Contents lists available at ScienceDirect

Transportation Research Part E

Green product pricing with non-green product reference

Zhaofu Hong[a,b], Hao Wang[a], Yugang Yu[b,*]

[a] School of Management, Lanzhou University, Lanzhou, PR China
[b] School of Management, University of Science and Technology of China, Hefei, PR China

ARTICLE INFO

ABSTRACT

This study investigates a green-product pricing problem by taking into account consumer environmental awareness (CEA) and non-green (regular) product reference. The pricing strategies under three scenarios are investigated: single-product pricing; dual-product competition; and asymmetric-information case. The analytical results show that differential pricing strategies should be adopted, facing consumers with differential purchase behaviors (i.e., differential levels of CEA and reference recognition). The green product's pricing strategy is significantly affected by asymmetric information. In contrast to the case of symmetric information, the firm should adopt distinguished pricing strategies in consideration of its green production cost.

1. Introduction

Green products have gained increasing attention in recent years, because of their environmental friendliness in the green manufacturing process, low emissions in use, recyclability, and so on. Owing to their potential environmental benefits, an increasing number of firms are focusing on green products. For example, PepsiCo[1] and Coca-Cola[2] developed recyclable PET plastic soft drink bottles instead of corrugated materials in order to reduce the environmental impact of their products. These two soft-drink giants compete against each other not only on product development, but also on pricing their "green products".[3] They face practical issues: how to price their green products? What factors should be taken account into green product pricing? Pricing green products properly is important for firms, thanks to these products are commonly innovative in markets.

Consumer environmental awareness (CEA) is a critical market-driven factor that facilitates green product development and consumption, which should be considered in green product pricing. Empirical studies have shown that consumers are willing to *pay a premium* for green products, owing to the additional utility they gain from purchasing such products (Schlegelmilch et al., 1996; Hopkins and Roche, 2009). In 2014, a Eurobarometer survey on the environment in the 28 member states of the European Union found that 75% of Europeans are willing to pay more for environmentally friendly products, up from 72% in 2011.[4] In contrast, the Accenture Global Auto Consumer Survey of March 2010 showed that 56% of U.S. and Canadian consumers would *not pay more* for a hybrid or electric car, as compared to a fuel-only vehicle (Drozdenko et al., 2011). Facing the differential consumer behaviors on purchasing green products, deciding on a pricing strategy for green products is an important real-world issue for firms. Therefore, this study investigates the effects of CEA on green-product pricing decisions.

In addition to CEA, reference is another important factor that affects consumer purchase behaviors when choosing/purchasing green products (Joshi and Rahman, 2015). An example is Method, a cleaning product manufacturer, who puts 'powerful' before 'plant-friendly' in their advertisements when promoting its green product.[5] Its aim is to meet consumer's comparison of functional attribute with other non-green products, when telling consumers that their products are environmentally friendly. In this study, the non-green product is taken as the reference for consumers when choosing a green product. To the best of our knowledge, few studies consider the reference effects when investigating the pricing problem of green products. This study also differs from the existing literature in that previous studies usually regard price as the reference point. In contrast, we consider the consumer's utility as the reference point. Compared to the price reference, the utility reference provides a better way to depict consumers' purchasing behavior, i.e., comparing products' cost performance when choosing products.

This study is to fill the above research gaps in the literature related to green-product pricing. More specifically, we investigate pricing strategies for a green product that consider consumer environmental awareness and reference behavior. Here, two products, a green product and regular (non-green) product, compete for market share. A valuation-based demand function is formulated for the two products. Then, the problem is investigated in three different scenarios. First, we study a single-product pricing problem, where the price of the regular product is exogenous. This scenario can occur when the price of a regular product is determined by a fully competitive market, and a manufacturer does not have the power to break the price equilibrium. Next, we examine a dual-production competition problem, where a manufacturer produces the regular product, and the other produces the green product. The manufacturers set a price for their respective products, and compete for market share in order to maximize their own profit. Here, a Nash equilibrium is presented, and the optimal pricing strategies of the green and regular products are proposed. The results show that the optimal price of the green product is not always higher than that of the regular product. The green manufacturer should adopt a pricing strategy based on the quality of the green product and on consumers' levels of reference recognition and environmental awareness. Finally, we consider a case in which asymmetric information exists in the market, where the manufacturer producing the regular product does not know the pricing and cost information of the manufacturer producing the green product. Several interesting analytical results are obtained. Green products are commonly innovative products in markets, and their pricing strategies are affected significantly by asymmetric information. Compared with the strategies under symmetric information, the pricing strategies of both green and regular products are distinguished. The threshold policies are addressed to point out these differences and to support firms' decisions in different information cases.

The remainder of this paper is organized as follows. Section 2 presents a review of the literature. Section 3 formulates the demand function and presents the analysis for a single-product pricing problem. Section 4 investigates the pricing problem for a dual-product competition scenario. Then, Section 5 examines the effects of asymmetric information, and presents the optimal pricing strategies. The final section concludes the paper.

2. Literature review

Two streams of research are closely related to our work: green product pricing and reference-dependent demand. In the following sections, we review studies relevant to each stream, and highlight the research gap between this study and the existing literature.

2.1. Competition pricing and green-product pricing

Pricing is one of the most common and significant issues drawing attention from industry and the academic community. Pricing strategies are widely investigated in revenue management (Bitran and Caldentey, 2003; Maglaras and Costis, 2006; Chiang et al., 2007; Bacon et al., 2016), supply chain management (Bernstein and Federgruen, 2004; Leng and Parlar, 2005; Maddah and Bish, 2007; Tang and Yin, 2007; Kuo et al., 2013; Niu et al., 2015; Xu et al., 2017), and so on. Specific pricing scenarios are considered in the existing literature, including dynamic and static scenarios, single- and multiple-product scenarios, competitive scenarios, and so on (Soon, 2011). This section reviews research related to *a competitive market scenario with multiple products*, and *consumer demand with environmental awareness*.

Investigating the pricing strategies in *competitive scenarios*, game theories such as Bertrand and Nash games are widely adopted to study the competitive market share and interactive decisions among multiple firms. Sudhir (2001) uses a theory-driven empirical approach to research the competitive pricing behavior in the U.S. auto market. They measure the competitive behavior by the degree of deviation from Bertrand prices. Using a Hotelling model, Pan et al. (2002) establish a price competition game model between a pure e-commerce retailer and a combination of an e-commerce and a traditional retailer. With regard to competition in the supply chain channel, Yao and Liu (2005) use Bertrand and Stackelberg competition models to study the price competition between retail and online channels. Alptekinoğ˘lu and Corbett (2008) study variety and price competition between a mass customization firm and a mass production firm. Chen et al. (2013) use Nash and Stackelberg games to formulate the price competition in a supply chain with one manufacturer and a retailer. Some researchers also consider production decisions in pricing a two-echelon supply chain. Wang et al. (2015) study a jointly pricing and lot-sizing decision in a two-echelon supply chain; while Heydari and Norouzinasab (2015) address a two-level discount policy to coordinate pricing and ordering decisions in the supply chain, where a stochastic consumer demand is involved. To investigate the impacts of competition on the performance of the supply chain, Luo et al. (2017) study the horizontal competition between two manufacturers, and vertical competition between the manufacturers and the retailer in different

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[5] https://methodhome.com/.