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Imitation Versus Differentiation: Balance Between Product Similarities and Differences in a Hotelling Model

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Abstract: Firms not only differentiate their products to increase their market power but also imitate the successful product characteristics of their competitors to increase their market power or neutralize that of their competitors. Although many studies have been conducted on differentiation and imitation, the balance of product similarities and differences in each industry has not been explicit. Hence, this study introduces the concept of imitation and the costs of differentiation and imitation into the Hotelling model to analyze both. Thereby, this analysis shows that firms need not only to differentiate but also to imitate from each other to maximize profits. Thus, increasing product similarities between firms in an industry characterizes that industry as different from others; increasing product differences between firms in an industry increases the diversity of products in that industry.

JEL classification: D21, O3

Keywords: differentiation, the Hotelling model, imitation, industrial variety, product variety

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Imitation Versus Differentiation: Balance Between Product Similarities and Differences in a Hotelling Model*

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1. Introduction

To what extent do firms differentiate their products from their competitors' products, and to what extent do they imitate their competitors' products? Competing firms face two choices of product characteristics from the perspective of product similarities and differences. The first choice is to develop product characteristics that other products do not have in the market. Firms attempt product differentiation and innovation activities to increase market power and win the competition. The second choice is to imitate product characteristics that other products in the same market have. If competitors succeed in differentiation or innovation activities that increase market power, then firms will imitate competitors' product characteristics, thereby increasing their own market power or attempting to neutralize that of their competitors. Considering that both choices are necessary for businesses, firms must find the optimal balance between differentiation and imitation in the face of competition.

Many studies have been conducted on differentiation and imitation. First, differentiation has long been studied as a form of imperfect competition since the beginning of the 20th century (Thisse and Norman eds., 1994).[1] In studies on imperfect competition,

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[1] Innovation, which began to attract the attention of researchers after World War II, is also closely related

Chamberlin (1933) studied monopolistic competition with various differentiated products. Meanwhile, Hotelling (1929) developed an address or location model that indicates the extent of differentiation of interest in this study and showed the result of minimum differentiation in his model settings. Moreover, the address model allowed for many subsequent studies on differentiation in various settings. Contrary to Hotelling's result, d'Aspremont et al. (1979) drew the result of maximum differentiation with a two-stage game by choosing locations and prices. Furthermore, various studies have been accumulated, such as Alexandrov (2008), who introduced the set of product characteristics; Matsumura and Matsushima (2012), who allowed locations other than the general range; and Kou and Zhou (2015), who introduced relative performance evaluation.

Next, imitation and related concepts began to attract attention in economics in the second half of the 20th century.[2] First, the growing interest in technological progress for economic growth has led to increased research on technology and knowledge diffusion, social learning, spillovers, and others (Griliches, 1957; Kapur, 1995; Mansfield, 1961; Stiglitz and Greenwald, 2014). In addition, as firms' strategic behavior has been actively analyzed, research on imitation and its countermeasures has increased (Besanko et al., 2017; Lieberman and Asaba, 2006; Örtenblad ed., 2019). In this way, differentiation and imitation have accumulated much research in their respective fields.

However, the balance or composition of product similarities and differences in each industry has not been explicit in previous studies. An industry is generally a group of firms that provide differentiated products when compared within an industry and similar products when compared across industries. In other words, although actual products in the same industry have similar and different characteristics, decisions to differentiate and imitate have not been analyzed in a unified framework.

Therefore, this study analyzes the optimal balance of product similarities and differences of firms in an industry. To do it, the model in this study differs from existing Hotelling models mainly by introducing the following two concepts: one is imitation, and another is differentiation and imitation costs. Thereby, this analysis shows that firms need not only to differentiate but also to imitate from each other while bearing costs in order to maximize profits. Furthermore, it shows that there can be a variety of balances of product similarities and differences from industry to industry, depending on the differentiation and imitation costs. Hence, increasing product similarities between firms in an industry characterizes that industry as different from others; increasing product differences between firms in an industry increases the diversity of products in that industry.

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to differentiation (Godin, 2020; Hall and Rosenberg eds., 2010).

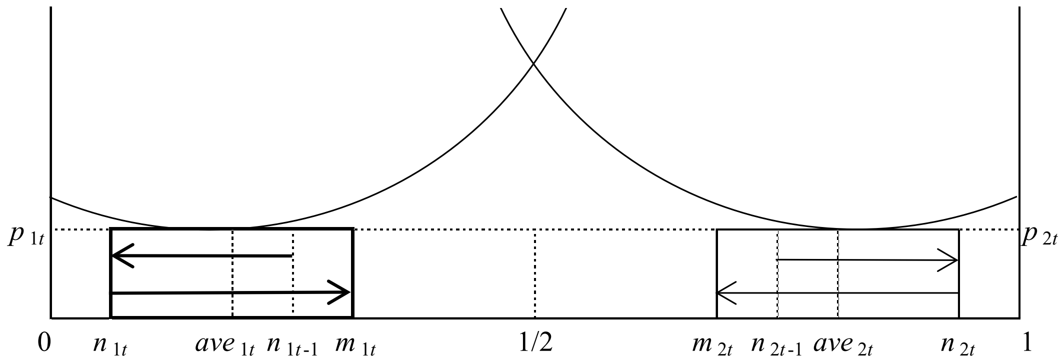
[2] Studies on industrial development in developing countries are also closely related to imitation and related concepts in terms of the advantages of backwardness, catching up, and others.

The remainder of this paper is structured as follows. Section 2 presents a model for analyzing differentiation and imitation. Section 3 analyzes how firms differentiate and imitate and discusses the results. Finally, Section 4 concludes this study.

2. Model

This study analyzes the balance between differentiation and imitation based on the Hotelling model specifically expressed by d'Aspremont et al. (1979).[3] Thus, unlike the original Hoteling model, firms in this model determine location and price. Furthermore, unlike the Hoteling model of d'Aspremont et al. (1979), firms in this model also imitate and bear the differentiation and imitation costs.[4] In this economy, consumers with different preferences are uniformly distributed on a linear space [0, 1], and each consumer buys a product that is close to each preference (Figure 1).

Figure 1: Locations of n_{it} and m_{it}



Source: The author.

Products are supplied by two firms, Firm i ($i = 1, 2$), and their product characteristics are determined by the extent of differentiation n_{it} and that of imitation m_{it}. Specifically, n_{1t} and n_{2t} start from the left end 0 and from the right end 1, respectively, and locate from 0 to 1/2 and from 1 to 1/2, respectively. Then, m_{1t} and m_{2t} start from the right end 1 and from the left end 0, unlike n_{1t} and n_{2t}, respectively, and locate from n_{1t} to n_{2t} and from n_{2t} to n_{1t}, respectively. The starting points are different between n_{it} and m_{it}, even for the same Firm i's location choices, because m_{it} imitates the other Firm j ($j \neq i$)'s n_{jt}. In other words, m_{it} is an extension or genealogy of the characteristics of n_{jt}.

[3] The specific formulation is also based on Tirole (1988).

[4] Kimura (2023) also analyzes imitation after differentiation but does not simultaneously determine differentiation and imitation.

Consequently, products in this model have a width, not a point.[5]

Based on the above, suppose that arithmetic averages $ave_{it} = (n_{it} + 1 - m_{it})/2$ specifically give product characteristics. Therefore, even if areas of overlap exist between the product characteristics of the two firms, if their ave_{it} is not completely the same, then the products are somewhat differentiated. Similarly, even if no areas of overlap exist between the product characteristics of the two firms, if their ave_{it} becomes closer, then the products are relatively imitated.

This model assumes that products are differentiated n_{it-1} to some extent at the previous time $t-1$ as an initial condition to analyze not only differentiation but also imitation of differentiation. However, n_{it-1} is not endogenously obtained in the model but is exogenously given. Therefore, the relationship among n_{it}, m_{it}, and n_{jt-1} is finally as follows: $0 \leq n_{it} \leq n_{it-1}$ and $n_{it} \leq 1 - m_{it} \leq 1 - n_{jt-1}$.

First, Eq. (1) shows firms' profits π_{it}. In the equation, revenues consist of prices p_{it} and demands x_{it}, and costs include the marginal cost c and the differentiation and imitation costs. The differentiation and imitation costs are the products of the differentiation cost coefficient h^D and s, and the imitation cost coefficient h^I and s, respectively. s is the disutility or transportation coefficient of the cost that consumers bear in response to the mismatch between their preferences and firms' product characteristics. The differentiation and imitation cost coefficients and the disutility coefficient are certainly different. However, Eq. (1) includes s as a coefficient that constitutes the differentiation and imitation costs to simplify the calculation results. Although the two costs are based on s just as a form, they increase with the size of the differentiation and imitation cost coefficients, so the essence of the argument is not lost.

$$\pi_{it} = (p_{it} - c)x_{it} - h^D s(n_{it-1} - n_{it})^2 - h^I s(1 - m_{it} - n_{it})^2 \tag{1}$$

The differentiation and imitation cost coefficients can each take different values, and the larger coefficient is likely to vary with the respective differentiation and imitation technologies. The cost of differentiation or innovation may seem higher than that of imitation or learning. However, given that the objects of differentiation and imitation are one's own technological genealogy and that of another firm, imitating another firm's own product characteristics means being a latecomer in terms of time. Thus, although imitators may enjoy the advantage of backwardness, they may also face the disadvantage of backwardness if the technology being imitated is particularly sophisticated and complex.[6] In other words,

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[5] Alexandrov (2008) analyzes product characteristics with a width but does not explicitly include imitation.

[6] Such timing differences are highly pronounced between firms in developed and developing

imitating another firm's technological genealogy is more likely to be technologically unfamiliar than continuing to develop its own technological genealogy. Therefore, the imitation cost can be as high as the differentiation cost or even higher.

Next, Eq. (2) is the price function, which shows that prices rise as differentiation between the two products increases. Specifically, if the distance between Firm i's ave_{it} and Firm j's n_{jt-1} is 1, then $p_{it} = c + s$; if the two locations are equal, then p_{it} becomes c.

$$p_{it} = c + s\left(1 - \frac{n_{it} + 1 - m_{it}}{2} - n_{jt-1}\right)\left(1 + \frac{\frac{n_{it} + 1 - m_{it}}{2} - n_{jt-1}}{3}\right) \tag{2}$$

Third, Eq. (3) is the demand function. Based on the case where both firms share the market equally, that is, 1/2 of the market, demand will fall if prices rise owing to differentiation and rise if prices fall owing to imitation.

$$x_{it} = \frac{1}{2} + \frac{n_{it} - n_{jt-1}}{6} + \frac{1 - m_{it} - n_{it}}{2} \tag{3}$$

Finally, substituting Eqs. (2) and (3) in Eq. (1), π_{it} becomes as follows:

$$\pi_{it} = \left\{c + s\left(1 - \frac{n_{it} + 1 - m_{it}}{2} - n_{jt-1}\right)\left(1 + \frac{\frac{n_{it} + 1 - m_{it}}{2} - n_{jt-1}}{3}\right) - c\right\}$$
$$\left(\frac{1}{2} + \frac{n_{it} - n_{jt-1}}{6} + \frac{1 - m_{it} - n_{it}}{2}\right) - h^D s(n_{it-1} - n_{it})^2 - h^I s(1 - m_{it} - n_{it})^2. \tag{4}$$

Firms maximize Eq. (4) by choosing n_{it} and m_{it} depending on s, h^D, and h^I given exogenously.

The following two solution methods are used to obtain the optimum variables and the resulting profit. The first is numerical calculation. If a single variable n_{it} or m_{it} is included in the equations, the optimal variable can be solved algebraically. However, if both variables n_{it} and m_{it} are included in the equations, solving the optimal variables algebraically is difficult because the relationship between the variables may be nonlinear even after first-order partial differentiation. The second is to obtain the profits of the two firms after solving for n_{it} and m_{it} when only a single firm makes the decision. In other

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countries; however, they also occur when firms in the same country develop different product characteristics at a given point in time.

words, the firms determine their behavior at time t under the assumption that the other firm's product characteristics remain the same at the previous time $t-1$. However, because the profits of the two firms depend on each other's n_{it} and m_{it}, the profits are finally obtained by substituting each other's n_{it} and m_{it} into the profit function. This method is intended to simplify the calculations, but it is a realistic assumption because it is difficult for firms to know in advance what their competitors will do.

3. Analysis and Discussion

3.1. Differentiation or Imitation: A Special Case as a Benchmark

First, this subsection analyzes behaviors that involve only differentiation or imitation, which serves as a benchmark for comparison with the analysis results of both behaviors in the next subsection.

3.1.1. By a Single Firm: Optimal Behavior at the Firm Level

This sub-subsection analyzes cases in which a single firm engages in differentiation or imitation. First, to analyze differentiation, Eq. (5) is obtained by extracting from Eq. (4) only the part related to differentiation and by assuming that both firms differentiated to half of the possible values at the previous time $t-1$ and substituting 1/4 for n_{it-1} and n_{jt-1} in Eq. (4) for simplicity. Therefore, although the specific value is substituted, this analysis does not lose the essence of analyzing the differentiation and imitation behavior of firms based on a specific value.

$$\pi_{it} = \left\{c + s\left(1 - n_{it} - \frac{1}{4}\right)\left(1 + \frac{n_{it} - \frac{1}{4}}{3}\right) - c\right\}\left(\frac{1}{2} + \frac{n_{it} - \frac{1}{4}}{6}\right) - h^D s\left(\frac{1}{4} - n_{it}\right)^2 \qquad (5)$$

The top row of Case 1.1 in Table 1 shows the numerical result of differentiation by a single firm. If $s = 1$ and $h^D = 1$, then $n_{it} = 0.1213$ and $\pi_{it} = 0.2714$. If the firms neither differentiate further nor imitate at time t, they will operate at 1/4 of what they differentiated at the previous time $t-1$. Then, if $s = 1$, $n_{it} = 0.2500$ and $\pi_{it} = 0.2500$. Therefore, firms bear differentiation costs, but profits increase with further differentiation at time t.

Table 1: Numerical solutions

Case	Conditions [1] h^D	h^I	n_{it}	m_{it}	Length [2]	Profit
1. Differentiation or Imitation						
1.1. By a Single Firm						
1.1.1. Differentiation	1	–	0.1213	–	–	0.2714
1.1.2. Imitation	–	1	0.2500	0.7333	0.01665	0.2503
1.2. By Both Firms						
1.2.1. Differentiation	1	–	0.1213	–	–	0.3622
1.2.2. Imitation	–	1	0.2500	0.7333	0.01665	0.2414
2. Differentiation and Imitation						
2.1. By a Single Firm						
	1	1	0.1090	0.8384	0.05265	0.2746
	0.5	0.5	0	0.8661	0.1339	0.2967
	2	2	0.1748	0.8052	0.02000	0.2629
	0.5	2	0.02384	0.9359	0.04023	0.2884
	2	0.5	0.1690	0.7681	0.06300	0.2648
2.2. By Both Firms						
	1	1	0.1090	0.8384	0.05265	0.3421

Notes 1: In all cases, $s = 1$.

2: "Length" indicates the length between n_{it} and m_{it}. Specifically, $1 - m_{1t} - n_{1t}$ is for Firm 1 and $1 - n_{2t} - m_{2t}$ for Firm 2.

Source: The author.

Next, Eq. (6) is obtained by extracting only the part related to imitation from Eq. (4) and substituting 1/4 for n_{it} and n_{jt-1} in Eq. (4) to analyze imitation.

$$\pi_{it} = \left\{ c + s\left(1 - \frac{\frac{1}{4} + 1 - m_{it}}{2} - \frac{1}{4}\right)\left(1 + \frac{\frac{\frac{1}{4} + 1 - m_{it}}{2} - \frac{1}{4}}{3}\right) - c \right\}\left(\frac{1}{2} + \frac{1 - m_{it} - \frac{1}{4}}{2}\right) - h^I s\left(1 - m_{it} - \frac{1}{4}\right)^2 \qquad (6)$$

The bottom row of Case 1.1 in Table 1 shows the numerical result of imitation by a single firm. If $s = 1$ and $h^I = 1$, then $m_{it} = 0.7333$ and $\pi_{it} = 0.2503$. Hence, the width of the product characteristics becomes 0.01665 obtained by $1 - m_{it} - n_{it}$. Conversely, if firms do not imitate at time t, they will lose demand, and their profit will be 0.2410. Therefore, despite bearing the imitation cost, profits are higher than those in the case of neither differentiation nor imitation but lower than those in the case of only differentiation.

3.1.2. By Both Firms: Consequences at the Industry Level

This sub-subsection analyzes cases in which both firms engage in either differentiation or imitation. First, Eq. (7) is obtained by extracting only the part related to differentiation from Eq. (4) and substituting 1/4 for n_{it-1} and n_{jt} for n_{jt-1} to analyze differentiation.

$$\pi_{it} = \left\{c + s\left(1 - n_{it} - n_{jt}\right)\left(1 + \frac{n_{it} - n_{jt}}{3}\right) - c\right\}\left(\frac{1}{2} + \frac{n_{it} - n_{jt}}{6}\right) - h^D s\left(\frac{1}{4} - n_{it}\right)^2 \quad (7)$$

The top row of Case 1.2 in Table 1 shows the numerical result of differentiation by both firms. If $s = 1$ and $h^D = 1$, and substituting $n_{it} = 0.1213$ obtained in Eq. (5), then $\pi_{it} = 0.3622$. Therefore, profits are higher than those in the case of differentiation by a single firm because both firms differentiate their products and the distance between the two products increases.

Next, to analyze imitation, Eq. (8) is obtained by extracting only the part related to imitation from Eq. (4), substituting 1/4 for both n_{it} and n_{jt-1}, and assuming that both firms share the market equally, that is, 1/2 of the market. If both firms behave in the same way, each firm's demand will never exceed 1/2.

$$\pi_{it} = \left\{c + s\left(1 - \frac{\frac{1}{4} + 1 - m_{it}}{2} - \frac{1}{4}\right)\left(1 + \frac{\frac{\frac{1}{4} + 1 - m_{it}}{2} - \frac{1}{4}}{3}\right) - c\right\}\frac{1}{2}$$
$$- h^I s\left(1 - m_{it} - \frac{1}{4}\right)^2. \quad (8)$$

The bottom row of Case 1.2 in Table 1 shows the numerical result of imitation by both firms. If $s = 1$ and $h^I = 1$, and substituting $m_{it} = 0.7333$ obtained in Eq. (6), then $\pi_{it} = 0.2414$. Therefore, profits are lower than those in the case of imitation by a single firm because of competition in the market.

3.2. Differentiation and Imitation: A General Case of a Real Economy

Next, this subsection analyzes behaviors that involve differentiation and imitation, which is a general case from the perspective of actual products in an industry.

3.2.1. By a Single Firm: Optimal Behavior at the Firm Level

This sub-subsection analyzes cases in which a single firm engages in differentiation and imitation. Eq. (9) is obtained by substituting 1/4 for n_{it-1} and n_{jt-1} in Eq. (4).

$$\pi_{it} = \left\{ c + s\left(1 - \frac{n_{it} + 1 - m_{it}}{2} - \frac{1}{4}\right)\left(1 + \frac{\frac{n_{it} + 1 - m_{it}}{2} - \frac{1}{4}}{3}\right) - c \right\}$$
$$\left(\frac{1}{2} + \frac{n_{it} - \frac{1}{4}}{6} + \frac{1 - m_{it} - n_{it}}{2}\right) - h^D s\left(\frac{1}{4} - n_{it}\right)^2 - h^I s(1 - m_{it} - n_{it})^2. \qquad (9)$$

Case 2.1 of Table 1 shows the numerical results of differentiation and imitation by a single firm. If $s = 1$, $h^D = 1$, and $h^I = 1$, then $n_{it} = 0.1090$, $m_{it} = 0.8384$ and $\pi_{it} = 0.2746$. Therefore, the width of the product characteristics becomes 0.05265, which is wider than that in the case of only imitation. Moreover, the profits are higher than those in the case of only differentiation or only imitation by a single firm. In the case of both firms, profits increase as prices improve through differentiation and demand increases through imitation.

In addition, Case 2.1 of Table 1 also shows the results when the differentiation cost coefficients are larger or smaller than 1. As one may intuitively expect, the smaller/larger the coefficients, the larger/smaller the movement of n_{it} and m_{it}. Therefore, the product characteristics of each firm vary greatly depending on the size of the differentiation and imitation cost coefficients. Therefore, this model can show various conditions in terms of the balance between product differentiation and imitation depending on the amount of the differentiation and imitation costs.

3.2.2. By Both Firms: Consequences at the Industry Level

Finally, this sub-subsection analyzes a case in which both firms engage in differentiation and imitation. Eq. (10) is obtained by substituting $(n_{jt} + 1 - m_{jt})/2$ for n_{jt-1} of the price, n_{jt} for n_{jt-1} of the demand, and 1/4 for n_{it-1} in Eq. (4), and by assuming that both firms share the market equally, that is, 1/2 of the market, through imitation.

$$\pi_{it} = \left\{ c + s\left(1 - \frac{n_{it} + 1 - m_{it}}{2} - \frac{n_{jt} + 1 - m_{jt}}{2}\right)\left(1 + \frac{\frac{n_{it} + 1 - m_{it}}{2} - \frac{n_{jt} + 1 - m_{jt}}{2}}{3}\right) - c \right\}$$
$$\left(\frac{1}{2} + \frac{n_{it} - n_{jt}}{6}\right) - h^D s\left(\frac{1}{4} - n_{it}\right)^2 - h^I s(1 - m_{it} - n_{it})^2. \qquad (10)$$

The values of Case 2.2 in Table 1 show the numerical results of differentiation and imitation by both firms. If $s = 1$, $h^D = 1$, and $h^I = 1$, and substituting $n_{it} = 0.1090$ and $m_{it} = 0.8384$ obtained in Eq. (9), then $\pi_{it} = 0.3421$. Therefore, the profits are higher than those of differentiation and imitation by a single firm.

3.3. Discussion

This subsection discusses the profits in Table 1. Table 2 lists them in descending order of amount to easily compare profits. However, the table only includes the case of $h^D = 1$ and $h^I = 1$ in Case 2.1 to compare between the same conditions. Meanwhile, the table also includes the case of neither differentiating nor imitating at time t shown in 3.1.1, that is, doing nothing, as in the second case from the bottom of the table.

Table 2: Profit per case

Case Number	The Number of Firms	Behavior	Profit
1.2.1	2	Differentiation	0.3622
2.2	2	Both	0.3421
2.1	1	Both	0.2746
1.1.1	1	Differentiation	0.2714
1.1.2	1	Imitation	0.2503
–	2	Nothing	0.2500
1.2.2	2	Imitation	0.2414

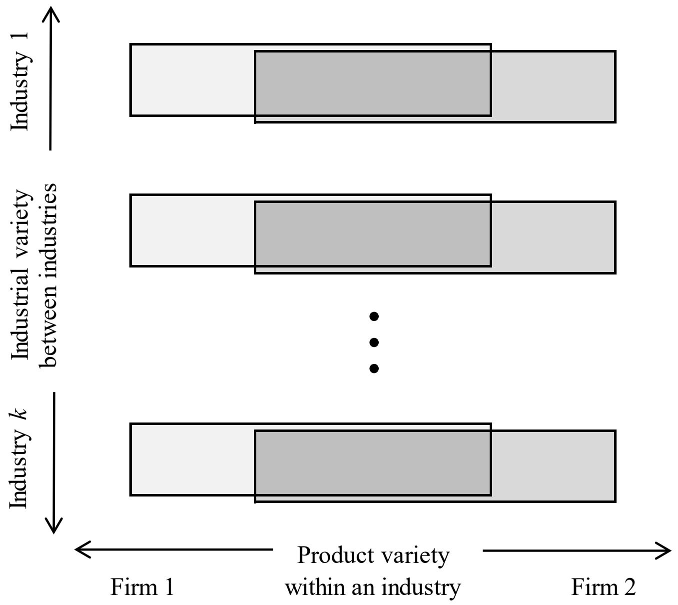
Note: The row with "–" is a case in which both firms neither differentiate nor imitate.
Source: The author.

First, for a single firm, the profit of both behaviors is larger than the benefits of only differentiation or imitation. Therefore, when firms do not consider the existence of their competitors in the same industry, differentiating and imitating products become rational for them, thereby increasing product similarities and differences.

Next, for both firms, the benefit of both behaviors is smaller than that of only differentiation but larger than that of only imitation. In the case of only differentiation, profits increase because the distance between the two firms' product characteristics is larger than those when only a single firm differentiates at time t. From another aspect, in the case of only imitation, profits decrease because the two firms compete to expand demand through imitation. Therefore, although differentiation and imitation are not the best for profits, firms can improve their profits, at least more than if they did nothing.

Consequently, competition among firms develops product similarities and differences in the industry. Each aspect of product similarities and differences has the same effect in terms of expanding the width of product characteristics. However, each has a different meaning for the products. To illustrate each aspect in the following paragraphs, Figure 2 shows product variety in the horizontal direction and industrial variety in the vertical direction. In the horizontal direction, as analyzed in this study, we assume that Firms 1 and 2 differentiate toward the right and left ends, respectively, and conversely imitate toward the left and right ends, respectively. Therefore, if each of the two rectangles represents the product characteristics of the two firms, then some of the product characteristics are different, but some are similar. In the figure, the rectangles overlap, but in reality, this is not necessary. Even though the rectangles do not overlap, they are close according to the length of the width. From another aspect, in the vertical direction, k such industries exist. In a real economy, the composition of product similarities and differences will differ depending on the competitive and technological conditions within the industry; however, it can assume an economy similar to that shown in Figure 2.

Figure 2: Product and industrial variations



Source: The author.

Regarding similarities, the direction of imitation indicates a new industrial differentiation or specialization from existing industries. As products become highly similar within an industry, they lose their unique product characteristics within that industry. However, when compared with those in other industries, they share product characteristics within that industry that are not shared by products in other industries. As shown in Figure 2, such common or standardized characteristics of products in an industry characterize that industry relative to other industries. Thus, imitation by firms within an industry leads to an increase in industrial variety.[7]

Next, regarding differences, the direction of differentiation indicates the product characteristic lineage of each firm. Expanding differences emphasize the characteristics of each firm's products while expanding similarities emphasizes industrial differentiation. As shown in Figure 2, different characteristics in an industry lead to providing diverse value to consumers in the market. Thus, differentiation by firms within an industry leads to increased product variety.

This is how competition shapes an industry. At the industry level, firms offer distinctive products relative to products in other industries through imitation. By contrast, at the firm level, they also offer distinctive products relative to products of other firms in the same industry through differentiation. By discussing the balance between product differentiation and imitation of firms, industries with a set of firms whose products are differentiated when compared within an industry can be shown, but they are similar when compared with other industries.

4. Conclusions

This study analyzed the balance between product similarities and differences under competition. Hence, the study introduced the concept of imitation and the costs of differentiation and imitation in the Hotelling model for differentiation in Section 2. Moreover, the study showed that firms expand product similarities and differences through imitation and differentiation in Section 3. Consequently, this study showed that competition develops product and industrial varieties.

Therefore, product similarities and differences have at least the following effects within and between industries, respectively. First, the relationship between product similarities and differences within an industry can affect a firm's performance. Incorporating common or standardized product characteristics into their products does not increase profits; however, maintaining demand for their products and profits is necessary. Without differentiation based on common product characteristics, the product will not be in high demand in the market. Therefore, introducing product similarities can affect the effectiveness of product differences. In other words, communalization or standardization is necessary to

[7] This model does not endogenize the creation of the new linear space itself, in which firms imitate and differentiate their products, and thus does not show the true dynamics of the creation of new industries. However, this model shows the formation process of the new industry by showing the accumulation of imitation and differentiation after the initial product development, that is, differentiation at the previous time $t-1$, on the new linear space.

avoid losing in the market; individuality is necessary to win in the market.

Next, among industries, sunk costs invested by incumbents can disadvantage latecomers. Firms within the same industry compete fiercely for survival, and in the process, firms collectively raise barriers to entry for those outside the industry. In other words, firms are in a competitive relationship to invest within the industry, but also in an unintended "cooperative" relationship to create barriers to entry from outside the industry. Of course, barriers may be imperfect or even unstable owing to declining demand, and technology diffusion to outside firms, especially developing countries, and the emergence of disruptors through technological change. However, sunk costs can allow the industry to survive, at least temporarily.

This study showed that competition among firms creates product and industrial varieties through differentiation and imitation. However, the composition of product similarities and differences may vary from industry to industry, although the composition of product similarities and differences is the same as that in Figure 2 for simplicity. Therefore, empirical analysis should be conducted, and case studies must be collected from different industries in the future to understand the differences and their changes in product characteristics in each industry.

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