Transportation Research Part E 87 (2016) 113–129

Contents lists available at ScienceDirect

Transportation Research Part E

journal homepage: www.elsevier.com/locate/tre

Delivery leadtime and channel structure decisions for make-to-order duopoly under different game scenarios

Tiaojun Xiao [a,b], Tsan-Ming Choi [c,*], T.C.E. Cheng [d,b]

[a] Institute of Game Behavior and Operations Management, Nanjing University of Finance and Economics, Nanjing 210046, China
[b] School of Management Science and Engineering, Nanjing University, Nanjing 210093, China
[c] Business Division, Institute of Textiles and Clothing, Faculty of Applied Science and Textiles, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong
[d] Faculty of Business, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

ARTICLE INFO

Article history:
Received 24 June 2015
Received in revised form 18 December 2015
Accepted 2 January 2016
Available online 29 January 2016

Keywords:
Channel structure
Leadtime
Strategic decentralization
Game theory
Supply chain management
Make-to-order manufacturer

ABSTRACT

We develop game-theoretic models to explore the quoted delivery leadtime, price, and channel structure decisions for a make-to-order duopoly system under three game scenarios. Under the integrated-manufacturer first scenario, we find that (i) decentralization of the supply chain increases quoted leadtime; and (ii) both manufacturers may choose different channel structures under symmetric duopoly. By comparing with the symmetric scenario and the retailer first scenario, we find that a manufacturer facing a decentralized rival adopts decentralization when leadtime sensitivity, leadtime cost, and price elasticity are very small; the effect of decentralization on quoted leadtime largely depends on game scenario.

1. Introduction

The make-to-order (MTO) manufacturers, such as those offering mass customization services to consumers, offer products that meet the specific needs of individual consumers at a cost (Choi, 2013; Yeung et al., 2010). This model of operations is popular in industries such as fashion apparel, home furniture, and office equipment industries. For example, fashion companies such as Nike, and Adidas both offer mass customization programs in which consumers can order customized apparel products from them. These companies compete by offering short leadtimes as well as appealing prices. Home furniture companies that offer MTO furniture to consumers are competing by price as well as leadtime. For manufacturers of office equipments and computers, such as Xerox and HP, they compete with each other by offering competitive prices and also delivering products within short leadtimes. In all of the above examples, an MTO manufacturer quotes a delivery leadtime to satisfy consumers' demands, in which a longer leadtime yields a higher consumer disutility because the consumers need to wait for a longer time. Although a shorter quoted leadtime can attract more consumers, the manufacturer must spend and invest more in capacity to deal with demand uncertainty. There is obviously a trade-off between (short) lead time and (high) cost.

Regarding the manufacturer's channel structure (CS) decision, we consider in this paper two mutually exclusive choices, namely integration and decentralization. In the decentralized CS setting, the manufacturer sells its product through the retailer from whom consumers order products, and the manufacturer and the retailer make decisions independently (based on their self-interests and objectives). Here the manufacturer decides the quoted leadtime and announces it to consumers

* Corresponding author. Tel.: +852 2766 6450.
E-mail addresses: xiaotj@nju.edu.cn (T. Xiao), jason.choi@polyu.edu.hk (T.-M. Choi), edwin.cheng@polyu.edu.hk (T.C.E. Cheng).

http://dx.doi.org/10.1016/j.tre.2016.01.003
1366-5545/

through the retailer. For example, in the furniture industry, Snimay (a manufacturer) sells products through Red Star Macalline (a retailer) in China. After obtaining the price and quoted leadtime information, a consumer can order a product from Red Star Macaline which sends the specific order to Snimay, and then Snimay produces and delivers it to the consumer. On the other hand, in the integrated CS setting, the manufacturer (e.g., a company like Shanzhong Classical Furniture, Aris, etc.) receives the orders from consumers directly and makes all the decisions with a view to maximizing the supply chain's channel profit. It is a rather common belief that in the single supply chain setting, an integrated manufacturer should perform better than a decentralized one because the decentralized supply chain suffers the double marginalization effect. This is why the mainstream literature on supply chain coordination focuses on developing proper incentive alignment schemes so that individual agents in the decentralized case will behave in the same way as the integrated case (Jeuland and Shugan, 1983; Ingene and Parry, 1995). However, this belief has been challenged by several findings that in the competitive environment, the manufacturer's resulting profit under the integrated setting may be worse than that under the decentralized setting (Balasubramanian and Bhardwaj, 2004; McGuire and Staelin, 1983). In fact, the competition among supply chains decreases the wholesale prices and retail prices, which has a negative effect on the channel profits. Decentralization of the supply chain raises the retail prices through the double marginalization effect, which offsets a part of the negative effect of channel competition. However, the manufacturer using the decentralization strategy only achieves a part of the channel profit. Thus, it is important for manufacturers to choose good CS strategies in the competitive environment (i.e., the entrant competes for consumers with the incumbent firm). In general, for obtaining analytically tractable results, the CS models consider a duopolistic competition rather than a perfect/oligopoly competition because duopolistic competition has reflected the effect of competition on price (McGuire and Staelin, 1983). In this paper, we also consider a duopolistic competition; specifically, we explore the case where two supply chains compete on price and delivery leadtime.

Intuitively, the manufacturer's CS strategy affects the retail price and quoted delivery leadtime decisions, which further influences market demand and the manufacturer's profit. It is well known that decentralization of the supply chain increases the retail price due to the double marginalization effect. However, it is unclear how decentralization of the supply chain affects the quoted leadtime and how the quoted leadtime decision affects the CS strategy, especially in the competitive environment (i.e., there exist competing incumbent firms). As a result, we examine the CS decision of an MTO manufacturer under duopoly, and explore the effects of CS on the price and leadtime decisions.

Motivated by both industrial features of MTO operations and recent findings in the literature, we develop in this paper duopoly gaming models to examine the delivery leadtime and CS strategies of two MTO manufacturers that compete on the price and delivery leadtime. Our main objective is to explore how the quoted leadtime depends on the CS strategy, and explain when and why "decentralized CS" is optimal for a manufacturer (and hence exists in practice). Following the probable cases on pricing sequence, we divide the discussions into three pricing game scenarios: the symmetric pricing power (simultaneously act) scenario, the integrated-manufacturer first scenario, and the retailer first scenario. In some cases, the headquarters of the integrated manufacturer first announces a retail price via the direct store in advance, where the direct store cannot change the retail price, and then the rival retailer announces the retail price, i.e., the integrated-manufacturer first scenario emerges. Sometimes, when the consumer's order arrives, the direct store of the integrated manufacturer communicates with the headquarters to decide the retail price, which delays the retail pricing decision, and the rival retailer first announces the retail price to take the first-mover advantage, i.e., the retailer first scenario emerges. We investigate the interactions among the optimal decisions on retail price, quoted leadtime, and CS, and illustrate how the CS strategy depends on the key factors such as price elasticity, leadtime sensitivity, and leadtime cost. We find that two manufacturers will choose decentralization when these key factors are very small for each game scenario. Unlike the extant literature, we find that two manufacturers may choose different CS strategies even when the respective two supply chains are fully symmetric; and decentralization of the supply chain increases the quoted leadtime. Comparing with the extant literature on CS, some new managerial insights are generated because we incorporate the leadtime competition into the model and explore the effect of the pricing game scenario on the CS decision. For example, we find that the pricing game scenario may reverse the effect of decentralization of the supply chain on the quoted leadtime; and whether two manufacturers choose different strategies or not depends on the pricing game scenario.

2. Literature review[1]

This paper is related to channel structure decisions in the competitive supply chains, pricing game scenario, channel coordination, and the price and leadtime competition.

As we pointed out earlier, decentralization and integration are two important decisions for an MTO manufacturer in the competitive environment. There are two streams of research on decentralization and integration. It is well known that in the monopoly setting, from the supply chain's perspective, the manufacturer has no incentive to adopt decentralization in its distribution channel due to the double marginalization effect. However, under duopoly, the situation is different. For example, McGuire and Staelin (1983) show that, when the two players at the same level are symmetric, the channel structures equilibrium are symmetric, and symmetric decentralization (both firms choose decentralization) is an equilibrium when product substitutability is sufficiently high. Bonanno and Vickers (1988) find that vertical separation is profitable under

[1] We sincerely thank an anonymous reviewer whose advice has substantially enhanced the coverage of this literature review section.