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Product quality and return policy in a supply chain under risk aversion of a supplier

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ABSTRACT

This study aims to identify the relationship between return policy and product quality decisions in a decentralized system. We consider a supply chain situation, as in a retail or OEM supply chain system, where a buyer decides a return policy for consumers and delegates the product quality decision to a supplier. We consider the supplier's different risk attitudes, whether risk averse or risk neutral. A penalty contract is introduced to control the supplier's hidden action, conveying external failures due to returns to the supplier. We show the conditions for supply chain coordination and demonstrate that product quality enhancement needs to precede a generous return policy setting in view of the prevalent business environment and current supply chain management practices. Moreover, we indicate the optimal conditions for a generous return policy setting without quality enhancement.

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1. Introduction

In the purchase decision, consumers often do not have enough information about the true quality of a product. Therefore, a firm's after-sales assurance policies, such as return policy and warranty, play an important role in consumers' purchasing decisions, through mitigating consumers' risk by insuring for quality dissatisfaction (Balachander, 2001). A recent survey indicates that more than 70% of consumers consider a product's return policy before purchase (Mukhopadhyay and Setaputra, 2007), and there are many companies renowned for their return policies, such as a 365-day return policy of Zappos.com (2012) and a buyer protection program of Hyundai Motor (Wall Street Journal, 2009). The return policy has now become an important competitive element for most businesses. Although a return policy enhances the consumers' buying intention, a firm must consider its tradeoff. A more generous return policy increases the probability of returns (Davis et al., 1998), so it can adversely affect a firm's profitability by increasing external failure costs, already considered serious issues. In fact, the annual value of returns is estimated at $100 billion in the U.S. (Stock et al., 2002). The return rates range from 5% to 9% of sales to as high as 25% to 40% of sales in the high-fashion apparel industry (Chen and Bell, 2011).

Another main motivation behind commercial returns is the quality problem. It pertains not only to defect problems related to conformance quality but also to consumer dissatisfaction with design quality of a product, related to the specifications or characteristics of a product that fulfill consumers' needs and preferences (Jacobs et al., 2008). A survey of 45 apparel manufacturers by Reverse Logistics Executive Council (1999) reveals that the average return rate amounts to 19.44%, of which 21.98% is due to consumer dissatisfaction from the mismatch between product design and consumers' needs, and 49.45% is due to defect problems. A survey of Hewlett-Packard printers by Guide et al. (2006) also shows that 40% of the returns pertain to product performance not meeting the consumers' expectations, while 20% of the returns are related to conformance quality problems. Thus, we use the term “quality” to refer to overall aspects of quality, including both design and conformance, since both aspects are of interest to consumers not only when they evaluate the product, but also when they face return-related issues.

While it is clear that the quality problem is the primary reason why a return policy is needed, several questions remain, especially about the relationship between the return policy setting and product quality. In practice, we often observe various return policies even among direct competitors (Ketzenberg and Zuidwijk, 2009), and there are many retailers, selling common goods but differentiating their return policies (MSN Money, 2013). However, it is difficult to find the literature revealing the relationship between the generous return policy setting and the level of product quality. Even though there have been some studies investigating the relationship between quality and assurance policies, their focus have been on product warranties (Balachander, 2001). Thus, we will build a comprehensive model incorporating quality enhancement efforts and return policy setting, and then we will answer the following

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questions: *What is the relationship between quality and return policy*? *Which of these two aspects needs to be prioritized in a contemporary business environment*?

To investigate the quality-related return issues, we also need to consider that product quality is the result of the interaction between various members of a supply chain. A product can fail to satisfy consumers due to poor quality of any of the supply chain members. Particularly in OEM or retail supply chains, most quality decisions are made at a supplier's end, regardless of design or conformance. However, the external failure cost is incurred at a buyer which faces consumers (Balachandran and Radhakrishnan, 2005). Therefore, this study considers a penalty contract based on external failure to control the supplier's action in a decentralized system, which is becoming common in practice (Balachandran and Radhakrishnan, 2005). Under this two-stage return (and penalty) policy, we also consider the supplier's risk aversion. The firm sizes and bargaining power of suppliers are various in a practical supply chain, and thus suppliers can have different risk attitudes (McMillan, 1990). Moreover, suppliers can have different incentives based on their respective risk attitudes (Choi et al., 2008). Therefore, we focus on investigating the interaction between a buyer, who decides a two-stage return policy for both consumers and supplier as a focal company, and a supplier, responsible for overall aspects of product quality, to answer the other main question of this study: *Can a buyer coordinate the opportunistic behavior of a supplier when a supplier is either risk averse or risk neutral*?

2. Literature review

Many recent studies have addressed various aspects associated with return-related issues. These include joint inventory optimization for new and remanufactured products (Atasu and Çetinkaya, 2006; Tai and Ching, 2014); pricing and quantity decision of new and refurbished products based on the queuing network model (Vorasayan and Ryan, 2006); ordering decision, considering sales of returned products based on the newsvendor problem (Mostard and Teunter, 2006); joint decision on procurement and production quantities with the refurbishment of returned items (Zikopoulos and Tagaras, 2007); supply chain coordination using product returns under limited and stochastic salvage capacity (Lee and Rhee, 2007); disposition decisions for product returns between salvage and rework (Guide et al., 2008); investigation of the effect of imperfect return information on inventory management performance (De Brito and van der Laan, 2009); pricing of remanufactured product returned after the leasing (Aras et al., 2011); and pricing and ordering quantity decision, considering consumer returns and demand uncertainty (Chen and Bell, 2011).

Amongst these studies, many studies have also focused on various issues relevant to the return policy decision. However, most studies considered the interaction between a buyer (a seller) and a supplier (a manufacturer) in the upstream supply chain, investigating the ordering quantity decision in a buyback contract under the issue of demand uncertainty and left-over inventory (e.g., Padmanabhan and Png (1997, 2004), Tsay (2001) and Zhao (2008); see Cachon (2003) for more details). Only a few studies are directly related to the main concern of this study, the return policy decision between a firm and general consumers in the downstream supply chain.

Davis et al. (1998) investigated the return policy of a retailer that sets a full refund or no refund policy for returns. They pointed out that various characteristics of a product need to be considered when setting the return policy, such as cross-selling opportunity, salvage value, and moral hazard of consumer returns. Mukhopadhyay and Setoputro (2004) proposed a joint pricing and return policy model in the B2C e-commerce environment where a manufacturer sells a product directly to consumers. They used the refund price as a proxy for the return policy setting. Then, Mukhopadhyay and Setoputro (2005) also investigated a joint decision model for product modularity and return policy for build-to-order products. Mukhopadhyay and Setaputra (2007) presented a dynamic model to investigate the joint decision on price, product design and return policy. They compared the pricing and return policies over various product life cycle stages through numerical analyses. Ketzenberg and Zuidwijk (2009) investigated a two-period model for joint decision on price, return policy, and ordering quantity under the newsvendor setting. They classified the types of products into innovative and functional by considering the sensitivity of demand to price and return policy, return fraction, and volatility of market size and returns. Extensive numerical analyses indicated that the type of product needs to be considered in order to enhance the supply chain performance through investments. Xiao et al. (2010) investigated the coordination issue under conditions of demand uncertainty and consumer returns in a manufacturer–retailer supply chain. They consider a buyback/markdown money contract and investigate how the return policy of the retailer can be coordinated. Shulman et al. (2011) investigated a joint decision model for pricing and return policy. They used the restocking fee of a consumer, a financial penalty for a return, to define the return policy. They focused on product returns owing to lack of information about the product's fit with consumers' preferences. They showed that competition between firms can induce a stricter return policy. Li et al. (2013) examined the effect of return policy, product quality and pricing strategy in online direct selling. They showed that the return policy decision can be complementary with product quality and pricing decisions.

On the other hand, some previous studies have investigated the relationship between quality and assurance policies, but their focus has primarily been on product warranties. These studies show various results depending on the situation (see Balachander (2001) for more details). For example, Spence (1977) suggested that the product with a high quality would provide a longer warranty to signal its high quality to buyers. In contrast, Lutz (1989) showed that a low warranty signals high quality when the buyer's moral hazard is considered. On the other hand, Cooper and Ross (1985) insisted that the warranty bears no general relation to the quality of a product.

Through this review, we discovered the following crucial points that serve to underpin the context of our study. First, few studies provide a clear understanding on the relationship between the level of product quality and the generous return policy setting. Although Mukhopadhyay and Setaputra (2007) and Li et al. (2013) provide a study similar to this one dealing with the joint decision on quality and return policy, they do not focus on investigating the relationship between quality and return policy. This study will build a comprehensive model incorporating quality enhancement efforts and return policy setting. Then, we will explore the prioritization between quality improvement and a generous return policy setting in the recent business environment. Second, while previous studies have investigated various aspects relevant to the return policy decision, their scope has been limited to a single firm's operational environment. However, contemporary firms tend to gain competitiveness by outsourcing many functions to suppliers. In previous literature, Xiao et al. (2010) have provided a study similar to ours, considering a manufacturer–retailer supply chain and investigating the coordination issue under the two-stage return/buyback policy. However, they do not consider the quality decision of the manufacturer, a main motivator of returns, and instead only focus on the return policy decision of the retailer.

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