Int. J. Production Economics 148 (2014) 81–89

Contents lists available at ScienceDirect

Int. J. Production Economics

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

Supply chain coordination with customer returns and refund-dependent demand

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ARTICLE INFO

Article history:
Received 8 May 2013
Accepted 12 November 2013
Available online 18 November 2013

Keywords:
Customer returns
Demand uncertainty
Coordination
Buyback policy
Refund-dependent demand

ABSTRACT

This paper examines a supply chain consisting of a single manufacturer and a single retailer, who faces with demand uncertainty. We investigate how customer returns influence the retailer's ordering decision as well as the profits of the manufacturer and the retailer. When the refund amount is exogenous, the supply chain can be coordinated by the buyback contract. We then treat the refund amount as a decision variable and show that in that case the buyback contract generally cannot coordinate the supply chain. We numerically illustrate and measure the profit loss to the supply chain due to this lack of coordination.

1. Introduction

Accepting customer returns has been an important device for retailers to attract customers and stimulate demand (Pinkerton, 1997; Trager, 2000; Wood, 2001), in the increasingly competitive market environment. To draw customers' attention, many retailers permit partial or even full refund. Such customer returns policies can enhance customers' confidence in purchasing the goods, stimulating the demand and possibly increasing the retailer's market share.[1] It has been shown that return policies stimulate emotional responses and positively impact customers' willingness to pay and purchase intentions (Suwelack et al., 2011).[2] According to Mollenkopf et al. (2011), return management can create value for customers.[3] However, despite the positive benefits that return policies encapsulates, they also bear some negative implications. For example, return policies are bound to increase the retailers' and the manufacturers' processing cost,[4] or may even devaluate the goods and delay sales if the returned goods are resold after some processing. It has been reported that the value of products returned in the United States has exceeded $100 billion per year (Stock et al., 2002). Hence, in offering a customer return policy, the retailer needs to consider both the positive and negative effects. So from an operational standpoint, a natural question emerges: how should the retailer design the customer returns policies, or more specifically, how should the positive and negative effects of customer returns be traded off to yield greater profits?

Such refund policies are particularly important for online distribution channels, where consumers cannot try and examine the products before purchase. Consider, for example, the case of Amazon.com. If the reason for return is not due to an error of Amazon, then the cost of return shipping is deducted from the refund. Some products have different policies or requirements. For example, for items in original condition past the return window, the refund amount is 80% of the item's price.[5]

The scope of the paper, however, is not limited to the retailer's perspective, as we seek to integrate the entire supply chain, namely, the interaction between the retailer and the upstream supplier. Indeed, contractual decisions made by the supplier can critically affect decisions made by the downstream retailer. Oftentimes, the retailer and the supplier have some agreement in place to take care of the excess inventory. A commonly used contract is the "buyback policy", which has been also referred to as "returns policy". In this paper, we use the former term, "buyback policy", to refer to the arrangements between the manufacturer and the

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[1] It has been argued that return policies could also signal the product's quality when customers cannot verify the quality ahead of the purchase (Moorthy and Srinivasan, 1995; Shieh, 1996). When this is the sole purpose of the return policy then, in the absence of moral hazard, full refunds are optimal.

[2] Suwelack et al. (2011) have further shown that the design of the refund policy and that the type of product in consideration also affect customers' decision making.

[3] Specifically, Mollenkopf et al. (2011) develop a framework for customer value across six categories: the return management policy, return processing, product quality, service support, personal interaction, and supplier know how.

[4] For example, through impact on staffing levels (Guide and van Wassenhove, 2001).

[5] See www.amazon.com/gp/help/customer/display.html/ref=hp_left_v4_sib/176-1210622-1489529?ie=UTF8&nodeId=901926.

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http://dx.doi.org/10.1016/j.ijpe.2013.11.009

retailer, to be distinguished from the retailer–customer agreement, to which we refer as "refund policy".

Our study is motivated by general practices in various markets and in particular by the book industry, where buyback contracts have been adopted by agents of the supply chain. Retailers in many industries generally accept customer returns. Returned good could be perceived as used, and the refund amount is set according to the damaged degree (unopened, open box, package missing), the cost of return shipping. Simultaneously, upstream suppliers provide buyback contracts to share the cost of return and to encourage the retailer to increase the order amount.

Therefore, it is of great importance to study how to set the refund policy in a centralized and decentralized supply chains. Accordingly, we build the customer returns model under demand and customer valuation uncertainty. We first assume the refund amount as being set exogenously (Xiao et al., 2010) and examine how the refund amount impacts the supply chain. Then, we treat the refund amount as a decision variable, and study the optimal refund decisions and whether supply chain can be coordinated by buyback policy. Our main contribution is in the internalization of the refund policy and the resulting insight that in such a situation a buyback contract will generally *not* coordinate the supply chain any longer.

The rest of this paper is organized as follows. In the next section, we review the related literature. Then, we introduce the modeling approach for customer returns and the notation in Section 3. Section 4 introduces the basic model. Section 5 studies coordination of the supply chain via buyback contract under partial refund policy, where the refund amount is exogenous. Then, in Section 6, the refund amount is treated as a decision variable and we derive the optimal order quantity and refund amount in the centralized and decentralized cases, respectively. We demonstrate that since the refund amount is endogenous, the supply chain cannot be coordinated any longer. Section 7 summarizes the results and directs the future work.

2. Literature review

There are two streams of literatures related to our paper. The first one is on customer returns policy in supply chain management. The second is on buyback policy in coordinating a supply chain. We briefly review both streams herein.

The first focus of the literature examines customer returns policy. Some studies have examined partial refunds. Indeed, a Wall Street Journal article (Merrick and Brat, 2005) described the trend towards increasingly tougher return policy: "for several years, retailers have been making return policy more and more strictly. Sears, for example, now imposes a restocking fee of 15% for some products."

Researchers mainly investigated the optimal decisions problem in a single-echelon supply chain. Ringbom and Oz (2004) used partial refunds in advance booking, and developed methods for calculating profit-maximizing and socially optimal rates of partial refunds on customers' no-shows and cancellations. Mukhopadhyay and Setoputro (2004) saw the refund amount as a decision variable and developed a profit-maximization model to obtain optimal policies for price and the return policy in terms of certain market reaction parameters. When mass customization (MC) companies are considered to be risk-averse, Liu et al. (2012) studied the optimal policy with three dimensional decisions on pricing, consumer return, and level of modularity. Choi (2013) analytically examined the optimal return service charge policy. Li et al. (2013) examined the impact of online distributor's return policy, product quality and pricing strategy on the customer's purchase and the return decisions. And they studied direct distributor's pricing strategy, the return policy and the quality policy in four scenarios, where customer's demand was sensitive to price or the return policy, as well as where return was sensitive to the return policy or quality. In our paper, we study a two-echelon supply chain and also investigate the interaction between the upstream supplier and the downstream retailer under customer returns.

The second focus is on buyback policy. Buyback policy has been extensively studied in the existing literature. Pasternack (1985) first considered buyback policies for a seasonal product with stochastic demand under the newsvendor framework. He examined that buyback contract could coordinate the supply chain and improve its performance.[6] More recent researches on buyback policies introduced other managerial problems. Yue and Raghunathan (2007) examined the impact of a full returns policy on a supply chain with demand information asymmetry between a manufacturer and a retailer. Ding and Chen (2008) considered the case where an assembler who also acted as a retailer faced two complementary suppliers. The return policies between each supplier and the assembler reacted on each other and happened to fully coordinate the whole system in equilibrium. Yao et al. (2008) numerically showed that a returns policy improved supply chain performance. However, under price-sensitive and variable demand, the benefits earned from the returns policy were different for different supply chain partners. Specifically, when price-sensitivity is high, the profit of the manufacturer decreases with increase in demand variability, and compared with a wholesale price contract, the retailer is always worse off when returns policies are employed. He and Zhao (2012) investigated coordination in multi-echelon supply chain under supply and demand uncertainty. They showed a returns policy used by the manufacturer and the retailer, combined with the wholesale price contract used by the raw-material supplier and the manufacturer, could perfectly coordinate the supply chain. To complement the supply chain literature on returns policies, in our work we further integrate a refund policy offered by the retailer to his customers.

However, buyback policy cannot coordinate the supply chain under some certain conditions. Emmons and Gilbert (1998) extended Pasternack's (1985) work by incorporating retailer's pricing decisions and showed that channel coordination using buy-back contracts might no longer be feasible, unless the retailer could commit to the selling price prior to the selling season. Cachon (2001) achieved that the supply chain cannot be coordinated by buyback policy when the retail price was considered to be exogenously given. Under very general assumptions on the form of the effort function, Krishnan et al. (2004)showed that buybacks adversely affected supply chain profits, and higher buy-back prices implied lower profits. For both symmetric-k and asymmetric-k-knowledge situations, Lau et al. (2008) revealed the widely studied buyback and revenue-sharing formats turn out to be largely ineffective when implemented by a dominant retailer.

Some existing literature investigates supply chain coordination under customer returns policy. It has focused on full refunds, which is a 100% money-back-guarantee (MBG) offered to ensure consumer satisfaction. Williams and Gerstner (2006) reported that, in their limited sample, 87% of the stores offered full money back guarantee within a "return period". Rocio (2007) and Chen and Bell (2011) examined supply chain coordination with buyback contract under customer returns were a fixed proportion of quantity sold. Further, through numerical analysis, Rocio and Ana (2013) showed that better coordination of the supply chain could be achieved when the players acting in a decentralized fashion did not consider any information about customer returns. However, they have not considered

[6] Other coordinating mechanisms exist, such as wholesale price contract, revenue sharing contract, quantity flexibility contract, and sales-rebate contract (see Cachon, 2001).