



Implementing coordination contracts in a manufacturer Stackelberg dual-channel supply chain

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ABSTRACT

We examine a manufacturer's pricing strategies in a dual-channel supply chain, in which the manufacturer is a Stackelberg leader and the retailer is a follower. We show the conditions under which the manufacturer and the retailer both prefer a dual-channel supply chain. We examine the coordination schemes for a dual-channel supply chain and find that a manufacturer's contract with a wholesale price and a price for the direct channel can coordinate the dual-channel supply chain, benefiting the retailer but not the manufacturer. We illustrate how such a contract with a complementary agreement, such as a two-part tariff or a profit-sharing agreement, can coordinate the dual-channel supply chain and enable both the manufacturer and the retailer to be a win-win.

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1. Introduction

The rapid growth of IT technology and the Internet presents manufacturers (or suppliers), who might previously have distributed only through traditional retail stores, with opportunities for innovation and the ability to sell directly to the customer (for example, through Web-based channels) for cost savings, revenue growth, and expansion to new market segments. Many companies, such as Dell, Sony, Hewlett Packard, and Lenovo, sell through a direct channel.

A direct channel offers the manufacturer the possibility of creating a niche market and attracting a different customer base to form manufacturer loyalty, affording a higher margin and avoiding domination by the retailer. The traditional retail channel may capture those customers who have difficulty in accessing the Internet or who prefer buying the product in a “bricks and mortar store” after seeing the product on the shelf. The direct channel may attract customers who prefer purchasing products from the manufacturer's website after viewing product photographs and descriptions on-line, to save transportation cost and time. The development of the direct channel may, however, squeeze the retailer's marketing share and result in reduction in the retailer's profit. Moriarty and Moran [1] argued that even though a dual channel is hard to manage, because of the inevitable competition

between the retail channel and the direct channel, it promises to take over as the dominant supply chain design for all kinds of businesses. Kumar and Ruan [2] developed a model for a manufacturer using retail and direct channels. They assumed that consumers can be brand-loyal or retailer-loyal, and that the retailer carries the manufacturer's brand and other brands. Brand-loyal customers buy only the manufacturer's product. They showed that the manufacturer can benefit from the direct channel. Yao et al. [3] compared three different inventory strategies, a centralized inventory strategy, a Stackelberg inventory strategy, and a strategy where the e-tail operation is outsourced to a third party logistics provider, in a dual-channel supply chain. Channel conflict, however, affects many managerial issues for both the manufacturer and the retailer [4,5].

The direct channel is usually used as a selling channel, but it has other functions as well. Cohen [6] pointed out that sometimes firms use the direct channel for information and sales support and leave the actual sales to the retailer. Chiang et al. [4] showed that the manufacturer can use the dual channel without sales in the direct channel to control the retailer's price, thus mitigating the double marginalization problem.

Questions therefore arise. Will the manufacturer benefit from opening a direct channel, given the potential for conflict and competition with the existing retail channel? How can the manufacturer, as a Stackelberg leader, collaborate and coordinate with the retailer? Allen et al. [7] stated in the Forrester Report that “as retailers and manufacturers recognize that their role is to serve empowered consumers together, channel cooperation will

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replace channel conflict.” Several mechanisms have been proposed to reduce or eliminate conflict between the channels. For example, Keenan [8] showed the steps that manufacturers can take in reducing channel conflict by explaining the direct channel as targeting a different market segment. Mukhopadhyay et al. [9] argued that retailers are able to differentiate their products from those sold through direct channels by adding value to on-the-shelf goods.

Price competition is inevitable between the existent retailer and the manufacturer's direct channel; the two channels can sell the same product at different prices because customers perceive the product differently. A number of studies have discussed the price competition between the retail channel and the direct channel. Scholten and Smith [10] found that price dispersion between retail and e-tail markets is persistent over time and across channels. An empirical study on two categories of homogeneous products, books and CDs, showed that prices through Web sales are 9–16% lower than prices in conventional outlets [11]. Lee [12] found that prices for used cars sold via electronic auction markets tend to be higher than those sold via conventional auction markets. Considering a dual-channel supply chain in this paper, we model segmentation of a regional market into two submarkets through consideration of two customer bases: one which prefers a retail channel and one which prefers an online channel. We find that, for a general product, whether or not the price of the retail channel is higher or lower than that of the direct channel depends heavily on the degree of the customer's preference for the retail channel.

Pricing and other questions relating to a dual-channel supply chain have been discussed in the literature. Swaminathan and Tayur [13] provided an overview of relevant analytical models. Chiang and Monahan [14] presented a dual-channel inventory model with stochastic demands for two customer segments and showed numerically that in most cases, the dual-channel strategy outperforms the retail-channel-only and direct-channel-only strategies. They did not, however, include pricing issues in their model. Hua et al. [15] examined a dual-channel supply chain and considered the factor of delivery lead time in the pricing decisions. Yan [16] applied a game theory model to determine the optimal prices when the firm competes in a retail channel versus a Web-based channel. None of these papers discuss the coordination of a dual-channel supply chain. In this paper, we consider not only pricing decisions but also the issue of coordination in a dual channel. With competition between the retailer channel and the direct channel, we show that when the customer's preference for the retail channel is sufficiently high, the direct channel may be left with no sales. Under certain circumstances, the manufacturer may be better off in a single retail-channel supply chain rather than in a dual-channel supply chain.

Collaboration and coordination in the supply chain has attracted much attention in the past few years. Contracts with various coordination mechanisms have been widely used in the supply chain coordination; for example, a quantity discount contract [17,18], a two-part tariff contract [19,20], a revenue-sharing contract [21,22], a buyback contract [23,24], profit sharing contract [25,26], and a rebate contract [27]. Taylor [27], Lariviere [28], and Cachon [29] reviewed supply chain coordination in various perspectives, and Cachon [29] pointed out that “the contract designer may actually prefer to offer a simple contract.” Qi et al. [17] investigated conditions under which a one-supplier–one-retailer supply chain that experiences a disruption in demand during the planning horizon can be coordinated by a quantity discount contract. Hua et al. [22] showed that a revenue-sharing contract can perfectly coordinate the distribution channel in the product design problem for a manufacturer–retailer distribution channel. Wei and Choi [25] found the

necessary and sufficient conditions under which the coordination of a manufacturer–retailer supply chain is achieved using a wholesale pricing and profit sharing scheme. Choi et al. [30] studied how a manufacturer, as a supply chain coordinator, uses a wholesale price contract to achieve coordination under different risk preferences of the agents. However, all these studies focus on coordination in a single channel supply chain.

Studies on contracts that provide insights on how to coordinate a dual-channel supply chain are limited. Under the assumption of demand uncertainty and fixed prices in the retail channel and the direct channel, Boyaci [31] found that simple contracts, such as wholesale price only, buyback, revenue-sharing, and Vendor Managed Inventory (VMI) contracts, cannot coordinate the dual-supply chain with inventory decisions. He showed that a penalty contract, which can achieve supply chain coordination, is difficult to implement. Cai et al. [32] showed that price discount contracts perform well in a dual-channel supply chain. Yao and Liu [33] discussed Bertrand and Stackelberg equilibrium pricing policies and compared the profit gains under these two types of competition in a dual channel. Neither [32] nor [33] discussed coordination in a dual-channel supply chain. Cai [34] investigated the influence of channel structures and channel coordination on the supplier, the retailer, and the entire supply chain in a dual-channel supply chain. He showed that a combination of a revenue sharing and a linear price relationship between the price in the retail channel and the price in the direct channel can coordinate the supply chain. Differing from their work, we propose contracts that can coordinate the two channels and can be easily implemented. We show that a contract in which offering a wholesale price and the direct channel price can coordinate the dual-channel supply chain, benefitting the retailer but not the manufacturer. We also show that with a complementary agreement, such as a two-part tariff agreement or a profit-sharing agreement, the contract can coordinate the dual-channel supply chain and enable both the retailer and the manufacturer to be more profitable. Furthermore, different from Cai [34], the coordination contract in our paper does not tie the retailer's pricing decision to the manufacturer's price decision for the direct channel. A comparison of our paper to other relevant papers in terms of similarity and difference is summarized in Table 1.

This paper contributes to the literature in several aspects. First, we discuss when the manufacturer and the retailer prefer a dual-channel supply chain and their price strategies. Second, we show that a contract with a wholesale price and the direct channel price can coordinate the dual-channel supply chain and enhance the retailer's profit, but not that of the manufacturer. Third, we illustrate that with complementary agreements, the contract with a wholesale price and the direct channel price can coordinate the two channels and allow more profit for both manufacturer and retailer, as compared to a decentralized dual-channel supply chain.

We organize the remainder of this paper as follows. Section 2 shows the equilibrium solutions and compares the decentralized

Table 1
Summary of recent research (✓: covered; X: not covered).

	Linear demand	Price competition	Channel coordination
Boyaci [31]	X	X	✓
Cai [34]	✓	✓	✓
Cai et al. [32]	✓	✓	X
Chiang et al. [4]	✓	✓	X
Chiang and Monahan [14]	X	X	X
Hua et al. [15]	✓	✓	X
Yao and Liu [33]	✓	✓	X

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