The effect of customer value and power structure on retail supply chain product choice and pricing decisions☆

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ABSTRACT

Customer value in goods not only affect his purchase decision but also bring about a big challenge for retail supply chain management. A two-stage retail supply chain consisting of one manufacturer and one retailer is investigated in this paper. The manufacturer produces two substitute products which belong to two different generations while the retailer determines his product choice decisions and pricing policies with considering heterogeneous customer demand based on different customer value. The key issues faced by the retailer are which products to purchase, single or both? And how to make pricing policies in different power structures? From three different game theoretical perspectives, we found that the retailer's purchase decision criterions are based on two thresholds, and in each power structure the optimal pricing policies of manufacturer and retailer are obtained. In addition, the impact of power structure has been explored and it shows that different power structures have no effect on the retailer's product choice decision criterions and behaviors, however, they have a great influence on supply chain members' pricing policies and performances. The revenue sharing contract achieves a Pareto improvement and makes a bigger pie, and the power structure determines the pie split between the supply chain members. Additionally, revenue sharing contract will not affect the retailer's purchase decision criterions and behaviors, either.

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1. Introduction

In respond to an increasingly fierce market competition and meet diverse customer demand, the production and sale substitutable products have become a common behaviour of manufacturers and retailers [13]. For example, Nike Inc. designs and produces shoes with different kinds of styles, colours, qualities, and functions all the year around. And just about one year ago Apple Inc. released iPhone SE, however, the iPhone 7, a new generation mobile phone, has been in a sale at the present time. What's more, the other older versions such as iPhone 6/6s are still on sales.

From the perspective of customers, product diversification has led customers to hold different customer values or customer reservation prices in different products due to their styles, colours, qualities and so on [20]. For a newer or higher-quality product, the customer may hold higher reservation price than others [32], and customers determine their buying decisions by comparing their reservation price with the actual price of the product [25]. Con-

sumer behaviour is becoming more and more rational. The price factor cannot be considered as the only pricing decision-making reference any more. Therefore, the customer value has become one of the importance factors that influence customer's product choice [41]. From the perspective of manufacturers and retailers, there exist phenomena that some stores, such as online stores or the stores in poor regions, may only sell specific types of products, and on the contrary, others may sell all kinds of products. Further, the same-type product in different stores which serve for different customers may labelled with different prices [49]. Therefore, big challenges of product choice and pricing decisions have arisen to both manufacturers and retailers [2,16,37,48].

In addition, the market position between manufacturers and retailers are not equal in different industries. For instance, in some electronics supply chains, Microsoft and Intel act as a leader with more powerful than downstream members. Some retailers, such as, Wal-Mart and Carrefour, however, may be in a relative strong competitive position and act as a leader than their upstream suppliers [14]. In many cases, supply chain members may be in balanced market position, in which they are engaged in vertical Nash competition ([12,52]). To our best knowledge, there are very limited studies that combine the product choice and the pricing model based on the customer value with considering power structures.

Hence, our research aims to fulfil this gap through addressing the following key questions:

(1) How does the retailer decide which products to purchase based on customer value with power structures?
(2) How to develop pricing policies for the manufacturer and retailer based on customer value when the retailer sells a single product or both products with power structures?
(3) What is the influence of the customer acceptance and the power structure on product choice, pricing decisions and profits?

In order to solve the above problems, a two-stage retail supply chain consisting of one manufacturer and one retailer is investigated. This is an essential supply chain structure, based on which many papers study interesting operational management and marketing problems. The manufacturer produces two substitute products which belong to different generations. The retailer sells directly to end-customers who have heterogeneous customer value in these two generations of products, which is characterized by different product acceptances. We investigate the retailer's product choice decisions and obtain the optimal pricing policies based on heterogeneous customer value in each purchase strategy and power structure. Therefore, using this basic and appropriate two stage supply chain model is fairly enough to solve this problem, and also it is easy to understand by readers. And indeed, we have done many important analysis and obtain some meaningful insights, which can provide useful decision supports to the end retailer. This study contributes to the theory and practice by investigating how customer acceptance and power structure influence retail supply chain management:

(1) Through the analysis of customer surplus (customer reservation price minus the actual retail price) for heterogeneous customer, we expand the demand function used in a dual-channel supply chain to product choice, which brings about a little enrichment in theory.
(2) We obtain pairs of thresholds for the retailer to make product choice decisions. The thresholds, measured by the production cost of the two substitute products, include a low threshold and a high threshold in each power structure. Therefore, a purchase decision criterions can be established based on the thresholds, by which the retailer can estimate the product acceptance based on some historical data, expertise, or the industrial reports on the similar products and then make product choice decisions. In addition, the retailer's purchase decision criterions will not be influenced with revenue sharing contract.
(3) The Power structure has a great influence on retailer supply chain pricing decisions and profits, however, it interesting to know that it has no effect on the product choice decisions. Namely, no matter which market position the retailer is in, the purchase decision criterions stay unchanged.

This paper is organized as follows. A survey of related literature is presented in Section 2. The model formulation and assumptions are provided Section 3, in which we formulate the demand functions based on heterogeneous customer value and obtain profit functions of manufacturer and retailer. In Section 4, we investigate the product choice decisions and obtain the equilibriums based on customer value in each power structure. In Section 5, we focus on the impact of customer acceptance and power structure on optimal pricing policies and profits. In Section 6 provides an extended model with revenue sharing model to coordinate the retail supply chain and investigate related conclusions. Finally, the research findings and highlight possible future work are concluded in Section 7.

2. Literature review

The literature reviewed here primarily relates to three streams of research: (i) customer value or reservation price; (ii) product choice strategies, and (iii) effect of power structure on decisions and profits.

Many literatures are on customer value or reservation price. Some researchers were focusing on estimating and measuring by using different methods, such as Sweeney and Soutar [43], Jedidi and Zhang [24], Wang et al. [46], and Kaplan et al. [25], etc. In the research of Sweeney and Soutar [43], they use a 19-item measure, called PERVAL, which is an empirical research method and is used to ssess customers' perceptions of the value of a consumer durable good at a brand level. This measure is usually used in a retail purchase situation to determine what consumption values drive purchase attitude and behavior. Jedidi and Zhang [24] proposed a conjoint-based approach to estimate consumer-level reservation prices. Form the perspective of consumer, they modeled consumer's decision of not only which product to buy, but also whether to buy at all in a category. Also, Kaplan et al. [25] proposed a two-stage method to elicit consumers' price acceptability range. Others conducted case studies from different perspectives and industries, such as Thompson and Troester [45] from case of the natural health microculture, Webster and Rennie [47] in leisure travel, Koller et al. [28] considering green consumption, and Perrea et al. [36] in food product industry, etc. Further, from the perspective of operational management, Shioda et al. [41] assumed that product choices of consumer depend on the reservation prices. They formulated maximum utility model an as a mixed-integer programming problem, and investigated a product line pricing problem. Abbey et al. [1] took customer reservation price into consideration. By using a model of consumers' preferences, they studied the optimal pricing of the new and remanufactured products based on extensive experimentation. Hu et al. [21] considered that consumers are sufficiently heterogeneous in product valuations in a crowdfunding mechanism, they examined the optimal pricing and product decisions and found that the firm should offer a line of products with different levels of product quality and prices. The above literature on customer value or reservation price are not taking supply chain management into consideration. However, in some cases, the customer value may not only affect the retailer who serves consumer directly but also retailer's upstream firms, i.e., distributors and manufacturers.

The second relevant stream of literatures are the researches on product choice. Moorthy [34] examined two identical firms competing on product quality and price. He assumed that the customer prefers the high quality product to the low quality. The quality-price equilibrium strategies of both a simultaneous-product-choice model and sequential-product-choice model were obtained. Liefeld et al. [31] investigated the Dutch customers' product choice. They found that Dutch customers bought one product not others mainly based on their heterogeneity in tastes and preferences and rely little on extrinsic information cues, and also they took little consideration of country-of-origin as a choice cue. Rath and Zhao [39] studied two producers' location and pricing policies with consideration customer product choice. They found that the equilibrium prices and locations rely on relative magnitudes of the customer reservation price and the transportation cost. Friese et al. [17] tested the assumption that customers may have explicit and implicit preferences toward a product at the same time. By using Implicit Association Test (IAT), the authors measured consumer preferences regarding generic food products and well-known food brands and found that the customer are more likely to choose the implicitly preferred brand when product choice has to be made in a short time. Mack and Sharples [33] investigated the important factors which affect people in mobile phone product choice