



The effect of forward integration on a single-vendor–multi-retailer supply chain under retailer competition



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ABSTRACT

This paper studies a single-vendor–multi-retailer supply chain and considers the case where the vendor merges with one of its retailers. After the merger, the vendor supplies products to the market both through a direct (integrated) sales channel and through the remaining retailers. Different types of competition are considered for the retailers, namely volume competition, price competition, and no competition. The operations policies of the vendor and the retailers are considered explicitly in this paper by taking account of inventory carrying, setup and ordering costs that result from production and ordering decisions. We compare the pre-merger situation to the situation after the merger and show under which conditions the merger is beneficial to the vendor, the retailers, the supply chain, and the consumers. The results of our paper indicate that the type of competition is of major importance for the structure of the supply chain after the merger, and that under certain conditions, the merger may benefit all parties involved, i.e. the vendor, the retailers, and the consumers.

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1. Introduction

Competition in and between supply chains has frequently been the subject of research in the past. Among the various topics that have been studied in this area, the impact the structure of the supply chain exerts on the competitive position of the supply chain and its members has received increased attention in recent years. Popular research topics include the study of multi-channel distribution systems, vertical or horizontal mergers in supply chains or entries and exits at different echelons of the supply chain, to name just a few examples (cf. Section 2 for a survey of related literature).

The present paper adds to this literature by investigating a scenario that can frequently be observed in practice: A vendor (manufacturer), who delivers a product to multiple competing retailers, vertically integrates by merging with one of its retailers. Such a scenario recently occurred in Korea when a producer of cold-rolled plate, Hyundai Hysco (retailer) merged with a steel producer, Hyundai Steel (vendor), and it almost occurred when General Motors considered selling its European car manufacturer Opel to the Canadian automotive parts supplier Magna International in 2009. If a vertical merger takes place in a supply chain, two types of competition occur in the chain, which

are commonly referred to as vertical and horizontal competition (cf. Boyaci, 2005; Xu et al., 2014). In the case of vertical competition, the vendor and the retailers compete in the wholesale price and the consumer prices, which brings about the well-known double-marginalization problem (see also Spengler (1950)). Horizontal competition occurs instead if the vertically integrated vendor competes with its independent retailers in selling a substitutable product. In the case of horizontal competition, the vendor could try to discriminate the independent retailers to promote its direct distribution channel.

Vertical integration in supply chains has frequently been studied in the past. A closer look at the literature reveals, however, that the existing literature falls short in two major respects: First, our survey of the literature indicated that vertical integration was thus far studied for rather simple supply chains consisting of a single vendor and two retailers in most cases. The case where multiple retailers compete has not received much attention so far. Secondly, we found that the focus of prior research has been on pricing and on the design of contracts that coordinate the system, but that operational aspects, such as lot sizing, have often been neglected, as was also observed by Boyaci (2005). Our paper thus contributes to the literature by studying vertical integration in a single-vendor–multi-retailer supply chain and by directing special attention to the influence of the merger on the operations policies implemented in the system.

The remaining sections of the paper are organized as follows: The next section gives an overview of related research, and Section 3 develops mathematical models for the case of forward integration in

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a single-vendor–multi-retailer supply chain under different types of competition. Section 4 presents theoretical findings for the models developed in Section 3, and Section 5 presents numerical examples and reports the results of a comprehensive numerical experiment. Section 6 highlights managerial insights and concludes the paper.

2. Literature survey

Three different streams of research are of relevance to this paper. The first research stream studies the impact of vertical and horizontal mergers as well as entries and exits in supply chains on the profits of the members of the supply chain. In the second stream of research, authors study how the use of multi-channel distribution systems influences competition in an industry and how such systems can be coordinated with the help of contracts. Works that fall into the third research stream develop policies for coordinating the production and order cycles of a producer and multiple retailers. All three streams of research will be reviewed briefly in the following.

2.1. Research on supply chain structures

An early work that studied the effects of changes in the structure of a supply chain on competition among the supply chain members is the one of McGuire and Staelin (1983). The authors studied a market that consists of two producers selling their products through downstream retailers, where the latter exclusively carry their producer's products. The authors considered the case of vertical integration, where each manufacturer may purchase its downstream retailer. This leads to three different channel structures, namely a fully integrated case, a fully unintegrated case, and a mixed case. The authors compared these three cases and concluded that the relative advantage of the channel structures depends on the degree of substitutability between the two manufacturers' products at the retail level. Further, they showed that in case one manufacturer integrates, there is an incentive for the other manufacturer to integrate as well. A related work is the one of Tyagi (1999), who assumed that a set of competing, homogeneous retailers sources a product from a single supplier. The author examined the effects of market entry on the supply chain and showed that a downstream market entry does not – as is usually assumed in the literature – lead to a lower end customer price and a higher quantity that is sold on the market. Instead, the supplier, who is the Stackelberg leader, may vary its price to reduce the quantity offered in the market and to maximize its own profit. Koulamas and Kyriaris (2010) extended the model of Tyagi (1999) to account for variable costs at the buyer, which were assumed to decrease in the number of buyers in the market. In contrast to Tyagi (1999), they showed that in their modified model, the wholesale price depends on the number of buyers in the market, and that a market entry induces the supplier to increase its price. Anderson and Bao (2010) studied the case of n competing supply chains and assumed that either all are integrated (i.e. all manufacturers use a direct sales channel), or all are decentralized (i.e. all manufacturers sell the product via an independent retailer). Their analysis showed that small supply chains benefit from horizontal competition if the competition intensity is small, both in the integrated and decentralized cases. Corbett and Karmarkar (2001) considered a multi-stage supply chain with multiple competing actors at each stage. The authors studied how the entry of a new actor at a stage impacts competition, and showed that market entry at one stage impacts market entry at all other stages as well. Market entry was shown to result in a higher production quantity and a lower price. In addition to market entry, the authors also studied some cases of vertical integration, where a company can enter multiple tiers of the chain. For this scenario, they showed that in the unintegrated case, lower quantities are delivered to the market at higher prices. Further, they showed that integrating successive oligopolists reduces the joint

profit of these companies, while integrating successive monopolists increases their joint profits. When both integrated and unintegrated chains exist, the integrated chains perform better. Reyniers (2001) studied vertical integration between a manufacturer and a retailer and considered inventory and shipment costs. The author explicitly modelled inventory build-up and shipments from the manufacturer to the buyer and showed that vertical integration only leads to a reduction in the end customer price if inventory carrying costs are sufficiently low and market size is large. In the opposite case, a merger of the two parties leads to a price increase. Matsubayashi (2007) studied the case where two firms compete in price and quality. The author assumed that one of the firms may integrate with another company that offers a complementary product. In this case, all customers buy from the new integrated company, and the second firm drops out of the market. Subsequently, a second case was analyzed where customers may still buy the original product from the unintegrated firm together with the complimentary product. The results indicate that a situation where the original product can no longer be bought from the second firm benefits the integrated firm and its customers. For the case where the original product can still be purchased from the second, non-integrated company, the effect of integration on the system depends on the number of customers switching to the integrated firm. Wu et al. (2007) considered a system with two manufacturers and two competing retailers in a newsvendor setting. They assumed that demand is stochastic and studied under which conditions forward integration is beneficial to the manufacturer. Their results indicate that an increase in demand uncertainty increases the benefit of forward integration. Cho (2014) studied a multi-stage supply chain with multiple competing actors on each echelon and considered the case where a horizontal merger occurs at one of the stages. The author showed that consumer prices only fall if the merger occurs at the stage that is the leader of the supply chain. A merger at any other stage only reduces consumer prices when the marginal cost reduction caused by the merger exceeds a threshold that is larger than the pre-merger markup. This threshold increases as the supply chain gets longer. Another result obtained by the author is that upstream mergers are less likely to raise consumer prices than downstream mergers. Lin et al. (2014) studied the case of two competing three-echelon supply chains, where each supply chain consists of a single supplier, a single manufacturer, and a single retailer. The manufacturers at each stage were assumed to have the option to forward integrate, to backward integrate, or not to change the channel structure. For the direction of the integration, it was found that the degree of product perishability, the cost of quality, and how much consumers value quality are critical. Further, competition was found to increase the attractiveness of backward integration relative to forward integration. The results also indicate that vertical integration leads to higher quality products sold at lower retail prices, which is a result of reduced double marginalization. A similar scenario was studied in Wang et al. (2011). The authors considered a supply chain with two manufacturers, multiple competing retailers and three groups of customers and assumed that each manufacturer has the option to forward integrate.

2.2. Research on multi-channel distribution system

The study of multi-channel distribution systems has received considerable attention in recent years, especially in the marketing literature. Works that fall into this area usually study a manufacturer that uses a direct distribution channel in addition to an independent retailer to sell its product to the end customers. Chiang et al. (2003), for example, studied a situation where a manufacturer, who sells through one or more private retailers, opens a direct channel. The authors assumed that customers attribute a perceived value to the product, which depends on the channel selling the product. The perceived product value was assumed to be higher for the retailer than

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