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Decision Support

# Customization competition between branded firms: Continuous extension of product line from core product

Noritsugu Takagoshi [1], Nobuo Matsubayashi *

*Department of Administration Engineering, Faculty of Science and Technology, Keio University, Hiyoshi 3-14-1 Kohoku-ku, Yokohama 223-8522, Japan*

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ABSTRACT

We study a competition of product customization between two branded firms by a game-theoretic approach. Firms produce products with two attributes: one attribute indicates a characteristic with regard to "function" or "design" of a product and the other indicates "taste" or "flavor" of the product, which reflects consumers' brand/taste preferences. Two branded firms have their own specific core products and our customization is defined as a continuous extension of their product line from the core product only along the "function" attribute. In particular, we allow asymmetric positions of core products, which may create the position advantage/disadvantage between firms. We suppose that consumers incur their selection costs with regard to finding their most favorable item among a rich variety of products and firms incur their customizing costs with regard to extending their product lines. We first show that in the equilibrium, branded firms should fundamentally adopt their customizations to cover the center space in the market as far as possible, regardless of the position of the competitor's core product. Therefore, the position of the core product contributes to the creation of a competitive advantage: when one firm's core product is located more closely to the center of the market than the competitor's, its customization can always cover more range of the center space in the market, while keeping its degree of customization smaller than the competitor's. Furthermore, we show some implications of unit-cost improvement: in a short run, a firm is better off concentrating on the improvement of the unit selection cost rather than the unit customizing cost. In contrast, in a long run, both firms can benefit from the improvement of the unit customizing cost.



## 1. Introduction

Recently, firms have been enhancing their product varieties to reflect the increase in the diversity of consumers' preferences. NIKE iD, which is a service offered by NIKE, allows consumers to create their own shoes to match their preferences. At the same time, mi adidas, in competition with NIKE, is also offering a service to satisfy consumers' individual needs. These customizing services can be offered due to the increasing flexibility of production processes and as a result of developments in the information technologies for marketing. There are many real-world examples of product customization (Wind and Rangaswamy, 2001).

In the marketing and manufacturing literature, competitive product customization has also been studied by many researchers. Some of these studies focus on a customizing competition including that between a traditional firm and a new customizing firm (Alptekinoglu and Corbett, 2008; Mendelson and Parlaktruk, 2008a), a competition between customizing firms (Dewan et al., 2003, Syam et al., 2006, Alexandrov, 2008) and so on. They consider the setting where firms offer their products in order to satisfy consumers' needs only from the aspect of product function. On the other hand, there might be a situation where consumers determine their purchase considering not only a function of products but also their brand preference for firms. However, the literature pays very little attention to a customizing competition between firms who are strongly differentiated in their brands.

In this paper, we study a competition of product customization between two branded firms. For example, in the luxury bag industry, one can easily recognize Louis Vuitton, PRADA and HERMES as branded firms. Furthermore, we can see that these firms have their own specific core products that have established their reputations over a long period of time, and that they have extended their product lines utilizing the core products. In fact, Louis Vuitton was the first to offer a leather traveler's bag with a monogrammed design and now also offers a wide variety of items including monogrammed luggage, men's tiga luggage, men's briefcases, women's damier canvas luggage, women's monogrammed city bags and so on. In fact, Louis Vuitton has extended its product line almost continuously from its core product and now produces over 66 items in

* Corresponding author.
*E-mail addresses:* noritsugu.t@gmail.com (N. Takagoshi), nobuo-m@pa2.so-net.ne.jp (N. Matsubayashi).
[1] Tel.: +81 45 563 1151; fax: +81 45 566 1617.

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the monogram women's city bag alone! (Louis Vuitton, 2009) Also, although PRADA started their history by producing only leather products, now more than 40 products are offered in their handbag range (PRADA, 2009). On the other hand, HERMES established a market for its hand bags departure in the 19th century which was based on its own technology of high-end trappings developed in the 18th century. It is noted that it has developed its product line, such as Kelly bags and Birkin bags, by utilizing the design of its first bag, the sac haut-a-croire (HERMES, 2009). These branded firms have been utilizing the advantage of their core products for extending their product lines in the competitive environment. In fact, the marketing departure of LVMH, which is a subsidiary of Louis Vuitton, says that it creates a new product in consideration of it being consistent with their tradition and brand image, which indicates that a new product is developed extensively from the core product (LVMH, 2009). Based on these motivations, we define our customizations by branded firms as the extension of product lines continuously from their core products.

When a branded firm extends its product line, it must incur the significant costs reflecting the specific properties of branded products such as handmade by professionals, sensitive design, and high quality. Thus, in general, it is known that increasing product variety can hardly accompany economies of scale (Lancaster, 1990). In fact, LVMH recognizes that it is important to consider a fusion of designers' creativity and modern marketing methods in order to keep its brand image and quality of products, so it necessarily takes sophisticated technologies for managing a design, production and logistics regarding its products (LVMH, 2009). As a result, it must incur very high costs to achieve product customization. In this paper, we assume that such a cost, namely customizing cost, is convexly increasing in a degree of customization.

How does the enormous increase in product variety affect consumers? First, the possibility that one of the available items meets a consumer's ideal would become extensive. Therefore, the consumer can get more satisfaction from a larger product line. The recent trend of customization reflects this positive impact well. However, we should note that at the same time, a consumer may bear temporal or psychological costs to find his/her desired product from an enormous number of items. In particular, when consumers purchase a branded product, they agonize over finding their ideal product since a branded product is usually expensive, and thus they do not want to regret the purchase of their selection. In the literature, this type of cost is called a confusion cost or a selection cost and has been studied by many researchers (Jacoby et al., 1974; Bettman and Zins, 1979; Malhotra, 1982; Huffman and Kahn, 1998; Broniarczyk et al., 1998; Bernhardt et al., 2007). In our study, we assume that consumers bear the selection cost arising from customization, which increases in proportion to the degree of customization.

In this paper, we take a game theoretic approach based on a stylized model; we employ the famous Hotelling's linear-city model considering two-attribute space. Utilizing this, we analyze a competition between two branded firms producing products with two attributes. One attribute indicates a characteristic with regard to "function" or "design" of the product, while the other indicates that with regard to "taste" or "flavor" thus reflecting consumers' brand preferences. Each firm is located at both edges on the "taste" space, that is, they are completely differentiated with respect to their brands. Both firms have their own core products and we assume that they are located at any given position on the "function" space. Both firms can extend their product lines continuously from their core products. Our customization is defined as these extensions of product lines from their core products. We consider a two-stage game where at the first stage both firms simultaneously determine how they extend their product lines from their core products, and they simultaneously set their prices at the second stage. Although we assume the symmetry between both firms regarding their cost structures, we allow the asymmetry regarding the positions of their core products. Therefore, firms should determine their customizations considering their relative position advantage/disadvantage of their core products, in addition to their cost structures. This asymmetry makes it difficult to predict the outcome of our game.

We present an overview of the results of this study. First, we show that a branded firm fundamentally should adopt its customization strategy depending only on the position of its own core product, regardless of that of the competitor's. More specifically, the result indicates that firms should extend their product lines to cover the center space in the market as far as possible regardless of the position of the competitor's core product. When a core product of a firm is located around the center of the market, the firm adopts customization symmetrically from the center of the market including its core product. However, when the core product is located far from the center of the market, the firm extends its product line from its core product only in the direction of the center of the market. In addition, we show the existence of the competitive advantage with regard to the position of core products: when its core product is located more closely to the center of the market than the competitor, the firm always can cover more range of the center space in the market, while keeping the degree of customization smaller than the competitor's. When both core products are located around the center of the market, however, this effect of asymmetry of core products vanishes and both firms set the identical product line bilaterally symmetrically from the center of the market, that is, they adopt the minimum differentiation strategy. We next analyze the impacts of the customizing cost and the selection cost on the equilibrium and show that in the short run frame, where it is only possible for both firms to invest in one of the cost improvements, a firm is better off concentrating on the improvement of the unit selection cost rather than the unit customizing cost. However, in the long term where both firms are affected commonly by cost reduction due to the technological advance, we show that the decrease in the unit selection cost causes severe customizing competition and thus both firms' profits decrease. In a similar way, as the unit customizing cost decreases for both firms, both firms decrease their profits because of the intense competition. However, after the unit customizing cost becomes sufficiently low, the benefit from the improvement of the unit customizing cost exceeds the negative impact of increasing intense competition, so that the equilibrium profits start to increase. This result suggests that in the long run, firms can rather benefit from the improvement associated with customizing cost.

The rest of this paper is organized as follows. We first review literatures considering product and customization strategies, and position our paper among these literatures in Section 2. In Section 3, we introduce our model used in this paper. In Section 4, we analyze the equilibrium outcome and investigate the impact of positions of core products on the equilibrium. We analyze the impact of cost improvements on the equilibrium in Section 5. Section 6 discusses assumptions of our model. In Section 7, we conclude our study. All technical details are provided in Appendix A.

## 2. Literature review

In this section, we review marketing, operations management and economics literatures related to our study.

In the last ten years, literatures on customization have been frequently produced. Many papers show that it is valuable for firms to customize their products as a way of targeting consumers. For example, Peppers et al. (1999) study one-to-one marketing by firms based on the fact that consumers are willing to purchase