



Production, Manufacturing and Logistics

Optimal ordering and pricing strategies in the presence of a B2B spot market

Wei Xing^{a,*}, Shouyang Wang^b, Liming Liu^c^aSchool of Management, Qufu Normal University, Shandong 276826, China^bAcademy of Mathematics and Systems Science, Chinese Academy of Science, Beijing 100080, China^cFaculty of Business, Lingnan University, Hong Kong, China

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ABSTRACT

In the current paper, we examine the effect of a B2B spot market on the strategic behavior and the performance of a reseller who continues to use the traditional channel while participating in a B2B spot market. We analyze the case in which a risk-neutral reseller faces an additive or multiplicative demand function and identify sufficient conditions under which the optimal order quantity and retail price exist and are unique. We then analytically examine the case in which a risk-averse reseller participates in a fully liquid spot market. We also study numerically how varying liquidity, spot price volatility, demand variability, and correlation coefficient affect a firm's strategies and performance. We find that demand variability significantly affects both pricing and ordering strategies, whereas the spot price volatility has less influence on pricing decisions. Our results also show that for a risk-averse reseller to charge a lower retail price when the spot market liquidity increases is desirable. We further show that a B2B spot market cannot always improve a reseller's utility. These findings shed light on how resellers can adjust their procurement and pricing strategies to align with the new business environment created by the emergence of B2B spot markets, as well as have obvious implications for the development of a B2B spot market.

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1. Introduction

Many organizations predicted that B2B spot markets (online spot markets or e-marketplaces) would have a grand future (e.g., Gartner Group, 2004; e-Marketer, 2002). However, the development of B2B spot markets has not been smooth. Expected by many to be the next major innovation in business, many B2B spot markets sprang up virtually overnight between 1999 and 2000, and a tremendous amount of capital was poured in (Kaplan and Sawhney, 2000). However, the frenzied development came to a halt by the end of 2000 (Grey et al., 2005). During these gloomy years, many B2B spot markets failed or were merged (Brunn et al., 2002). The boom and burst of the dot com during that period created skepticism about the future of B2B spot markets. However, many did not lose hope, and the development continues until today. In recent years, hundreds of B2B spot markets have opened or reopened on the Internet. Many commodity products, such as commodity metal, chemical products, semiconductors, plastics, and agricultural products, are traded over B2B spot markets. In China alone, over 100 B2B spot markets have been established since 2000, many of which have achieved reasonable success. BOCE (www.boce.cn, Tianjin), a leading B2B spot market for crude oil,

coke, and rebar, has achieved an average daily trading volume of more than 100,000 metric tons on rebar.

Resellers are major participants of B2B spot markets for commodity products. B2B spot markets can be a double-edged sword to resellers. On the one hand, resellers can offload their excessive inventories and eliminate stockout costs through B2B spot markets. They can earn additional revenue by speculating (purchasing more through contracts and then selling) in B2B spot markets. On the other hand, trading in B2B spot markets also exposes resellers to price volatility. Therefore, to participate in a B2B spot market, a reseller needs to tailor his/her pricing and procurement strategies to the new business environment. However, for many resellers, there is a lack of understanding of this evolving business environment, which may limit the participation of resellers in the B2B spot market. Clearly, how a B2B spot market serves or is perceived to serve the reseller needs is crucial to its success.

Another critical concern for resellers is the lack of liquidity in the B2B spot market. As many B2B spot markets are still in their early development stage, most of them cannot provide buyers or sellers with perfect matches. In such business environment, resellers cannot effectively offload their excessive inventories or procure the shortfall in the spot market. In addition, the speculation behavior may also be affected by the imperfectness of the spot market access. Therefore, resellers should develop different pricing and procurement strategies for different market liquidities, but it

* Corresponding author.

E-mail address: xingweimail@gmail.com (W. Xing).

cannot be done properly without a clear understanding of the effect of the spot market liquidity. Motivated by the concerns elaborated above, we consider a single-period inventory model in which a reseller participating in a B2B spot market faces an uncertain price-sensitive demand. The reseller makes a procurement-quantity decision and a selling-price (retail price) decision simultaneously before spot trading with the objective of maximizing his/her expected utility. We consider two types of resellers, that is, the risk-neutral reseller and the risk-averse reseller, and investigate how the B2B spot market affects the reseller's strategies by focusing on such characteristics as price sensitivity, demand uncertainty, and price volatility.

The rest of this paper is organized as follows. Section 2 reviews the relevant literature. Section 3 describes the basic model. Section 4 presents the strategies for a risk-neutral reseller. In Section 5, we examine the strategies for a risk-averse reseller. We first analytically investigate optimal strategies with a fully liquid B2B spot market and an additive demand function, and then numerically investigate the effects of the B2B spot market on the reseller's strategies. Finally in Section 6, we give the concluding remarks and present some issues for future research.

2. Literature review

The popularity and development of B2B spot markets have stimulated extensive research in the last 10 years. Detailed reviews of research on B2B spot markets from a supply chain perspective can be found in Swaminathan and Tayur (2003), Grieger (2003), Eng (2004), Grey et al. (2005), and Haksöz and Seshadri (2007). Here, we only review the works closely related to this paper.

The emergence of B2B spot markets has provided manufacturers and resellers with a new business avenue while forcing them to adjust their strategies to align with the new business environment. Thus, a key question is how the procurement and pricing strategies of a reseller will be affected by the presence of a B2B spot market. Motivated by HP's Internet-based exchange TradingHub.com, Lee and Whang (2002) use a two-period newsvendor model to explore the effect of a secondary market, which can readjust resellers' inventories. They show that although the sales volume of the manufacturer may increase or decrease, the secondary market can always improve the supply chain performance. Peleg et al. (2002) compare three procurement strategies using the long-term relationship-based contract, the short-term spot market, and the combination of both. They find that the optimal strategy depends on the market characteristics. Etzion and Pinker (2008) study the asymmetric competition between two types of suppliers in a B2B spot market environment; one uses the combination of forward contracts and spot market, whereas the other utilizes only the spot market. They find that the supplier with forward contracts can benefit from the spot market more than the supplier without using forward contracts. Wu et al. (2002) examine the capacity reservation contract strategy for a capital-intensive product. The buyer purchases a certain amount of option contracts from the seller. On exercising day, both the buyer and the seller can sell excess capacities or buy additional quantities in a spot market. Buyers's optimal reservation quantity depends on both the reservation cost and execution cost, whereas the seller's optimal strategy is to set the execution cost as low as possible. Spinler and Huchzermeier (2006) extend Wu et al.'s (2002) results to the case in which the buyer's demand function is state dependent. They show that the combination of the option contract and the spot market is a Pareto improvement compared with other market structures. Seifert et al. (2004) analyze the benefits of an online spot market from the supply chain operational perspective. In their model, the buyer can procure through forward contract or

the spot market. In spot trading, the commodity can be both bought and sold through the spot market. The optimal procurement strategies are analyzed based on different market situations. Their result shows that a significant profit can be achieved through the readjustment of the order quantity. Martínez-de-Albéniz and Simchi-Levi (2006) study a risk-averse manufacturer's portfolio procurement strategy option contract and having access to a spot market. The analysis of Serel et al. (2001) and Inderfurth and Kelle (2011) of the capacity reservation in the presence of a spot market is also an interesting source of information. The model presented in the current paper differs from the above mentioned studies in that it incorporates optimal pricing and ordering decisions in the presence of price-dependent stochastic demands in the resell channel and an exogenous random price in the spot market. The reseller's risk attitude is also considered. These factors enable us to study from different angles the effects of a B2B spot market on the performance and strategic behaviors of a reseller.

Our work relates to the literature on joint ordering and pricing decisions. A recent work on this area is by Petruzzi and Dada (1999), who study a newsvendor problem in which the reseller has to make the stocking and pricing decision simultaneously. They analyze the effect of the nature of the stochastic demand function on the pricing and stocking decisions. Elmaghraby and Keskinocak (2003) and Yano and Gilbert (2003) examine the various related issues and provide comprehensive reviews. Recently, Bernstein and Federguen (2005), Ray et al. (2005), and Song et al. (2008), among others, have studied the joint decision problem in a price-dependent stochastic setting. Studies also address the combined pricing and ordering strategy of a risk-averse newsvendor. For example, Agrawal and Seshadri (2000) model risk aversion with the general utility function, Chen et al. (2007) extend Agrawal and Seshadri's (2000) model to a multi-period setting, and Chen et al. (2009) use CVaR as risk criteria. Our focus is different. We examine the effect of B2B spot markets with a volatile price on the strategies and performance of a reseller.

3. Basic model description

We consider a one-period model in which the decisions and events form a three-stage process, as shown in Fig. 1. Before the selling season, i.e., at T_0 , knowing the procurement price w and facing a random price-sensitive demand D , the reseller decides the quantity q to order through forward contract and the retail price p_r for the resell channel simultaneously. During the selling season T_1 , knowing the realized demand and spot price, the reseller can sell his/her excessive inventory or buy some extra products through the B2B spot market. After the selling season, i.e., at T_2 , the spot market is closed, and the unsold surplus is salvaged at price s . To avoid trivial outcomes, we assume that $s < w$. A newsvendor type model is formulated to study the procurement and pricing decision of a reseller who faces uncertain future demand and a spot market with an uncertain exogenous spot price. We assume that the reseller cannot reorder from the manufacturer during the selling season. The reseller, such as catalog resellers or resellers with planned promotional campaigns, cannot change the price during the whole selling season. These kinds of decisions

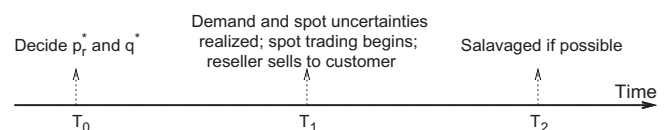


Fig. 1. Sequence of events on a timeline.

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