



Production, Manufacturing and Logistics

## When should a manufacturer set its direct price and wholesale price in dual-channel supply chains?

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## ABSTRACT

Applying an observable delay game framework developed in noncooperative game theory, we investigate the timing problem concerning when a manufacturer managing dual-channel supply chains, consisting of a retail channel and a direct channel, should post its wholesale price and direct price. Conventionally, operational research models describing dual-channel supply chains examine price competition, where the retailer and the manufacturer simultaneously determine the retail and direct prices, respectively. In contrast to this conventional setting, our model demonstrates that such simultaneous price competition never arises if the manufacturer and retailer can choose not only the level of the price but also the timing of pricing. If the manufacturer sets the direct price after setting the wholesale price to the retailer, the retailer accelerates the timing of retail pricing prior to the direct price setting by the manufacturer. Our findings suggest that the manufacturer should post the direct price before or upon, but not after, setting the wholesale price for the retailer. This upfront posting of the direct price not only constitutes the subgame perfect Nash equilibrium of the noncooperative game between channel members but also maximizes the profits for a manufacturer employing multichannel sales strategies.

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## 1. Introduction

Multichannel sales strategies are now very popular owing to the prevalence of the Internet, which makes it much easier for manufacturers to engage in direct sales. Because direct channels, including catalogs and the Internet, compete against, substitute for, or complement conventional retail channels, finding the best way to utilize them in conjunction with retail channels continues to be a challenge for many firms. Specifically, multiple channels give rise to channel conflict when different channels compete for almost the same market with substitutable products.

Particularly after the rise in Internet use among general households, many manufacturers that previously only distributed products via a retail channel have added a direct channel. To manage these dual distribution channels successfully, different manufacturers have adopted a variety of channel strategies. For instance, when manufacturers, such as Daimler, Nikon, and Rubbermaid, first commenced use of the direct channel, they used the Internet merely as a medium to provide information about their products and/or to

direct users to the nearest retailer carrying the product but without offering the product for sale directly, in order to avoid potential channel conflict. Consider the market for computer products. As an example, IBM redirected orders taken at [ibm.com](http://ibm.com) to its distributors in an attempt to mitigate any conflict, while Hewlett-Packard provided their intermediaries with a commission fee for online orders (Tsay & Agrawal, 2004a). Compaq undertook a profit-sharing strategy whereby the company paid intermediaries an agent's fee when their current clients purchased products on Compaq's website (Lee, Lee, & Larsen, 2003). Finally, in contrast to these manufacturers, Dell, a successful Internet marketer in the personal computer (PC) market, added its retail channel only after selling its products and establishing its brand through its direct channel. Dell opened kiosk locations in shopping malls across the US from 2002 and has operated full-scale manufacturer-owned stores since late 2006 (Zehr, 2008). In 2008, Dell expanded into retail stores, such as Wal-Mart and Best Buy, and shut down all of its US kiosks.

In the context of multichannel management, the extent to which a manufacturer should set a direct price to maximize total profits across all channels has commanded significant attention from both the academic and practical viewpoint. However, the existing operational research literature has neglected the question of the timing at which the manufacturer should determine the di-

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rect price, even though it is a critical practical issue for manufacturers adopting a multichannel sales strategy. Consequently, this paper investigates the timing problem when a manufacturer managing dual-channel supply chains, comprising a retail channel and a direct channel, should post its wholesale and direct prices using an observable-delay game framework recently developed in the noncooperative game theory literature (e.g., Hamilton & Slutsky, 1990; van Damme & Hurkens, 1996, 1999, 2004). Put differently, our main research questions are:

- "When" does a manufacturer managing a dual-channel supply chain set the wholesale and direct prices to maximize profit, and
- "What" prices should the manufacturer set?

Conventionally, operational research and management science (OR/MS) models describing dual-channel supply chains examine price competition where the retailer and the manufacturer simultaneously determine the retail and direct prices, respectively. In contrast, our model demonstrates that such simultaneous price competition never arises if the manufacturer and retailer can choose not only the price level but also the timing of pricing. If the manufacturer sets the direct price after setting the wholesale price for the retailer, the retailer accelerates the timing of retail pricing prior to the direct price setting by the manufacturer. Our findings suggest that the manufacturer should post the direct price before or upon, but not after, setting the wholesale price for the retailer. Such upfront posting of the direct price not only constitutes the subgame perfect Nash equilibrium (SPNE) of the noncooperative game between channel members but also maximizes profits for the manufacturer.

The logic behind this outcome is as follows. If the manufacturer determines the direct price after setting the wholesale price for the retailer, the direct price cannot fully reflect any future reaction by the retailer, leading to a lower level of channel profits. Conversely, if the manufacturer determines the direct price before setting the wholesale price, then the manufacturer can adjust the direct price to its optimal level for both channels by predicting the future reactions of the retailer, thus mitigating double marginalization in the retail channel. This adjustment is the source of the advantages accruing to the manufacturer by posting the direct price before setting the wholesale price.

Nowadays, many manufacturers across a wide range of industries utilize both direct and indirect channels to distribute products. In the IT industry, IBM is often cited as a company that has successfully managed the two types of channels over about three decades.<sup>1</sup> The indirect channels of IBM, which include distributors, value-added resellers, and partners, can be regarded as the retail channel in the model in this paper. Moreover, IBM is known as a company that undertakes a channel strategy to launch several new products only in the direct channel at first, and subsequently through the indirect channel. The following are three examples of products distributed in this way. First, the RS/6000, a reduced instruction set computer technology open system equipped with a UNIX operating system, was a product initially sold through the direct channel and subsequently through the indirect chan-

nel.<sup>2</sup> Second, the enterprise servers designated S/390s were also sold through the IBM internal channel until 1997, and subsequently were distributed by qualified resellers, as discussed in [Gandolfo and Padelletti \(1999, p. 110\)](#). Third, the sale of System x iDataPlex, a relatively recent IBM product, was initially sold only directly and subsequently through partners.<sup>3</sup> Because selling and pricing timing of these products is different between the two channels, they represent appropriate real-world examples of our model.

As discussed, the results of our model suggest that setting the direct price before the wholesale price in the retail channel is the best timing for the manufacturer. Therefore, if we interpret the IBM's channel strategy using our model, IBM initially sells a new product in its direct channel, thereby improving profitability by making the direct price observable to its resellers, including its partners. As such, our model provides a rationale for why a company with dual channels, like IBM, makes the decision to sell a new product first directly to buyers and subsequently through its indirect channel. Our model then effectively explains real-world cases, including that of IBM, thereby providing useful managerial insights for manufacturers managing both retail and direct channels.

The remainder of the paper is structured as follows. [Section 2](#) provides a review of the literature relating to supply chain management from a game-theoretic perspective. In [Section 3](#), we delineate the basic settings of our noncooperative game model. We then investigate when the manufacturer should choose the timing of setting the direct price and the wholesale price applicable to the retailer, identifying the relevant SPNE that specifies the choice of both the timing and level of prices. In [Section 4](#), we extend our model to consider consumer behavior in relation to services, especially because these and not goods receive increasing attention in the supply chain management literature. The final section concludes the paper.

## 2. Literature review

To date, many OR/MS studies have investigated supply chain management problems from a noncooperative game theoretic perspective (e.g., [Anderson & Bao, 2010](#); [Atkins & Liang, 2010](#); [Groznik & Heese, 2010](#); [Jeuland & Shugan, 1983](#); [Kumoi & Matsubayashi, 2014](#); [Matsui, 2012](#); [Matsushima & Mizuno, 2013](#); [McGuire & Staelin, 1983](#); [Parlar & Weng, 2006](#); [Xia & Gilbert, 2007](#); [Xie & Wei, 2009](#); [SeyedEsfahani, Biazaran, & Gharakhani, 2011](#); [Wang et al., 2013](#); [Zhou & Cao, 2013](#); [Xiao et al., 2014](#)). In particular, several studies have focused on the management of dual-channel supply chains including direct marketers and conventional intermediaries, such as retailers, typically analyzing the economic impacts of the introduction of a direct Internet channel (e.g., [Balasubramanian, 1998](#); [Chiang, Chhahed, & Hess, 2003](#); [Yao & Liu, 2003](#); [Tsay & Agrawal, 2004a, 2004b](#); [Chiang & Monahan, 2005](#); [Yao, Yue, Wang, & Liu, 2005](#); [Cattani, Gilland, Heese, & Swaminathan, 2006](#); [Liu et al., 2006](#); [Kurata, Yao, & Liu, 2007](#); [Bernstein, Song, & Zheng, 2008](#); [Chen, Kaya, & Özer, 2008](#); [Dumrongsiri, Fan, Jain, & Moinezadeh, 2008](#); [Mukhopadhyay, Zhu, & Yue, 2008](#); [Cai, Zhang, & Zhang, 2009](#); [Huang & Swaminathan, 2009](#); [Cai, 2010](#); [Chiang, 2010](#); [Hua, Wang, & Cheng, 2010](#); [Khouja & Wang, 2010](#); [Ryan,](#)

<sup>1</sup> [Hardy and Magrath \(1988, pp. 65–66\)](#) state, "most makers of personal computers desire the stability and strength of IBM's Value Added Reseller (VAR) network. ... In 1983, IBM executives decided they would have to use indirect channels rather than their own sales force to establish their personal computers in multiple markets." Moreover, [Cespedes and Corey \(1990, p. 71\)](#) write: "IBM, which had virtually no indirect channels as recently as 1981, was using more than 16 third-party channels by the mid-1980s, including distributors, VARs, retail computer dealers, and a variety of 'complementary marketing organizations' (firms with which IBM conducted marketing activities including joint sales presentations and product installations)."

<sup>2</sup> [Gandolfo and Padelletti \(1999, p. 110\)](#) conclude "Dealers are the main distribution channel for RS/6000s and PCs. Large quantities of these computers are directly bought from IBM, and since 1996 they have been bought from qualified first-layer resellers."

<sup>3</sup> [IBM \(2008\)](#) notes "System x iDataPlex is announced as available through IBM direct sales channel only. It is currently not available through IBM Business Partners." Subsequently, [Watts and Bachmaier \(2012\)](#) state "iDataPlex solutions are acquired either directly through IBM direct sales channels or through IBM business partners." These two documents prove that iDataPlex was initially sold only through the direct channel and then through the indirect channel.

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