



Contents lists available at ScienceDirect

European Journal of Operational Research

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

Production, Manufacturing and Logistics

Competitive strategies and market segmentation for suppliers with substitutable products

Yu Xia*

Middle Tennessee State University, Department of Management and Marketing, Jennings A. Jones College of Business, Murfreesboro, TN 37132, USA

ARTICLE INFO

Article history:

Received 5 August 2009

Accepted 22 September 2010

Available online 1 October 2010

Keywords:

Supply chain management

Supplier price competition

Substitutable product

Market segmentation

Product preference

ABSTRACT

This research studies the competition between two coexisting suppliers in a two-echelon supply chain. The suppliers have different inventory cost structures (holding cost and setup cost). Each supplier offers one type of the two substitutable products to multiple buyers. Buyers' preferences between the substitutable products differ. Each buyer has a particular order profile (order frequency and quantity). A buyer chooses between the suppliers based on the prices offered by both suppliers and his/her own preference. A Hotelling-type model is used to describe buyers' preferences for the products. We are able to describe the conditions for buyers to switch between the suppliers, and therefore spot the buyer groups that may or may not switch when the suppliers compete. Pricing strategies for different buyer groups are suggested to the competitive suppliers accordingly. Furthermore, equilibrium prices, market segments, and overall profits for the suppliers are revealed based on Game Theory. An algorithm is also proposed to forecast buyers' reactions to suppliers' pricing strategies given the buyers' order profiles and preferences between the substitutable products.

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1. Introduction

Many supply chain management research papers have focused on the optimization and coordination between one supplier and one buyer or between one supplier and multiple buyers. However, in reality, a supply chain is more of a network than a simple channel. Fierce competition exists among suppliers, especially those offering substitutable products. The competition between suppliers is the focus of this research.

In studying supplier competition, research papers in operations management focus on supplier operating efficiency; while research papers in marketing and economic areas emphasize buyer loyalty and product preference, neither approach can fully describe a competitive market. Take the telecommunication equipment market for example. Ten years ago, American company Lucent Technology and French company Alcatel were the two major competitors in the market. Both of them operated efficiently and had loyal customer groups. In the year 2000, Lucent started to adjust its operating strategy by outsourcing production processes and focusing on marketing and research. At the beginning, the company successfully changed some of the customers' preferences, and expanded market share. However, as the outsourcing processes started to lose control, Lucent's logistic system was crushed. On one hand, regular parts and semi-products accumulated in warehouses; on the other hand, critical parts were always missing. Lucent had to frequently delay delivery times. Inventory cost rose dramatically (Hoyt, 2001). The company then rapidly lost its market share and was acquired by Alcatel in year 2006. This practical example tells us that both operating efficiency and buyer preference need to be considered in supplier competition, which is exactly what we try to do in this research.

Although suppliers compete on many levels (for example, product quality, customer service, additional service packages, technology support, etc.), price competition between suppliers is inevitable and critical. Suppliers must determine their pricing strategies based on their own cost structures, their market "sweet spots," and buyers' preferences and loyalty. They then act and react to their competitors' attempts to earn maximized long-term profits. In other words, a supplier's pricing strategy must never be an aimless price fight but a rational action adjusted to specific competitive situations.

Buyers may switch between suppliers when there are better deals. Although buyers tend to stick with their current or previous decisions, they switch to the supplier offering a lower price when certain conditions are met (Samuelson and Zeckhauser, 1988). Buyers'

* Tel.: +1 615 494 8993; fax: +1 615 898 5308.

E-mail address: axia@mtsu.edu

preferences between suppliers and their possible switching decisions further intensify the competition between suppliers, thus lowering prices, and therefore must never be ignored in analyzing competition in marketplaces or in deciding pricing strategies for suppliers.

In this paper, we try to understand the market competition and pricing strategies for suppliers in a supply chain with two competitive suppliers and multiple buyers. The buyers choose and switch between the suppliers. The operations management view is followed in estimating the inventory cost of the supply chain; however, the ideas of product preference and switching cost from marketing and economic perspectives are also included. We then linked the suppliers' inventory costs and buyers' switching decisions with the suppliers' market segments and pricing strategies. Game Theory ideas are used to find the equilibrium prices and market segments in different competitive situations.

Our analysis follows the subsequent major steps. First, the pricing strategies, market segments, and profits are determined for the competing suppliers when their costs vary and buyers' preferences differ. Then, buyers' order profiles are associated with the inventory costs of the suppliers. Thus, we are able to connect suppliers' pricing strategies with buyers' order profiles and describe the suppliers' marketing segmentation.

Our research results aim to answer the following questions:

- What should be the suppliers' pricing strategies for a certain buyer given the buyer's order profile and preference regarding the substitutable products?
- What sort of buyers may switch between suppliers, and what sort of buyers may tend to stick with their suppliers?
- How do buyers' order profiles and preferences affect supplier competition and market segments?
- How do pricing strategies change a supplier's market segment and corresponding profit in a competitive environment?

The structure of this paper is as follows. A brief literature review is provided in Section 2. The model is introduced in Section 3. Equilibrium prices, market segments, and profits for the competing suppliers are analyzed in Section 4. We then connect the inventory cost efficiencies of the suppliers with buyers' order profiles and describe market segmentation in term of buyers' order profiles in Section 5. Numerical examples are provided in Section 6. In Section 7, contributions of the research are stated; limitations and possible future research ideas are discussed.

2. Literature review

Recently, competition in supply chains has received more and more attention in operations management study as well as in market and economic literature.

In operations, most research on supplier competition focuses on traditional factors such as price discount, operation cost, and capacity. Choi (1991) examines two suppliers whose partially substitutable products are sold through a common buyer, while Choi (1996) considers two suppliers using two common buyers that price-compete with each other. O'Brien and Shaffer (1993) address the question of whether competing suppliers should sell through a common buyer or exclusive buyers. Chiang and Monahan (2002) advise a supplier on how to set inventory levels when distribution occurs through one direct sales channel and one company-owned store, given that each customer has an initial preference for one of the channel types.

Some other research papers in operations management study supplier competition through buyers' choices, such as whom to purchase from, the number of suppliers to keep and work with, the allocation of orders among suppliers, etc. The choices are mainly based on various demand conditions, required service level, risks, or costs. Considering risks associated with a supplier network and various financial loss functions, Berger et al. (2004) and Berger and Zeng (2006) present a decision-tree based model (BGZ model) to determine the optimal number of suppliers for a firm. Ruiz-Torres and Mahmoodi (2006, 2007) present an extension of the BGZ model by considering the presence of supplier failure risks and equal failure probabilities. Yu et al. (2009) evaluate the impacts of supply disruption risks in the choice between single and dual sources. Xiao and Qi (2008) examine the effects of price competition and demand disruption on the coordination of a dual sourcing system. Matsubayashi and Yamada (2008) show that in moderately quality-sensitive and price-sensitive markets, higher consumers' sensitivity as well as lower consumers' loyalty to any firm leads to intense competition, resulting in a decrease of both firms' equilibrium profits. The greedy algorithm (Chen et al., 2001), discrete-time Markov chain (Smith et al., 2006), and frontier portfolio (Yue et al., 2009) are used to approach the optimal or acceptable allocations of buyer orders to chosen suppliers.

Marketing and economic literature includes other factors in supplier competition. One of the most important factors considered is a buyer's preference for different products. Even with the same price and product quality, some buyers may prefer one product to another due to brand loyalty, product design, or perceived quality. A standard Hotelling model is a well-accepted approach in describing product differentiation among buyers since D'Aspremont et al. (1979). Bloch and Manceau (1999) analyze the effect of persuasive advertising in a Hotelling model where consumers differ in their tastes for two competing products. The paper also introduces a cost for a buyer to buy a product different from his/her ideal choice. The cost is linearly related to the distance between the buyer's preference location and the location of the product. A stream of research papers followed the ideas (Shaffer and Zettelmeyer, 2004; Chioveanu, 2008; Chen et al., 2009; Granot et al., 2010). Subramaniam and Gal-Or (2009) even extend the standard Hotelling model to two dimensions: buyers' relative preference for the products and the marginal benefit they derive from increased consumption of the product.

Although supplier competition has been studied through different factors in operations research, most of the research papers focus on suppliers' logistic strategies in competition, the related market segmentation is excluded. Xia et al. (2008) find the market segmentation and equilibrium pricing strategy for suppliers through the competition of inventory cost efficiency in serving different buyers. However, buyer preference, the traditional marketing factor, is not included in describing the competition and market segmentation.

There is only scarce operations research on supplier switching, although the fact that buyers constantly search for resources offering favorable prices is well accepted in both academic research and business practice. Wagner and Friedl (2007) introduce a fixed switching cost when a buyer includes a supplier in his/her purchase decision. They find conditions under which switches occur and provide broader implications for supplier relationship management and sourcing strategy decisions. Gallay and Hongler (2008) consider market sharing dynamics between two service providers while the transaction between the brands characterized by a Hotelling model.

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