



Impact of secondary market on consumer return policies and supply chain coordination



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ABSTRACT

In this paper, we develop a unified model to study the inventory management problem of a product and the coordination of the associated supply chain consisting of a single supplier and considerably many retailers in the presence of a secondary market. Specifically, consumer returns are allowed in the initial sales. Then, we introduce a secondary market to salvage the returns and the leftovers from the initial sales. In this secondary market, a discount price will be offered to the consumers but no returns are accepted. Moreover, between the primary and the secondary market, there is an internal market where retailers can trade among themselves so that they are able to adjust their inventory levels to prepare for the sales in the secondary market. We study the retailers' and the supply chain's inventory decision in this case and highlight the impact of the secondary market on the sales as well as on the supply chain coordination contracts. We conclude that the secondary market helps us to increase the total wholesale volume. Numerical examples show that the total sales profit is also increased. However, the secondary market aggravates the incentive conflict between the retailers and the supply chain on deciding the optimal inventory levels and hence requires the supplier to offer more generous buyback or sales rebate contracts for coordination of the supply chain. Finally, we extend our analysis to more general cases and also show that our results are robust to some of the modeling assumptions.

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1. Introduction

Consumer return policies offered by stores are omnipresent today. These policies usually allow consumers to return the products for any reason within a specific period of time (typically 90 days) after the purchases. The volume of returns is growing rapidly and has already exceeded \$100 billion per year in the United States (see for example [24]). The first problem caused by these policies is that they may bring in excess inventory to the retailers when the products are returned, and hence render the management of inventory a more challenging problem. To deal with this issue, we briefly reproduce some results in [25] where the author investigated the problem of inventory decisions and supply chain coordination when returns are taken into account. These results will be used as a benchmark for comparisons in the later discussions for highlighting the impact of the secondary market.

The second important question posted by the return policies is that: what is a good way for the retailers to better extract the residual value from these returns along with the leftover inventory remaining from the initial selling season due to the uncertainty of both consumer

returns and market demand? This paper attempts to address this critical issue by a novel approach based on the establishment of a secondary market where retailers can sell the leftovers and the returns at a discount price as a way to salvage them. Such secondary markets can be widely observed in practice. For example, some boutiques have special sales at the end of the season, many retail stores have a discount section for those returned or out-of-date products, and online retailers, such as Newegg.com and Bestbuy.com, offer open-box items at discount prices. In our model, we also allow the retailers to trade among themselves in an internal market in between the primary and the secondary market to re-adjust their inventory levels so as to better prepare themselves for the secondary market sales. In some industries, suppliers who do not have customer-direct channels may also be willing to set up this kind of internal markets for retailers to reduce inventory-related costs. Such internal trade is facilitated by the advent of new technologies such as e-marketplace and more convenient means of transportation.

In this paper, we first investigate the optimal inventory decisions for the retailers and the supply chain with the existence of the secondary market. Next, we also construct coordination contracts for the associated supply chain to further increase total profit. Then, the impacts of the secondary market on both the sales and the coordination contracts are analyzed in depth.

Our work contributes to the literature in multiple aspects. First, we introduce a secondary market to salvage the remaining inventory

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after the initial selling season, while most of the existing works commonly consider two approaches to deal with the returns: one is to assume that the returns can directly go back on the shelf, which may not be feasible in some cases due to the following reasons. First, the returns may have some packaging damages or other defects due to the circulation. Secondly, consumers may delay the return of the products for some time after the purchases; on the other hand, for retailers or suppliers who keep a high standard of quality control, they may need to inspect the products thoroughly before reselling. So in either case, it is possible that by the time the products are ready for sale again after being returned, they no longer worth the original price and can only be sold at discount. Alternatively, some researchers consider handling the returns through a remanufacturing process. But in some situations, this is not necessary because under the ubiquitous liberal return policies, customers can return the products for just any reason, consequently, returns without any functional defects constitute a large portion of the total returns (95% in the electronic industry in the United States by [14]). They are ready for sale again in terms of product quality. Moreover, a variety of products, such as books and compact discs, mainly realize their values through market sales while their material values for remanufacturing are low. So in comparison, establishing a secondary market should be a more viable and economical way to salvage the remaining inventory and hence increase profit in many situations.

Secondly, in addition to studying the optimal inventory decisions, we also investigate the design of incentive contracts to coordinate the supply chain in the presence of the secondary market. Our results provide guidance on utilizing these contracts to help further improve the performance of the supply chain.

Another contribution of our work is a detailed analysis of the impact of the secondary market. To begin with, we compare the sales indices. It is illustrated that the secondary market establishment is beneficial to the supplier because it results in a larger wholesale volume ordered by the retailers. On the other hand, numerical examples show that for the retailers, there is also considerable growth in total sales profit. Besides, the impact of the secondary market on the coordination contracts is also explored. We inspect the buyback and the sales rebate contracts, both of which are extensively applied to align interests within supply chains. Conclusions from the analysis of the two contracts are consistent: they show that the secondary market aggravates the incentive distortion originated from the double marginalization problem, when the retailers are deciding their inventory levels. To be more specific, the retailers, when acting independently for their own accounts, order less than the supply chain optimal level; however, this gap is even bigger when there is a secondary market. Therefore, with the same wholesale price, a higher buyback payment, or a higher sales rebate, is needed for the supply chain coordination.

Our analysis offers insights on evaluating the establishment of the secondary market as a way to salvage returns and leftovers from regular sales from different aspects. So our results will be valuable and useful in making informed decisions on whether to embrace or reject the secondary market.

We have also extended the analysis and show that our main insights are robust and remain valid in much more general scenarios even after relaxing some assumptions in the model.

The rest of this paper is organized as follows. Section 2 exhibits a comprehensive literature review of research related to our work. In Section 3, the results of a benchmark case without the secondary market are first presented. Then, after establishing our model with the existence of the secondary market, we study the inventory decisions within the supply chain and construct the coordination contracts. Section 4 conducts an analysis of the impacts of the secondary market on both the sales indices and the coordination contracts. Some generalizations of the model are then discussed in Section 5. Finally,

concluding remarks and directions for future research are summarized in Section 6.

2. Literature review

Our paper draws on and contributes to the following research streams: consumer return policies, secondary market, and supply chain coordination. An overview of related works in each area and their key implications for our research are provided in this section.

A growing literature studies the consumer return policies. There are several rationales for accepting consumer returns in retailing. One of them is that, with the proliferation of divergent products in the market, consumers may have difficulties in determining whether particular types of products really match their taste or meet their needs until they have made the purchases. Customers may hesitate to buy when bearing such uncertainty about the product value. But the return policies enable the retailers to share this risk of mismatch with customers and hence stimulate sales. This aspect of return policies was discussed in [3,10]. The second rationale is that of warranties which protect the customers against any functional defects of the products, they resemble those quality warranties offered by manufacturers in [18,16]. Moreover, the return policies are capable of signaling quality because products of higher quality inhere lower probability of being returned (see for example [17]). Finally, the availability of return policies also assists in achieving more efficient resource allocation: instead of insisting the customers who find the products unfit to keep them, the policies allow them to be returned and channeled to better use. There are some research works studying the return policies from other different angles. For example, in [12], the authors considered imposing nonrefundable charges to deter consumers from the moral hazard of purchasing the products with an intention to return them after the trial. In [6], the coordination of a three-echelon supply chain with returns was investigated. Another related paper is [25], in fact, we include some of its conclusions in this paper. Because in [25], the author assumed the existence of consumer returns and then studied the inventory decisions and supply chain coordination. Hence it is able to serve as a benchmark case for later comparisons to highlight the main results of our paper. However, the main focus of [25] was on the optimal design of the return policies. Nevertheless, the focus of our work is to reveal the effect of the secondary market on salvaging the returns and the leftovers.

Since the quantity and timing of returns are difficult to predict, the uncertain returns along with the uncertain demand may bring in excess inventory to retailers. There are two common approaches in the existing literature to deal with these remaining inventory. One is to consider the cases where they go directly back on the shelf for sale, such as [5]. The other one proposes to channel the returns and the leftovers to the reverse supply chain for remanufacturing. For example, in [8], the authors investigated the design and the management of the reverse supply chain to maximize the net asset value recovered from the returns; [7] studied integrated material planning systems for remanufacturing facilities. Interested readers are referred to [9] for a review of reverse supply chains.

In this paper, we propose a new way of salvaging the returns and the leftovers by establishing a secondary market after the initial selling season, with an internal market in between the primary and the secondary market where the retailers can trade among themselves to realize their optimal inventory levels for the second sales. A related paper is [20], where the authors constructed a two-period model with declining market price to study inventory decisions of a dominant retailer with uncertain demand. Another one is [4], where the authors explored the profit uncertainty for the supply chain while assuming

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