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Information asymmetry, pricing strategy and firm's performance in the retailer- multi-channel manufacturer supply chain

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ABSTRACT

In this research paper, we assume a retailer-multi-channel manufacturer (with online and traditional retail channels) supply chain where both the multi-channel manufacturer and the retailer have private information about the state of consumer demand. In this setting, we examine the effect of an information sharing strategy on both firms' performance. Our results show that the multi-channel manufacturer always benefits from an information sharing strategy. When the product is highly compatible with the online channel, information sharing becomes much more valuable to the multi-channel manufacturer. On the other hand, the retailer's performance is not impacted by an information sharing strategy. Thus, a bargaining model is utilized to implement profit sharing for the multi-channel manufacturer and retailer so that an information sharing equilibrium can be reached. Based on our results, we derive optimal market strategies and identify probable paths of future research.

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1. Introduction

There has been a growing interest in improving performance and supply chain efficiency for all members of a supply chain through information sharing. In many cases, supply chain players make decisions with limited information. A significant benefit of information sharing is that the shared information (i.e., consumer demand information, sales trend and point-of-sale data, etc.) improves information accuracy and distribution planning. Recently, information sharing initiatives such as Collaborative Planning, Forecasting, and Replenishment (CRFR), Radio Frequency Identification (RFID) technology, Supply Chain Management integration, and Efficient Consumer Response (ECR) in the grocery industry have facilitated the sharing of demand information among the supply chain players. In the business market, for example, Wal-Mart and Warner-Lambert, maker of Listerine brand mouthwash, agreed to share demand information 6 months in advance of the expected retail sale date to improve order accuracy (Seifert, 2003). Apparel manufacturer VF and its retailer ShopK have benefited from exchanging information during product distribution. Information is essential to the supply chain players' decision making and planning process, and better information contributes to better decision making and stronger supply chain performance.

The case of information sharing between the multi-channel manufacturer (with online and traditional channels) and the retailer has recently gained interest because many manufacturers, such as Hewlett & Packard, Lenovo, Dell Computer, Compaq, Sony, Panasonic, Mattel, Pioneer Electronics, Cisco System, and Estee Lauder, in a variety of industries, have begun to use multiple channels (online and traditional channels) to sell their products to consumers (Tsay and Agrawal, 2004; Kumar and Ruan, 2006; Seifert et al., 2006; Chen et al., 2008). Consequently, channel coordination through information sharing between the multi-channel manufacturer and its retailer becomes significantly important.

The rest of our paper is organized as follows. Section 2 provides a summary of the relevant literature. Section 3 presents our modeling framework. Section 4 analyzes the cases of non-information sharing and information sharing under the Stackelberg game. Section 5 compares the impact of different information strategies on firm's performance. We present our numerical examples in Section 6. Conclusions and managerial implications are presented in Section 7.

2. Literature review

2.1. Horizontal information sharing

Several works focus on information sharing between horizontal retailers. For example, Vives (1984) examined the impact of information sharing on the performances of horizontal competitive firms in a case of information symmetry. Lages et al. (2005) conducted an empirical study to show that the relationship quality between an exporting firm and an importing firm is positively related to the amount of information sharing. Yue et al. (2006) studied information sharing between two firms selling complementary products and found that information sharing is not always beneficial for each firm. If

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the total profit for the two firms in the information sharing is less than the total profit in the non-information sharing, then information sharing is not a beneficial strategy. Yue et al. (2006) further showed that only a strategic alliance is the best choice all the time. We distinguish our work from previous work by the fact that we study information sharing in a vertical channel structure. Eastlick et al. (2006) examined whether traditional B2B relationship framework can be applied to information-intensive online B2C channel and found that consumer trust towards an online retailer and the online retailer's reputation are strongly related to online purchase intention of consumers. Dixit et al. (2008) showed that information technology can effectively improve pricing strategies.

2.2. Vertical information sharing

A number of studies on vertical information sharing in the supply chain management literature identify benefits relating to inventory and replenishment. For example, Parlar and Weng (1997) developed optimal replenishment schedules under the cases of non-information sharing and information sharing, and found that the information sharing schedule is superior to the non-information sharing schedule if replenishment costs are relatively high. Gavirneni et al. (1999), in a study of partial and complete shared information of inventory policies between a supplier and a retailer, estimated the savings to the supplier due to information sharing and addressed when information sharing was more valuable. Cachon and Fisher (2000) investigated the value of information sharing between one supplier and multiple identical retailers. They found that information sharing led to savings due to decreased lead time and batch size reduction. Lee et al. (2000) looked at the value of information sharing in a two-level supply chain and found that information sharing can provide significant inventory reduction and cost savings. Aviv (2001) found that collaborative forecasting can provide substantial benefits to the supply chain members' replenishment process. Gavirneni (2002) examined information sharing in a capacitated supply chain with fixed ordering costs and showed that the manufacturer can significantly benefit from information sharing when the wholesale price changes. However, these studies focused solely on the inventory-related and replenishment-related benefits of information sharing. Our focus is on the effects of information sharing on pricing decisions. In addition, unlike the studies mentioned above, which focus on information sharing between the retailer and the single-channel manufacturer (with a single traditional channel), our study focuses on information sharing between the retailer and the multi-channel manufacturer (with online and traditional channels).

There are only a few studies that examine information sharing between the retailer and the multi-channel manufacturer. Yue and Liu (2006) showed that both the manufacturer and the retailer can benefit from information sharing only when the manufacturer's forecast is higher than the retailer's forecast. If the manufacturer's forecast is lower than the retailer's forecast, the manufacturer would benefit from information sharing while the retailer would not. Mukhopadhyay et al. (2008) provided a mechanism for the retailer to add value to the product, thereby differentiating the retailer's product from the product sold directly by the manufacturer. By assuming the manufacturer has only incomplete information about the retailer's cost of adding value, Mukhopadhyay et al. (2008) showed that the retailer would voluntarily share its information with the manufacturer only if the cost of adding value is lower than the threshold value. However, these two papers fail to address product web-fit, which is well known for its strategic importance for online sales (Lal and Sarvay, 1999; Kacen et al., 2002; Kwak et al., 2002; Korgaonkar et al., 2006; Kumar and Ruan, 2006). In our study, we incorporate product web-fit into our channel structure to study the effect of different information strategies on each firm's performance in the retailer-multi-channel manufacturer supply chain.

2.3. Product web-fit

A substantial body of literature (e.g., Liang and Huang, 1998; Kacen et al., 2002; Chiang et al., 2003; King et al., 2004) indicates that a product purchased online is less valuable to the consumer than an identical product bought through a regular retailer. There can be several reasons for why consumers perceive a product purchased through an online channel to be less valuable than the identical product purchased through a traditional channel. First, many product attributes that are transparent to a consumer in the traditional channel (e.g. the fit of a pair of trousers) are hidden in the online channel. Second, for the online purchase, possession and gratification is delayed, whereas they are instant when the product is purchased through the traditional channel. Third, consumers typically will be charged a shipping and handling fee for online purchases (Hess et al., 1996). Fourth, returns to online stores are difficult. These elements all reduce the value of the product for online purchases.

We can say, then, that the value of the product is v, when this product is inspected on the spot and the customer can take possession immediately in the traditional market, and the value of the product is θv when this product is purchased through the online channel. The parameter θ is defined as product web-fit, and is determined by considering the characteristics of the product and the nature of online marketing. Kacen et al. (2002) show that product web-fit, based on empirical analysis of data, turns out to be less than one for many product categories (Insert Table 1 here). Therefore, product web-fit varies with product categories and the value of product web-fit ranges from zero to one ($0<\theta<1$). The value of zero signifies that the product is not compatible with online sales at all and the value of one signifies that the product is completely compatible with online sales.

However, there would be some products (e.g. digital music, airline tickets, etc.) where the online channel enjoys overwhelming advantage over the traditional channel, that is, the value of product web-fit is greater than one. Here the result is straightforward. Since the online channel would dominate the traditional channel and, over a period of time, the traditional stores would disappear and only the online stores would remain. For illustration, notice the demise of traditional music stores and travel agents. In such a scenario, information sharing would not exist. Therefore, in this article, we consider only those products for which product web-fit is less than one.

3. Model framework

In this paper, we consider a supply chain made up of a multi-channel manufacturer (with online and traditional retail channels) and a traditional retailer. Consumers can purchase products from either the traditional channel or the online channel. We assume that the manufacturer and the retailer play a Stackelberg game, in which the manufacturer is the leader and the retailer is the follower. We also assume that the demand is a linear function of prices and the manufacturer and the retailer have private information about the demand. When their information is not shared, the manufacturer and the retailer set their optimal prices independently, based on their own private information. However, when information is shared, both the manufacturer and retailer use the shared information to set their optimal prices. For our research, we use a game theoretic model to show that the multi-channel manufacturer always would like to share information with the retailer, especially when the product has a strong

Table 1
Product web-fit θ for web-based online channel.

Category	Book	Shoes	Toothpaste	DVD player	Flowers	Food items
Acceptance	0.904	0.769	0.886	0.787	0.792	0.784

Note: The above values come from Kacen et al.'s research in 2002.

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