Supply Chain Decisions Considering Heterogeneous Consumer Greenness Preference and Reservation Utilities

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ABSTRACT

This article focuses on how the prices set by supply chains and the product greenness level changes when there exists a difference for consumers in both their greenness preference and their reservation utility for the common product with minimal greenness, based on a two-dimensional model which is built and the market is partitioned into four groups. In this study, the authors use the Stackelberg game model to analyze the decisions of a two-stage supply chain, providing environmentally friendly products affected by a consumer greenness preference which is represented by the willingness-to-pay (WTP) for product greenness. The authors found that manufacturers may lower the product greenness level with the decrease of the valuation of consumer's WTP for product greenness, but he may prefer keeping the same product greenness, he will even improve it, when there is a reduction in reservation utility for the traditional product. Moreover, this article shows that there is different impact for different combinations of both WTP for product greenness and product greenness level (different market segmentations) on price decisions of the manufacturer and retailer. In consideration of the asymmetric information about consumer's utility and willingness to pay between manufacturer and retailer, the authors introduce the bargaining power into the study, and then they conclude that during the different market segmentations, the wholesale price and retail price go down as a retailer strengthens his bargaining power, and increasing sales volume can improve profit to make up for a loss in retail price.

KEYWORDS

1. INTRODUCTION

The environmental pollution problem has become more and more serious. A great deal of pollutants are created from the process of manufacturing and using, such as automobiles and home appliances. In the meantime, an increasing number of consumers pay attention to protecting the environment (Hartman Group, 2007), this will lead to changes in purchasing behavior of consumers who prefer to purchase green products. OECD (2002a) points out that twenty seven percent of consumers in OECD countries can be regarded as "green consumers" or "environmentalists" on account of their strong preference for green products and positive environmental activism. The BBMG Conscious Consumer

Report indicates that 67% of American consumers are willing to buy the products which can benefit environment and 51% prefer to pay more for products with high greenness level, i.e. the products with friendly impact on the environment (Bemporad & Baranowski, 2007; Barksdale, 2009). European Commission (2008) studies the consumers' behavior responding to environmental protection, and finds that 75% of European consumers prefer to purchase environmentally friendly products even though the price of this type is higher than that of the not environmentally-friendly products which are purchased by 31% of Europeans. Although the consumer spending is slower throughout the economy in the US, the consumption of natural products increased by 25% from 2006 to 2008 (Mintel, 2009).

The cost of producing green products is higher than that of creating conventional products, resulting in the product price is high (Conrad, 2005). For example, the report of Toyota indicates that the price of hybrid-cars, which can cut down on carbon emissions by nearly 3.5 million tons by the end of April 2007 (Yakita, 2009), are more than 1.5 times that as much of the gasoline powered ones. The key issue that determines the strategic direction (producing green products or traditional products) of supply chain players is whether consumers prefer to pay more to cover the additional green costs. Moon et al. (2002) show that a strong preference for purchasing green products will lead to a significant effect that the higher the extra payment for greenness is, the more producers convert to adopt environmentally friendly techniques. This paper assumes that the cost of green product is an increasing function of greenness level. Based on this assumption, we analyze the impact of consumer's WTP for green product on the strategic decisions of centralized supply chain and members of decentralized supply chain, considering different market segmentations.

Consumer utility is not static and change over time, when consumer purchase a unique product. This implies that supply chain players should dynamically adjust the product orientation and pricing decisions. It is still not clear that when and why the firm adopts what degree of the product greenness if consumer changes his utility. Some previous researches have showed the choice of product greenness level when there exists difference for consumers in their preference for green products. These studies analyze consumer utility through building a model of consumer preference for greenness (e.g. Liu et al., 2012; Linghong et al., 2015) or study reservation utility to analyze consumer's basic utility for products with minimum greenness level. However, these studies assume a one-dimensional utility function for all consumers with reservation utility or greenness preference utility not both. In this analysis, we build a two-dimensional utility function combining consumer's greenness preference and their reservation utility for the traditional product with minimal greenness. In prior studies, consumer greenness preference affects consumer willingness-to- pay for green products (Chitra, 2007). Aforementioned, the higher the consumer greenness preference is, the higher the consumer's willingness-to-pay for product greenness is. Such willingness to pay may vary significantly with time and is different among different consumer segments and change across different economic environment (Laroche et al., 2001; Carlson, 2005). In addition, consumers' desired value for traditional products might also be different, relying on their private demands, disposable income, or interests. Rochet and Stole (2002) show that modeling consumer preferences needs to consider at least two variables. To match the practice better, two-dimensional model is built in this study and we solve the problem of how supply chain and its players make price and greenness level decisions aiming at heterogeneous consumers in reservation utility for traditional product and WTP for product greenness in centralized and decentralized supply chains, and we make an analysis of supply chain price and greenness level decisions considering four different market segmentations (formed by different combinations of consumer's reservation utility for traditional product and green WTP).

In reality, manufacturer, who is in charge of production, has less chances to know consumers, but knows complete information about products. Retailer, who has more opportunities to reach consumers directly, knows consumers' preference and utility well, but has little information about the products supplied by manufacturer. Due to the existence of this asymmetric information, manufacturer and retailer, depending on their personal information superiority, have to bargain with each other to maximize their respective profits. Chatterjee and Samuelson (1987) examine a non-cooperative

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