



Decision support

Quality coordination with extended warranty for store-brand products

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ABSTRACT

In the past two decades, many store-brand products have been introduced by their retailers as having low-cost alternatives to existing brands. However, many store-brand products are perceived with lower quality because their manufacturers do not own the brands. In this paper, we investigate using extended warranties to coordinate the quality decisions of store-brand products. We investigate three extended warranty contracts for the amount of revenue transferred from the retailer to the manufacturer: fixed fee, proportional sharing, and manufacturer direct. Under the fixed fee structure, the transferred amount is pre-negotiated, fixed, and independent of the price of the extended warranty; under the proportional sharing structure, the transferred amount is proportional to the price of the extended warranty; under the manufacturer-direct structure, the retailer let the manufacturer decide the price and collect all the revenue of the extended warranty. Our analytical results show that all three contracts provide incentives for the manufacturer to improve the product quality. In the numerical analysis, we compare the performance of the three extended warranty contracts with the baseline case, where no extended warranty is offered. It shows that the manufacturer-direct contract achieves the highest quality improvement and the highest profit among the three contracts.

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1. Introduction

Store-brand products, also known as private labels or private brands, are exclusively owned and sold by their retailers. Store-brands have grown rapidly not only among grocery, health, home and office supply products, but also among electronics products. For example, the sales of Best Buy's private-label electronics increased 40% in 2008, according to Wall Street Journal (Bustillo & Lawton, 2009).

Except for a few high-end brands, many store brands are often considered as low-cost and low-quality products by consumers, especially in the electronics industry. For example, Best Buy now sells many electronic products under five store brands: Insignia and Dynex televisions, Rocketfish video cables, Geek Squad flash drives and Init electronics cases and accessories. Those products are usually priced lower than the well-known national brands. The relatively new brands and the low prices partially contributed to the lower "perceived" quality of those products. Another major reason for this quality concern comes from the fact that the manu-

facturers, who play a key role in the product quality, do not own the brands and thus feel less responsible for the quality. Although the retailers can perform audits, inspections, and testing to ensure the products reach certain quality standards, they might not have as much control and expertise as the manufacturers to ensure the product quality in every perspective.

Extended warranties, also known as service agreements, service plans, service contracts, etc., have become an important component in the service package of many products. Today, we can easily find a variety of extended warranties for consumer electronics, offered by either the manufacturers, the retailers, or third parties (e.g., warranty administrators). The specific terms and coverage vary across product categories, but most extended warranties cover parts and labor for repairing product failures, natural and inevitable damages, and/or maintenance, etc.

Extended warranties are welcomed by both consumers and retailers. The percentage of consumers buying the optional extended warranties ranges from 20% on products such as automobiles to 75% on products such as home electronics and appliances (Desai & Padmanabhan, 2004). Extended warranties also provide substantial margins to retailers. Retailers' margins are usually between 60–70% from selling extended warranties (Hsiao, Chen, & C., 2010).

This paper studies the quality coordination problem for repairable, single-unit, store-brand home appliance products. We consider the product quality as an inverse depiction of the product

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failure rate, a parameter controlled by the manufacturer. For store-brand products, the manufacturer and the retailer have conflicting objectives in quality positioning. The retailer desires the highest quality possible for his own product within an acceptable cost range, while the manufacturer wants to lower the production cost, as long as the product reaches the quality requirement.

To resolve this conflict, we examine how extended warranty contracts can help coordinate the quality decisions for store-brand products. Under each contract, the retailer will transfer to the manufacturer a certain amount of revenue created by selling the extended warranty. Then the manufacturer will take the responsibility of repairing all the failed products purchased with the warranty. If a consumer purchases the product without the extended warranty, the consumer will pay for the repair, besides the inconvenience while the product is being repaired. We establish the demand functions for the product and the extended warranty by using the certainty equivalence (or mean variance) to compare the consumers' expected utilities under three options: no purchasing, purchasing the product with the extended warranty, or purchasing the product without the warranty. So consumers will be separated into three groups based on their heterogeneous risk averseness.

We investigate three contracts based on the amount of transferred revenue associated with extended warranty sales: the fixed fee contract, the proportional sharing contract, and the manufacturer-direct contract. Under the fixed fee contract, the transferred amount is pre-negotiated and independent of the price of the extended warranty; under the proportional sharing contract, the transferred revenue is proportional to the price of the extended warranty; under the manufacturer-direct contract, the retailer lets the manufacturer decide the price and collect all the revenue of the extended warranty.

We then compare the performance of the three extended warranty contracts with the baseline case, where no extended warranty is offered. Our numerical analysis shows that the store-brand product's quality will be significantly improved under the extended warranty contracts. We also show that the manufacturer-direct contract achieves the highest quality improvement, and the proportional sharing contract better coordinates the quality decisions than the fixed fee contract. The numerical results also indicate that the retailer's overall profit is improved under the extended warranty contracts, and the manufacturer also obtains higher profit in most of the cases.

The rest of the paper is organized as follows. We review the related literature in Section 2. The demand models for the product and the extended warranty are derived in Section 3. We study the manufacturer's and the retailer's optimal decisions under three types of contracts for extended warranties in Section 4. In Section 5, we conduct numerical simulations to get more managerial insights. Finally, we conclude with the important findings and suggest future research directions in Section 6.

2. Literature review

This paper is primarily related to the research in three streams: store-brand products, extended warranties, and product quality coordination. In the following, we review the literature in these three streams.

2.1. Literature on store brands

Store-brand products have gained increasing attention in the literature recently, and many of the papers focus on the impacts of introducing store-brand products on the existing brands, and then the impacts on the relationship between the retailer and the

manufacturer. Dhar, Raju, Sethuraman, and Sanjay (1995) investigate the problem with multiple national brands in the presence of a store brand. Narasimhan and Wilcox (1998) use the Stackelberg game to study the effects of introducing a store-brand product on the national-brand. All of those research efforts eventually come to the same conclusion that the introduction of a store brand increases the retailer's profitability as well as bargaining power. The quality of store-brand products is not considered in these papers.

To gain the market share from the existing brands, two product differentiation strategies are applied for store-brand products: horizontal differentiation and vertical differentiation. Horizontal differentiation refers to different product features, e.g., styles, colors, packaging, sizes, etc. vertical differentiation, on the other hand, refers to different product qualities, which is related to the quality coordination problem in the current paper. Bontems, Monier-Dilhan, and R aouillart (1999) study vertical product differentiation using a model with a manufacturer and a distributor, and they assume exogenous quality levels. Sayman, Hoch, and Raju (2002) extend the models in Dhar et al. (1995) by considering the retailer's decision on quality positioning of the store brand product. Du, Lee, and Staelin (2005) derive their model from the utility functions of two consumer segments facing the choices between two horizontally and vertically differentiated national-brand products and one store-brand product. Although quality is considered in these papers, their roles are to provide alternatives from the existing brands. The goal of the current paper, however, is to encourage the manufacturer to improve the quality of store-brand products.

In the literature on store brands, Heese (2010) is the most related to our work. Heese (2010) investigates the national-brand and store-brand positioning problem in a framework where the product quality affects both customer demand for the products and unit quality cost. Heese (2010) concludes that if anticipating a store-brand introduction by a strong retailer, the manufacturer should leverage the national-brand product quality and reduce the wholesale price. Although both our study and Heese (2010) build models based on consumers' heterogeneities, Heese (2010) characterizes the consumers' heterogeneities with their willingness to pay for product quality, while we feature consumers' heterogeneities with their risk averseness. Like other papers in this stream, Heese (2010) builds a model for two alternative products with different brands, i.e., a national brand and a store brand product. We, on the contrary, primarily focus on the relationship between the basic product and the supplemental service, i.e., extended warranty, under the same store brand.

2.2. Literature on quality coordination in supply chains

Product quality assurance and coordination has become an important issue, as many retailers outsource via global supply chains with little or no visibility. In operations management, there is growing attention on suppliers' quality investment and buyers' inspection policy. Reyniers and Tapiero (1995a); 1995b) study the impacts of contract parameters (e.g., price rebate and defect penalty) on the supplier's quality choice, the manufacturer's inspection policy, and the quality of the end product. Starbird (1997) tries to identify conditions where a buyer's inspection policy will induce the supplier to choose a zero-defect quality. Baiman, Fischer, and Rajan (2000) shows that making the inspection results contractible can reduce the inefficiency associated with the supplier's prevention activities and improve the quality of the end product. Lim (2001) studies how to design a contract where the buyer can use price rebate and defect penalty to derive the supplier's true quality level and maximize its profit. All of the above papers require buyers' inspections, but not buyers' investment in their suppliers' quality improvement.

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