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Bundling and Convergence: Theoretical Market Analysis of a New Convergence Product

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Abstract. The main purpose of this research is to develop a framework for a market analysis of new convergence products. The theoretical model for analyzing the effect of convergence products on existing markets begins from the characteristics of bundling and convergence, and the difference in demand and market form is derived according to three types of convergence products. This research may provide a meaningful implication for the development of a firm's strategies.

Keywords: convergence product, bundling, market analysis, similarity

1. Introduction

Since a majority of new products that are recently introduced in the market have a relationship with existing products, the boundaries of existing markets become ambiguous through convergence products [1], [2]. There are few researches on convergence products that theoretically or empirically analyze the relationship among markets, and the manner in which the boundaries of industries change. Hence, considering an interrelationship among products is meaningful for a firm's product development and marketing strategies [3]. The main purpose of this research is to develop a theoretical framework for the market analysis of a new convergence product.

The term "convergence" is an entirely new concept, and is also similar to traditional bundling. Generally, convergence and bundling are considered as identical notions and used together in a majority of researches [4]-[7]. Even though a convergence and bundling product are similar to each other in definition, there are certain differences between them. According to the bundling typology given by Stremersch and Tellis [8], a convergence product corresponds to product bundling, not to price bundling, and to mixed bundling, not pure bundling. In addition, according to the bundling typology of Simonin and Ruth [9], a convergence product is limited to integrated product or single product bundles; in other words, a convergence product has a high degree of product integration and a low/high degree of recognizability.

Further, as compared to bundling, there are several characteristics of a convergence product that are as follows. First, individual products can become a substitute or complementary product to each other due to the introduction of a convergence product, despite being originally independent. Second, as a convergence product tends to suffer functional or quality loss, the utility derived from the attributes of one product within a convergence product is equal to or smaller than that of the original single product. Third, a convergence product provides an additional utility derived from attributes that are not included in single products but created by the convergence process. These characteristics are used in this study for developing a theoretical model of market analysis for a new convergence product.

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2. Market Analysis of a Convergence Product

2.1. Consumer utility

The reservation price is defined as the maximum price that a consumer is willing to pay for a product or service [10] and consumers purchase a product when their reservation price is greater than the market price (in other words, when the net utility of product purchase is positive). Assume that there are two existing products A and B in the market and they are independent goods. As mentioned above, v_A and v_B are the consumer's reservation prices and p_A and p_B are the market prices of products A and B, respectively. Consumers purchase product A when $U_A > 0$, namely $v_A > p_A$, and purchase product B when $U_B > 0$, namely $v_B > p_B$.

Since a product can be perceived as a bundle of product attributes [11], the utility of a convergence product is defined as a sum of the partial utilities of attributes, since the technical attributes of tie-in products have a significant impact on a consumer's decision to purchase a convergence product. Hence, a consumer's utility or reservation price for a convergence product can be represented as $v_{\text{convergence}} = \sum v'_{\text{single}} + \mu$, where $v_{convergence}$ is a consumer's gross utility of a convergence product; v'_{single} is the partial utility derived from the attributes of a single product, which includes a convergence product; μ is the additional utility derived from attributes that are not included in single products but created by convergence. It may be ascertained that the consumer's reservation price for a convergence product is related to those of existing products.

However, as mentioned earlier, a convergence product tends to suffer a functional or qualitative loss, while the qualitative attributes of individual products in bundling remain unchanged. In other words, the utility derived from the attributes of product A within a convergence product is equal to or smaller than that of the original single product A. Therefore, assuming that a new convergence product "AB" is developed through the integration of two existing products A and B, the consumer's reservation price for it is defined as $v_{AB} = \alpha v_A + \beta v_B + \mu$ $(0 < \alpha, \beta \leq 1)$, where α and β represent how the functional attributes of existing products A and B are maintained within a convergence product, which can be defined as a similarity index between a convergence product and an existing product.

2.2. Condition of Purchase

There exist three products in the market: two existing products A and B, and a new convergence product AB. Although a convergence product suffers a quality loss as compared with an original product, there is an additional benefit obtained through integration. Therefore, a consumer is motivated to purchase the product. The condition for a consumer's purchase of a convergence product is described as $v_{AB} = \alpha v_A + \beta v_B + \mu > p_{AB}$, where p_{AB} is the market price of a convergence product AB. By rearranging this equation in terms of v_A and v_B, the purchase condition $v_B > -(\alpha/\beta) \cdot v_A + (p_{AB} - \mu)/\beta$ can be described in the demand surface of existing products together.

In this research, three types of convergence products are defined on the basis of the similarity between existing products and a convergence product: partial convergence, one-way convergence, and full convergence. A partial convergence product is defined as a product that partially comprises the attributes of existing products A and B. In other words, consumers can use a part of the functions of existing products through a convergence product. This type of convergence is a general case and can be perceived as an early stage of convergence product development. Moreover, the market boundary of such a product is difficult to define. A one-way convergence product is defined as a product that comprises all the attributes of product A, but just a few of the attributes of product B. In this case, the convergence product is perceived as an improved version or successive generation of product A. Hence, it is expected that such a product shares a potential market with existing product A. A full convergence product is defined as a product that comprises all the attributes of both existing products A and B. In other words, consumers can fully utilize the functions of both existing products through a convergence product without a quality loss. This type of a convergence product can be perceived as being similar to traditional bundling, or as a perfect version of partial convergence. The market for full convergence products is expected to integrate existing markets into a new market. Based on this classification, a theoretical model for the market analysis of each convergence type is derived.

2.3. Demand for three types of convergence products

Under the condition $0 < \alpha, \beta < 1$, a convergence product AB is a case of partial convergence. With the assumption of $\alpha p_A + \beta p_B + \mu > p_{AB}$,[1] the consumer's purchase conditions presented are illustrated in Fig. 1. The coordinates of point Q are $((p_{AB} - \beta p_B - \mu)/\alpha, p_B)$, and the coordinates of point R are $(p_A, (p_{AB} - \alpha p_A - \mu)/\beta)$. As indicated in Fig. 1, it is possible that consumers in Areas I, II, and III purchase both a convergence product and existing products because of their positive net utility. However, consumers compare the utilities of the convergence and existing products due to the overlapping of attributes.

First, it is possible that consumers in Area I can purchase both product A and convergence product AB because their net utilities for each product are positive. However, a convergence product AB partially comprises the attributes of product A. Therefore, consumers in Area I compare their net utility for two products, and purchase product AB in the case that $U_{AB} > U_A$. The purchase conditions of a convergence product in Area I is $v_B > \left((1-\alpha)/\beta\right) \cdot v_A + \left(p_{AB} - p_A - \mu\right)/\beta$, which passes point R when $v_A = p_A$. In the same manner, consumers in Area II purchase a product AB when $v_B < \left(\alpha/(1-\beta)\right) \cdot v_A + \left(p_B + \mu - p_{AB}\right)/(1-\beta)$. On the other hand, in Area III, it is possible that consumers purchase three products from the viewpoint of their net utility. However, consumers purchase convergence product AB in the case that $U_{AB} > U_A + U_B$. Therefore, it is evident that the market for convergence product AB is developed in the area, which satisfies $v_B < -\left((1-\alpha)/(1-\beta)\right) \cdot v_A + \left(p_A + p_B + \mu - p_{AB}\right)/(1-\beta)$. Based on these conditions, the demand for convergence product AB is illustrated in Fig. 2. Assuming that a consumer's reservation price has a uniform distribution, the total demand for product AB can be calculated as the area of quadrangle QRST.

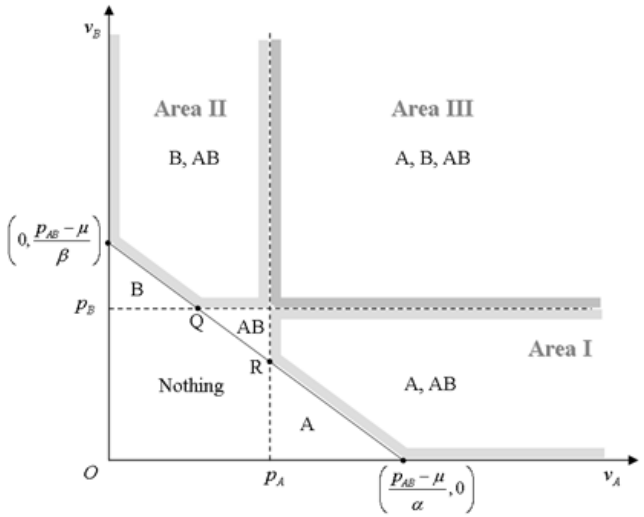

Fig. 1: Graph representing purchase conditions

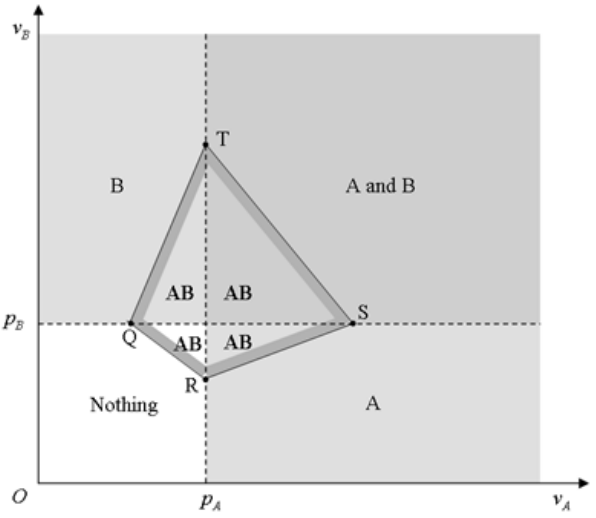

Fig. 2: Demand for a partial convergence product

Under the conditions of $\alpha = 1$ and $0 < \beta < 1$, convergence product AB has the characteristic of one-way convergence. Since a one-way convergence product is a product that comprises all the attributes of product A, it is reasonable to consider a one-way convergence product as a perfect substitute or successive generation of product A. Therefore, in this case, it is expected that convergence product AB shares the potential market with existing product A. Under the condition that $\alpha = 1$ and $\beta = 1$, convergence product AB has the characteristic of full convergence. This type of convergence can be perceived as being similar to traditional bundling, or as a perfect version of partial convergence. Hence, the market for a full convergence product is expected to integrate existing markets into a new market for product AB. The graphs representing purchase conditions of one-way and full convergence products are omitted in this paper.

3. Firm Strategy

In this section, the optimal strategy of a firm producing a convergence product is derived using the theoretical model in former section, with two scenarios on market competition. The first scenario is the case in which an incumbent firm that produces existing products A and B launches a convergence product AB.

[1] In the case in which this condition is not satisfied, the market for a convergence product cannot be developed.

The second scenario is the case in which products A and B are produced by two different firms, and the firm producing product A launches a convergence product AB. For the sake of convenience of analysis, the consumers' reservation prices v_A and v_B are assumed to be uniformly distributed, and convergence product AB is a partial convergence product.

Assume that only one firm (hereafter firm 1) produces and sells products A and B in the market. Firm 1 plans to launch a new convergence product that is a partial convergence product of A and B. The change in profit of firm 1 after the introduction of the convergence product is decided by the newly created sales of convergence product AB and the lost sales of former products. Therefore, the change in profit of firm 1 is calculated as $\triangle\pi_1 = \{(p_{AB} - c_{AB}) - \alpha(p_A - c_A) - \beta(p_B - c_B)\} \cdot (\alpha p_A + \beta p_B + \mu - p_{AB})^2 / (2\alpha\beta(1-\alpha)(1-\beta))$, where c_A, c_B, and c_{AB} are the marginal costs of products A, B, and AB, respectively. Firm 1 expends its best effort to maximize profit with strategic variables α, β, μ, and p_{AB} under the fixed prices of existing products. By the first-order condition $\partial\Delta\pi 1/\partial p_{AB} = 0$, the price of product AB for maximizing the change in profit is $p'_{AB} = (3\alpha p_A + 3\beta p_B + \mu + 2c_{AB} - 2\alpha c_A - 2\beta c_B)/3$. By the conditions on a limited range of prices, the optimal price of convergence product AB for firm 1 is $p^*_{AB} = \max\{p'_{AB}, \max(\alpha p_A + \mu,\ \beta p_B + \mu)\}$. In other words, if $p'_{AB} > max\ (\alpha p_A + \mu, \beta p_B + \mu)$, p^*_{AB} has an interior solution, and if $p'_{AB} < max\ (\alpha p_A + \mu, \beta p_B + \mu)$, p^*_{AB} has a boundary solution.

When firm 1 produces product A and convergence product AB simultaneously, while firm 2 produces only product B, the profit change of firm 1 is $\triangle\pi_1 = \{(p_{AB} - c_{AB}) - \alpha(p_A - c_A)\} \cdot (\alpha p_A + \beta p_B + \mu - p_{AB})^2 / (2\alpha\beta(1-\alpha)(1-\beta))$, and the profit change of firm 2 is $\triangle\pi_2 = -(p_B - c_B) \cdot (\alpha p_A + \beta p_B + \mu - p_{AB})^2 / (2\alpha(1-\alpha)(1-\beta))$. Under this circumstance, firm 2 will always be at a disadvantage in the market due to the introduction of the convergence product. Accordingly, firm 1 attempts to obtain maximum profit with strategic variables α, β, μ, and p_{AB}, while firm 2 attempts to minimize loss in profit with strategic variable p_B. By the first-order condition, the price of product AB for maximizing profit change is $p^*_{AB} = \max\{p'_{AB}, \max(\alpha p_A + \mu,\ \beta p_B + \mu)\}$, where $p'_{AB} = (3\alpha p_A + \beta p_B + \mu + 2c_{AB} - 2\alpha c_A)/3$.

For a simple numerical example, suppose that the price of products A and B are $p_A = p_B = 20$, and their marginal costs are zero, $c_A = c_B = 0$, for the sake of convenience. Moreover, suppose that the convergence product has a zero marginal cost and can provide a constant additional value of $\mu = 10$. For all the cases of α and β ($0 < \alpha, \beta < 1$), the optimal price of product AB determined by firm 1 is derived as indicated in Table 1 and Table 2 for each scenario. From the results, it is found that the optimal price of a convergence product is lower when two firms exist in the market. The price gap increases particularly when a convergence product is close to existing products. This result may be reasonable in that the product price in a monopoly is higher than that in a competitive market. In addition, a firm's strategy with regard to other variables can be analyzed in a similar manner for further research.

Table 1: Optimal price of a product AB in scenario 1

alpha / Beta	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.1	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0
0.2	14.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0
0.3	16.0	16.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0
0.4	18.0	18.0	18.0	19.3	21.3	23.3	25.3	27.3	29.3
0.5	20.0	20.0	20.0	21.3	23.3	25.3	27.3	29.3	31.3
0.6	22.0	22.0	22.0	23.3	25.3	27.3	29.3	31.3	33.3
0.7	24.0	24.0	24.0	25.3	27.3	29.3	31.3	33.3	35.3
0.8	26.0	26.0	26.0	27.3	29.3	31.3	33.3	35.3	37.3
0.9	28.0	28.0	28.0	29.3	31.3	33.3	35.3	37.3	39.3

Table 2: Optimal price of a product AB in scenario 2

alpha / Beta	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.1	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0
0.2	14.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0
0.3	16.0	16.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0
0.4	18.0	18.0	18.0	18.0	20.0	22.0	24.0	26.0	28.0
0.5	20.0	20.0	20.0	20.0	20.0	22.0	24.0	26.0	28.0
0.6	22.0	22.0	22.0	22.0	22.0	22.0	24.0	26.0	28.0
0.7	24.0	24.0	24.0	24.0	24.0	24.0	24.0	26.0	28.0
0.8	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	28.0
0.9	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0

4. Conclusion

The purpose of this research is to develop a theoretical framework for market analysis of a new convergence product. For this purpose, previous literatures on bundling and convergence are reviewed in order to understand the specific characteristics of convergence. In addition, three types of convergence are

defined by similarity index: partial, one-way, and full convergence. The market demand of a convergence product is derived through a mathematical and graphical approach, and discussion on firm's strategy is added.

This research has several significant implications. First, this research approaches the convergence phenomenon from the perspective of product and market. Convergence is newly defined through three types that focus on its characteristics. This typology can provide a new standard of classification to the researches on convergence. According to this typology, bundling can be considered as part of a convergence product. This research provides a theoretical model for market analysis of a new convergence product using a similarity level and consumer's utility. It is a discriminative approach from the theory of traditional bundling. The concept and theory of this research can be applied for the analysis of firm's strategy, market competition, and social surplus. In addition, this research provides a direction for the demand analysis of a new convergence product. When a demand analysis is initiated, this research can provide useful information on the relationship between a convergence product and existing products; thus, the market definition becomes clear and the burden of analysis decreases. Therefore, this research can be perceived as a work that integrates a theoretical model in economics and demand analysis in the field of business.

Despite these contributions, there is room for improvement in this research. First, the assumption of consumer distribution can be relieved. Second, the main issues in the literatures of bundling can be analyzed through a modification of the theoretical model, i.e. the effect of substitution/complementarity between products on the bundling strategy. Finally, the consumer's utility function must be embodied and segmented for the empirical analysis. The similarity index or additional value of a convergence product must be measured quantitatively as well.

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