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On the impact of advertising initiatives in supply chains

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ABSTRACT

Advertising plays an important role in affecting consumer demand. Socially responsible firms are expected to use advertising judiciously, limiting advertising of “bad” products. An example is the advertising initiative adopted by several major food manufacturers to limit the advertising of unhealthy food categories to children. Such initiatives are based on the belief that less advertising will lead to less consumption of these unhealthy food categories. However, food manufacturers usually distribute products to consumers through retailers whose advertising is not restricted by those initiative programs. In this paper, we examine the effectiveness of such advertising initiative in a leader–follower supply chain with one manufacturer and one retailer. We assume that both the manufacturer and the retailer can choose to participate in the advertising initiative by reducing their advertising levels. The problem is formulated as a Stackelberg game. We show that the effectiveness of the advertising initiative critically depends on the leader’s participation in the initiative. If the leader is willing to reduce the advertising level below a threshold, the market coverage of the product can drop significantly. On the other hand, if only the follower participates in the initiative, the market coverage is likely to expand in the majority of cases. Managerial implications of this research are also discussed.

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1. Introduction

Advertising plays an important role in affecting consumer demand and is a critical lever to enhance firm profitability in the marketplace. Major companies spend billions of dollars on advertising every year (Pergelova et al., 2010). On the other hand, companies are increasingly under pressure to behave responsibly in the society. They are expected to use advertising judiciously, limiting the advertising of “bad” products – products that may cause negative consequences for consumers. One category of products under increasing scrutiny is food product, reflecting the public’s concerns on obesity, especially for children. Childhood obesity ranks the highest among emerging public health concerns in the United States, Canada, and globally (Daniels, 2006; Ludwig et al., 2001; Reilly and Dorosty, 1999; Reilly et al., 2003). According to CDC website, the obesity rate has nearly tripled over the last thirty years among children in North America, coupled with complaints of excessive marketing of junk food to children.

As part of their response to the public’s concerns, many large food and beverage firms engage in some corporate social responsibility (CSR) activities (Carter and Jennings, 2002; Lewin et al., 2006;

Ludwig and Nestle, 2008; Simon, 2006; Wilde, 2009). In 2006, the Council of Better Business Bureaus (CBBB) launched the Children’s Food and Beverage Advertising Initiative (CFBAI) as a form of CSR to promote healthy dietary habits and lifestyles among children under the age of 12. CFBAI is a voluntary, self-regulatory program for food and beverage companies and is designed to shift the mix of advertising messages to children to encourage choices of healthy food. Under the terms of the CFBAI, 16 participating companies (see BBB website¹ for a complete list of the 16 companies) agreed to limit their advertising budget for traditional food and beverage products that are not considered healthy, especially under excessive consumption.

CFBAI is designed under the assumption that less advertising of unhealthy products by the large food and beverage companies will lead to less demand for these products. However, there is no evidence, empirical and otherwise, that supports such assumption. The central question that we would like to investigate is whether this assumption is valid. We consider a two-level supply chain with one manufacturer and one retailer that offers one product. We examine the impact of initiative restricting advertising on the market coverage of the product. The product under consideration is a “bad” product for which we would like to reduce the

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market coverage. We also study the profit implications for the two supply chain partners.

Our analysis considers several different initiative programs. It is possible that either the manufacturer or the retailer participates in the program alone, or they both participate. Note that even though companies involved in CFBAI are primarily food and beverage companies, there is increasing pressure for downstream supply chain partners (e.g., Walmart) to participate as well.

We formulate the problem as a Stackelberg game in which the powerful party is considered as the leader (*he* hereafter) and the less powerful party as the follower (*she* hereafter). Either party can participate in the advertising initiative. Both analytical and numerical results show that the effectiveness of the advertising initiative critically depends on the leader–follower relationship. In general, the advertising initiative would be effective and the market coverage will be reduced if the leader participates in the initiative. If the leader is willing to reduce the advertising level below a threshold, the market coverage can show a significant drop. In contrast, if only the follower participates in the program, the market coverage would expand in the majority of cases. Interestingly, the leader's profit would not be severely affected no matter who participates in the initiative; however, the follower's profit would reduce if the leader participates in the initiative. Not surprisingly, the initiative program would be most effective if both manufacturer and retailer participate.

Our paper belongs to the emerging stream of research on CSR in supply chains. There has been growing interest in managing CSR in supply chains proactively (Li and Lee, 2012; Cho et al., 2012; Plambeck et al., 2012). Guo et al. (2013) consider the a firm's optimal sourcing decision from a mixed pool of suppliers who may or may not be socially responsible while balancing procurement cost increase and demand from socially conscious consumers. Aral and Van Wassenhove (2012) analyze optimal sourcing decisions when the level of responsibility of the supplier base is unknown and must be learned by the buyer, following a multi-armed bandit approach. These theoretical studies help understand when responsible operation is the equilibrium behavior of rational, profit-maximizing firms. However, the vast majority of the literature on CSR in supply chains is empirical and descriptive, see Carroll (1991) and Maignan et al. (2002), etc.

There is a vast literature on advertising in supply chains in both the marketing and operations literature. Since the 1970s, marketing to children and their parents has become a core part of overall marketing strategy (McNeal, 1999). In the context of supply chains, the literature focuses on two streams: (i) co-op advertising that refers to national advertising by the manufacturer and local advertising by the retailer (Davis, 1994; Jørgensen et al., 2001; Milgrom et al., 1986); (ii) non-co-op advertising that delineates the advertising effectiveness by the manufacturer and the retailer and assumes the retailer retains equal or more power than the manufacturer (Achenbaum and Mitchel, 1987; Buzzell et al., 1990; Huang and Li, 2001). While marketing power has been shifting to retailers in recent years, manufacturers traditionally hold stronger power than do retailers and act as leaders in the supply chains. In analytical framework, this leads to models where manufacturers (the leader) make decisions (advertising levels, wholesale prices, etc.) first in anticipation of retailers' responses. Very few papers deal with the effect of limiting advertising limitation of one supply chain partner on the end demand, which is a key feature of the model we analyze in this paper.

In the area of operations management, many studies can be found in examining supplier–retailer or seller–buyer power relationships (Coughlan and Wernerfelt, 1989; Choi, 1991; Dawson, 2000; Lee and Staelin, 1997). Ertek and Griffin (2002) examined price, advertising and profit decisions in both manufacturer-driven and retailer-driven decentralized supply chains. Huang et al.

(2002) indicate that total demand and manufacturer's local advertising spending are higher in partnership as opposed to leader–follower structure. Similar results can be found in Esmaeili et al. (2009) and Esmaeili and Zeephongsekul (2010), where it is shown that both selling price and marketing expenditure are smaller in cooperative than in non-cooperative games, consequently demand is expected to be larger under a cooperative structure. Nonetheless, our analysis finds that the total demand can be *higher* in leader–follower structure when additional constraint is imposed. Other related research can be found in Netessine and Rudi (2004) and Lariviere and Porteus (1999).

The remainder of the paper is organized as follows. Our model is introduced in Section 2 and detailed analyzes are provided in Section 3. In Section 4, we provide some numerical experiments and discusses the managerial implications of this research and Section 5 summarizes our research findings and discusses future research directions. All proofs are given in the Appendix.

2. Model framework

We consider a decentralized food supply chain that consists of one manufacturer and one retailer. The manufacturer produces a family of traditional food products that can be aggregated into one product family, while the retailer (seller) sells the family of products in the market. We also assume the product is not healthy and the consumption of the food product might cause various diseases such as obesity and diabetes (Ebbeling et al., 2002; Reilly et al., 2003). Since the food industry has recently become a target for childhood obesity (Lobstein and Dobb, 2005), we assume either the manufacturer or the retailer might respond to the concern about childhood obesity by participating in the CFBAI-like CSR activity. In this research, we focus on the voluntarily reduced advertising level in the program, thus we use advertising pledge to replace the overall CFBAI program.

We formulate the problem as a Stackelberg game model in which the manufacturer and the retailer form a leader–follower relationship. Note that whether the manufacturer (retailer) is the leader or the follower is often determined by the relative power of the relevant parties, see, e.g., Cachon and Lariviere (2005) and Taylor (2002), etc. To discuss how the power is distributed between the two parties in a supply chain is beyond the scope of this paper. Therefore in our model, we assume the roles of the leader and the follower are preset.

The dynamics of the leader–follower game are as follows. There are two phases in a complete decision-making process. In the first phase, the leader decides on his advertising level; after observing the leader's decision, the follower makes her advertising decision. In the second phase, the leader set his price of the product; the follower then decides on her price after observing the price determined by the leader. Table 1 provides the notation used in our general model.

The objective of each party is to maximize his (her) profit that can be expressed as below:

$$\pi(x, w; y, \mu) = s(x, y)(1 - w - \mu)(w - c) - x, \quad (1)$$

$$\phi(y, \mu; x, w) = s(x, y)(1 - w - \mu)\mu - y, \quad (2)$$

where $\pi(x, w; y, \mu)$ and $\phi(y, \mu; x, w)$ represent the net profits made by the manufacturer and the retailer respectively resulted from the decisions of x , y , w and μ , which are explained below.

In Eqs. (1) and (2), x and y represent the advertising levels invested by the manufacturer and the retailer, respectively; c and w are unit production cost and wholesale price charged by the manufacturer; μ and p ($p = w + \mu$) are the profit margin and market price charged by the retailer; $s(x, y)$ can be considered as the *market penetration function* due to the advertising levels of x and y and

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