*: The last group we were confronted with simply uses the term cooperative advertising to describe a cooperative (or collusive) decision making concerning the advertising expenditures, which may occur both in inner-echelon as well as inter-echelon competition, in order to maximize the joint profit. Some authors propose either contracts or incentive strategies in order to ensure that all players stick to the agreements made. This approach can be found in, e.g., Buratto and Zaccour (2009), Forbes (1986), El Ouardighi, Jørgensen, and Pasin (2008), Jørgensen, Sigué, and Zaccour (2001a), Jørgensen and Zaccour (2003b), Jørgensen and Zaccour (2003a), Karray (2011), and Simbanegavi (2009).

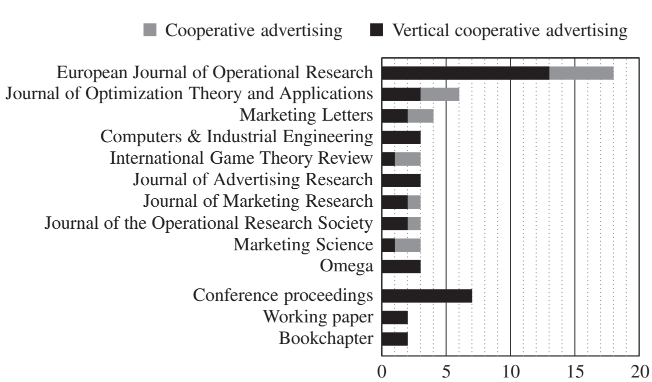

Fig. 1. Number of publications on cooperative advertising by journal (only journals with more than three articles).

In the following, we concentrate our review on the first group of articles, which analyses vertical cooperative advertising programs between manufacturer(s) and retailer(s). For the sake of simplicity, we may dispense the prefix vertical and refer solely to cooperative advertising. The remainder of this paper is organized as follows: In Section 2, we provide a theoretical basis of cooperative advertising, together with empirical data on the diffusion and design of such programs in practice. Subsequently, we review mathematical models dealing with cooperative advertising in Section 3 with regard to different possibilities for categorization, i.e., the general setting (3.1), the demand functions (3.2), and the game-theoretic concepts used (3.3). In Section 4, we summarize our findings and give possible directions for future research.

2. The design of cooperative advertising programs

In this section, our scope is to give a brief summary of the theoretical foundations of cooperative advertising as well as on some empirical data on the usage of those programs in practice. For a more elaborate discussion, we refer the interested reader to the books of Crimmins (1970, 1984), Hutchins (1953), and Young and Greyser (1983), which also comprise case studies as well as an overview of the legal restrictions due to antitrust legislation like, especially, the Robinson-Patman Act (for the legal aspects, see also Moran (1973)).

Vertical cooperative advertising belongs to promotional support programs which some manufacturers provide to their retailers. More specifically, a manufacturer offers to pay a certain fraction of the advertising cost of his retailer. Thereby, the advertising is mostly prepared and organized by the retailer (cf. Sorenson (1970)), while the manufacturer solely sets some guidelines like, e.g., the permitted media etc. After that, the retailer can claim a reimbursement of his expenditures within the predetermined conditions (cf. Young & Greyser (1983)). Crimmins (1970, 1984) explicitly emphasizes that cooperative advertising does not represent an own type of advertising, but rather a financial agreement on the sharing of related cost.

The reasons for such a cooperation between manufacturer and retailer can be manifold. Hutchins (1953) argues that manufacturers adopt cooperative advertising, because it generates immediate sales. To understand this reason, one has to consider the different character and effects of advertising, which depend on the supply chain echelon it emanates from. While manufacturer's global advertising creates a brand image and is more general and nationwide than retailer's local advertising, the latter treats more of promotions and prices. Hence, global advertising makes for publicity and reputation of the product, but does not necessarily lead to real consumer demand (cf. Herrington & Dempsey (2005) and Young & Greyser (1983)). Due to these complementary goals and effects, manufacturers are somehow reliant on a certain degree of local advertising. However, it may occur that the retailer's advertising level is not sufficient from the manufacturer's point of view (cf. Somers, Gupta, & Harriot (1990)). In this case, a cooperative advertising program can stimulate the retailer's advertising expenditures to a sufficient level. Another reason that can induce a manufacturer to offer a cooperative advertising program is the competition for shelf spaces, which allows retailers to demand promotion support from their manufacturer, or a simple financial consideration: On the one hand, manufacturers mostly do not bear all costs for local advertising, so that the retailer has to take his own share on his part; on the other hand, rates for local advertising may be more economical than rates for global advertising, like, e.g., in the case of newspapers (cf. Young & Greyser (1983)).

Vertical cooperative advertising programs are widely spread in practice. However, empirical data strongly depends on the source