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The effect of risk aversion on distribution channel contracts: Implications for return policies

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ABSTRACT

The return policy is often used in retailing supply chains. However, it is controversial in judging their practical value. In the literature, various theoretical and modeling explanations of why the return policy is used in practice and is preferred by the retailer and manufacturer have been put forth. The literature focusing on the channel agents' risk attitudes to explain the adoption seems to have led to the conclusion that the two agents' preferences for adopting the full-return policy over the no-return policy are always in conflict, and thus the risk attitudes do not explain the adoption of return policy in practice. In this paper, we reinvestigate this issue. We first identify two distinct phases of risk averseness, high or low, for each of the two agents. We show distinct behaviors of how the wholesale price and order size are set in each phase. Then, we show that the full-return policy can be preferred over the no-return policy by both the agents if both of them are high risk averse. This implies that the agents' risk attitudes can explain the adoption of return policy. This is a new theoretical result, which is contrary to the existing understanding in the literature. Our result highlights the importance and intricacy of channel policies especially when the risk attitudes of agents are considered.

1. Introduction

Return policies are often used in retailing supply chains. However, it is controversial when their practical value is assessed carefully (Padmanabhan and Png, 1995). Retailers may procure excessive inventory because they can return its unsold inventory without penalty. In spite of such a possibility, an incentive may be necessary for risk-averse retailers to procure the sufficient inventory that leads to superior channel coordination. Because of its managerial importance and inherent complexity, return policies have been studied in the literature, especially from the modeling and theoretical perspective (Pasternack, 1985; Marvel and Peck, 1995; Kandel 1996; Padmanabhan and Png, 1997; Emmons and Gilbert, 1998; Lau and Lau, 1999; Donohue, 2000; Webster and Weng, 2000; Tsay, 2001; Tsay, 2002).

The risk attitudes should be critical in designing the channel contracts. In general, the more risk-averse the retailer is, the less inventory is expected to be procured. Facing a more risk-averse retailer than the usual ones, should the manufacturer set the wholesale price lower to induce a larger order, or set it higher to directly increase the revenue? If the manufacturer by itself is more risk-averse than the usual ones, then how does this affect the consequence? We further address the following question: How does the interaction of two agents' risk attitudes affect the design and adoption of return policy?

Of the extensive literature on supply chain coordination in general, few studies address the effect of risk attitudes upon the manufacturer and retailer relationship (See Tsay et al., 1999; Cachon, 2003). Of the modeling literature on the return policy, Tsay (2002) is an exceptional and influential paper that addresses the effect of risk attitudes of channel agents upon the contracts involving the return policy. He concludes that the two agents' preferences for adopting the full-return policy over the no-return policy are always in conflict, and thus the risk attitudes of agents do not explain why the return policy is used in practice.

We use in this paper the same model as that in Tsay (2002). The risk-averse retailer faces the one-time demand that linearly decreases in retail price and takes either a low or high level of demand. The risk-averse manufacturer sets a wholesale price, and then the retailer determines its order quantity. After the demand is realized, the retailer determines the retail price to maximize its profit. The risk attitudes are represented by the mean-standard deviation (MS) value function. The MS value adjusts the mean downward by its standard deviation times a nonnegative risk sensitivity parameter. The retailer and manufacturer in the model

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maximize their respective MS values instead of their expected profits prior to the demand realization. All the information including the demand and the two agents' risk attitudes is shared by them. The manufacturing cost is assumed to be zero for simplicity of arguments.

In this paper, we identify two phases of risk averseness, low and high, for both the retailer and manufacturer. The wholesale price and order size for the no-return policy change with respect to the retailer's risk sensitivity. We show that they change discontinuously as the risk averseness shifts from the low phase to the high phase. The same can be shown with respect to manufacturer's risk sensitivity. This identification of two risk averseness phases, high or low, leads to the following propositions. First, the manufacturer prefers the full-return policy to the no-return policy if and only if the retailer's risk sensitivity is greater than the manufacturer's risk sensitivity. This is consistent with the common expectation that the manufacturer takes advantage of the lower risk averseness of the two. Second, we show that the high risk-averse manufacturer tends to set the wholesale price low to avoid the high profit variance situation associated with the full-return policy. This setting of low wholesale price is required for the retailer to prefer the full-return policy. Together, if the manufacture is high risk-averse and the retailer has even higher risk-averseness, then both the agents can prefer the full-return policy over the no-return policy. The contribution of this paper to the modeling literature investigating why the return policy is used in practice is that the agents' risk attitudes can explain the adoption of return policy. This is a new result, which is contrary to Tsay (2002)'s result described above.

The rest of this paper is organized as follows. In Section 2, we review the extensive literature using modeling approaches to justify the use of return policy over the no-return policy. In Section 3, we formalize the model used in this paper. In Section 4, we derive the two types of equilibrium outcomes for each of the no-return and full-return policies, which result for the two phases of risk averseness for each of the two parties. In Section 5, we discuss how the wholesale price and order size change in the different phases of risk averseness, and investigate which of the two policies is preferred by the two channel agents. In Section 6, we discuss the differences between Tsay (2002) and this paper. In Section 7, we summarize the insights derived in this paper.

2. Literature review

In this section, we review the literature using modeling approaches to justify the use of return policy over the no-return policy. In Section 2.1, we review the papers that assume risk neutral channel agents. These papers typically justify the return policy as a scheme to coordinate the supply chain in the sense of optimizing the expected performance of entire supply chain. Some papers justify the return policy as a scheme to achieve Pareto-improvement in the sense that all the agents involved are no worth off, and at least one agent is strictly better off using it over the no-return policy. In Section 2.2, we review the literature that explains the adoption of the return policy from the perspective of agents' risk attitudes. In this context, the coordination in the sense of optimizing a single objective function for the entire supply chain is difficult to formalize because the relationship between individual risk averseness and the integrative objection function cannot be articulated. Therefore, the Pareto-improvement is used to justify the return policy. Please refer to Gan et al. (2004) and Chiu and Choi (2013) for a variety of definitions of coordination in supply chain. The influential paper of Tsay (2002) shows that the channel agents' preference of the return policy over the no-return policy is always conflicting when the agents' risk attitudes are considered, and thus agents' risk attitudes do not explain why the return policy is used in practice. This somewhat negative result has led the researchers to explore other reasons to justify the use of return policy, which is reviewed in Section 2.3. In this paper, on the contrary to Tsay (2002), we show that risk sensitivity alone in such a basic supply chain setting explains why the full-return policy can be preferred by both the manufacturer and retailer.

2.1. Return policy with risk-neutral agents

Cachon (2003) and Tsay et al. (1999) provide comprehensive reviews of contract models in supply chain. Cachon (2003) provides an extensive review covering various contract types, multiple period or location models, asymmetric information models, and so on. He mainly considers the contract models to coordinate a supply chain. Tsay et al. (1999) provide a classification scheme for the literature on contracts in the supply chain management context. The classification scheme is based on the specification of decision rights, pricing, minimum purchase commitments, quantity flexibility, buyback or return policies, allocation rules, lead times, and quality.

The no-return policy is called a wholesale price contract in the supply chain coordination literature. Lariviere and Porteus (2001) analyze the no-return policy in detail. This simple contract is commonly observed in practice as the standard way to govern transactions in supply chain. At the same time it is known as a contract that does not maximize the supply chain wide expected profit. Double marginalization causes the inefficiency in supply chain (Spengler, 1950).

Assuming that both the retailer and manufacturer are risk-neutral, the return policy has been investigated as a scheme to coordinate the supply chain while regarding the no-return policy as its basic benchmark transaction policy. Pesternack (1985) is early work analyzing a return policy using the newsvendor model. He shows that channel coordination can be achieved under a return policy where the retailer returns either all unsold inventories for a partial credit, or a certain portion of his original order for a full credit. Emmons and Gilbert (1998) extend the work of Pesternack (1985) by incorporating retailer's pricing decision and shows that both the retailer and manufacturer can increase their expected profit using a return policy under certain conditions. Bernstein and Federgruen (2005) prove that a buyback contract cannot optimize the supply chain wide expected profit in price-dependent demand with uncertainty if the wholesale and buyback prices are constant. Chen and Bell (2011) investigate a return policy under the situation that the retailer is experiencing customer returns and price-dependent demand with uncertainty. They prove that a buyback contract cannot optimize the supply chain in the setting. They propose a buyback scheme that includes two buyback prices, one for unsold inventory and the other for customer returns to achieve supply chain optimization. For further discussions on the variations of return policy or buyback contract with customer returns, the reader is referred to Ruiz-Benitez and Muriel (2014) and the references therein.

Bose and Anand (2007) investigate a return policy in price-independent demand with uncertainty, considering the models in which the wholesale price is exogenously fixed. They show that when the wholesale price is sufficiently high, the equilibrium return policy achieves Pareto-improvement over a no-return policy (a price-only contract). That is, the supply chain members are no worse off with the return policy in place than with the no-return policy. However, they show that, in general, the equilibrium return policy does not achieve Pareto-improvement.

Some papers consider the return policy using the price-dependent additive demand model in which demand is modeled as the sum of a price-sensitive deterministic function and a