Single versus dual-channel: A strategic analysis in perspective of retailer's profitability under three-level dual-channel supply chain

S. Saha [a], S.P. Sarmah [b], N.M. Modak [c, *]

[a] *Institute of Engineering and Management, Salt Lake, Kolkata, West Bengal, India*
[b] *Department of Industrial and Systems Engineering, IIT Kharagpur, Kharagpur, India*
[c] *Palpara Vidyamandir, Chakdaha, West Bengal, India*

ABSTRACT

This paper explores characteristics of three different channel structures of three-echelon supply chain, namely a traditional retail channel; a manufacturer's dual-channel and a retailer's dual-channel. In the dual-channel setting, a manufacturer operates retail channel through a distributor and a retailer while either the manufacturer or the retailer operates the direct e-channel. Mathematical models for both non-cooperative and cooperative decisions are developed. Optimal pricing policies of all the proposed models are analyzed with theory. It has been showed that in three echelon supply chain, introduction of dual channel is not always profitable for the channel members compared to single retail channel. Optimal price of the product is always greater in single retail channel compared to retail prices in both the dual channels. To eliminate channel conflicts of non-cooperative supply chain, a two-way price discount mechanism is used to coordinate both the dual channels. It is analytically found that the retailer has opportunity to gain more profits in own dual-channel and in non-cooperative single retail channel instead of manufacturer dual channel. The distributor also prefers the retailer's dual-channel compared to the manufacturer's dual-channel. All analytical results are illustrated numerically.

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1. Introduction

With the rapid expansion of e-commerce, more and more companies have adopted multichannel distribution systems, i.e. a single firm sets up two or more marketing channels to sale products. Recognizing the great prospective of the Internet to reach customers, many suppliers, such as Apple, Alticore, Eastman Kodak, Hewlett-Packard, Cisco, Dell, IBM, Nike, Sony, have added direct channel operations. According to one survey, about 42% of the top suppliers in a variety of industries are selling directly to consumers through the direct channel (Dan, Xu, & Liu, 2012). Lien, Wen, Huang, and Wu (2015) showed that price, trust, and value are the driving forces of online purchase intentions, in particular these factors have a significant effect on the consumers' online hotel room booking decision. Feng, Tien, Feng, and Lai (2014) suggested that a well-designed Web-site will influence users' perceptions about its usability and revealed that system quality, comprised of security and privacy have a positive impact on the acceptance of online marketing. In Annual Survey of The Indian Direct Selling Industry, it is reported that the direct selling industry has grown at 12% during 2012—13, with its sales revenue expanding from INR 63,851 million in 2011—12 to INR 71,641 million in 2012—13. Sam and Chatwin (2015) developed a new Online Consumer Style Inventory model in the E-commerce environment to explore the behavior of the online consumers'. Indeed, there has been a large volume of literature focused characteristics of dual-channel supply chains (Ahn, Duenyas, & Zhang, 2002, Geyskens, Gielens, & Dekimpe, 2002, Xing & Grant, 2006, Bernstein, Song, & Zheng, 2008, Yu, Zeng, & Zhao, 2009, Khouja, Park, & Cai, 2010, Jiang, Xu, & Sheng, 2010, Lu & Liu, 2013). In the context of the supply chain, researchers typically focus exclusively on the situations in which the manufacturer is able to introduce the direct channel; see, e.g., Tsay and Agrawal (2004), Cattani, Gilland, Heese, and Swaminathan (2006), Dumrongsiri, Fan, Jain, and Moinzadeh (2008), Fruchter and Tapiero (2005), Hsiao and Chen (2013), Chen, Fang, and Wen (2013). But, it also observed that some traditional brick and mortar (B&M)

* Corresponding author.
E-mail address: nikunja.modak@gmail.com (N.M. Modak).
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retailers have incorporated online sales channels since the early stages of the commercial Internet (e.g., the Barnes and Noble website launched in May 1997). Thus, in the current economy it is essential to determine the pricing and replenishment policy of products (Cardenas-Barron, 2006, 2009a, b; Cardenas-Barron, Trevino-Garza, & Wee, 2012; Taleizadeh, Kalantari, & Cardenas-Barron, 2015, 2016). Panda, Modak, Sana, and Basu (2015) developed a retail-etail channel supply chain to determine the replenishment and pricing policy over the planning horizon for continuous unit cost decreasing product. Today, retailers' online channels are no longer an experiment but a relevant and growing part of their business. But recently many retailers integrate both offline and online presences by adopting dual-channel model. In India large retailer like Future Retail, Croma and Shoppers Stop are adopting to omnichannel models - selling both on and offline. Example includes but not limited to some globally recognized retailers like Nasty Gal in Los Angeles, Birchbox in New York, JustFab in Glendale Galleria. However, the extant literature generally focuses on pricing issues of manufacturer two level dual-channel supply chain and present literature have a theoretical gap on the characteristic of three levels dual-channel supply chain, particularly if the manufacturer and the retailer both have opportunity to establish a direct channel, then what will be the characteristics of each channel. It motivates us to analyze following research questions: *Is introduction of dual-channel supply chain at all profitable to the channel member under non-cooperative scenario compared to single retail channel? What is the coordination mechanism that coordinates both manufacturer and retailer dual channels? Does the retailer always participate in manufacturer dual-channel or operate own dual-channel?*

This study attempts to provide answers such questions and to derive managerial insights for channel members. A growing body of literature on operations management has suggested that a high degree of supply chain coordination is needed in order to optimize the performance of chain. We refer to Cachon (2003), Simchi-Levi, Kaminsky, and Simchi-Levi (2008), Bahinipati, Kanda, and Deshmukh (2009), for surveys of coordination with contracts for a wide range of supply chain models. But studies on contracts that provide insights on how to coordinate a dual-channel supply chain are restricted. Under the assumption of demand uncertainty and fixed prices in the retail channel and the direct channel, Boyaci (2005) has 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. As a consequence several researchers propose various coordination strategies under two echelon supply chain (Cai, 2010, Wang, Zhou, & Sun, 2011). Chen, Zhang, and Sun (2012) investigated the manufacturer's pricing strategies in a dual-channel supply chain and found that the manufacturer's contract with a wholesale price and a price for the direct channel could coordinate the dual-channel supply channel. Modak, Panda, Sana, and Basu (2014) used all unit quantity discounts with agreement of franchise fees as the coordination contract mechanism to resolve channel conflict in a social responsible dual channel supply chain. Xu, Dan, Zhang, and Liu (2014) used a two-way revenue sharing contract to coordinate dual-channel supply chain. However, to the best of our knowledge, little attention has been paid to coordination issue in three level dual-channel supply chain. Saha (2016) discussed coordination policy of only manufacturer dual-channel supply chain under consisting and inconsistent pricing. Modak, Panda, and Sana (2015) developed a three-echelon dual channel supply chain and discussed efficiency of all unit quantity discount with the agreement of franchise fee for coordination and surplus profit distribution. Saha, Sarmah, and Moon (2016) analyzed a dual-channel supply chain with a reward driven remanufacturing policy and to coordinate the supply chain they proposed a three-way

discount mechanism for the manufacturer. Although there exist huge literature regarding different issues of dual-channel supply chain but preference issue of the channel member between the manufacturer and the retailer dual-channel supply chain is not yet studied.

To explore characteristics of the three level dual-channel supply chain, in this paper we consider a stylized supply chain with a manufacturer, a distributor and a retailer. Models are formed for manufacturer as well as retailer dual-channel under non-cooperative as well as cooperative structures. We have also derived the expressions of corresponding single retail channel supply chain. A two way price discount mechanism is used to coordinate each dual-channel. Under coordination, we identified the maximum achievable profit for the retailer under manufacturer and retailer dual-channel. Then a comprehensive analytical analysis is conducted to examine the performance of retailer and distributor under two dual-channel structures. Finally, it is analytically identified that the retailer has opportunity to gain more profit in own dual-channel instead of manufacturer dual channel. The rest of this paper is organized as follows. The models are formally developed for three different channel structures under non-cooperative as well as cooperative scenarios in section 2. In section 3, characteristics of both retailer and manufacturer dual-channel are derived and a preference analysis is conducted. Channel coordination through a two-way joint discount mechanism has been discussed in section 4. Finally, the conclusion and the future extensions of the model have been discussed in section 5. Concavity of all models, proofs of lemmas and theorems are given in appendix.

2. The problem description

Single period pricing policies are considered in a supply chain where a manufacturer produces products and supplies to an independent distributor in a single lot. Distributor delivers the product to a retailer, who sells the product to customers. We further assume that the manufacturer or the retailer may introduce a direct channel and corresponding three different scenarios are illustrated in Fig. 1.

In scenario-1, a manufacturer sells products through a direct channel to consumers as well as through the distributor as well as the retailer. In scenario-2, a manufacturer sells products through a retail channel to consumers but the retailer introduces direct channel as well retail channel. Scenario-3 represents a traditional retail channel supply chain. Let D_d denote the consumer demand to the direct channel and D_r the consumer demand to the retail channel and the two channels compete in a common market with the potential market size a. The selling price of the manufacturer and the retailer direct channel are p_{md} and p_{rd} respectively. The selling price of the manufacturer and the retailer retail channel are p_{mr} and p_{rr} respectively. The manufacturer and the distributor set the wholesale price p_m and p_d for the retail channel. Let β_1 represents the relative portion of price sensitivity in the retail channel. c_m is the unit cost incurred by the manufacturer. Following Chiang, Chhajed, and Hess (2003) and Hua, Wang, and Cheng (2010), we assume that both the distributor and the retailer have no merchandizing costs associated with selling the products to end customers for analytical simplicity. Following Kurata, Yao, and Liu (2007) and Huang and Swaminathan (2009), we assume linear demand functions with self- and cross-price effects i.e., the demand functions in the direct channel and retail channel are as follows: $D_d = (1-k)a - \beta_2 p_{id} + y_1(p_{ir} - p_{id})$ and $D_r = ka - \beta_1 p_{ir} - y_1(p_{ir} - p_{id}), i = m, r$. There is no direct channel in scenario-3, as a consequence the demand will be $D_d = 0$ and $D_r = a - \beta_1 p_r$. Here y_1 can be interpreted as the number of customer switches from the retail