NEW DIFFERENTIATED PRODUCT WITH DISADVANTAGE

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This paper examines what happens when a new differentiated product with some disadvantage to the existing product is introduced, depending on whether it is the incumbent monopolist or an entrant that introduces the new product. The disadvantage is represented as a positive cost consumers must incur when purchasing the new product. This cost may be related to search cost, switching cost or any inertia of consumers.

In the benchmark case where the new product has no disadvantage and the total demand is inelastic to equilibrium price, social welfare is identical regardless of whether it is the incumbent or the entrant who offers the new product. If the new product has some disadvantage, the resulting welfare level is generally lower due to the disadvantage cost. But with disadvantage, the incentive to offer the new product is lessened, which is socially better. Finally, the entrant tends to be more aggressive in the sense that it may enter even when the incumbent would not offer the new product under the same conditions.

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I. INTRODUCTION

The ground floor of the social science building at Ewha Womans University is occupied by a take-out coffee shop. The shop, along with the building, was newly introduced to the campus a few years ago and is very popular among our students. When the new shop opened, another coffee shop was already in business on the other side of the campus. Two shops offer similar menus, from plain brewed coffee to cafe latte (hot or iced) and other varieties. They happen to use coffee beans from the same manufacturer.²

The two shops' pricing behaviors exhibited two interesting features. First, the new shop (entrant) charges lower prices than the old shop (incumbent) for identical or similar menus. For example, an iced cafe latte (a very popular item according to managers at both shops, especially in summer) is sold at 1,000 Won by the entrant but at 1,300 Won by the incumbent. Second, the incumbent's current price is higher than its own past price before entry. For example, the incumbent also used to charge 1,000 Won for an iced cafe latte.

The second observation is quite interesting because we usually expect prices to decrease when entry occurs and competition (supposedly) intensifies.³ So the fact that the incumbent raised prices in response to entry is somewhat surprising.

The first observation, however, is not trivial either because there is no obvious explanation for disparity between the current prices, especially by supply-side factors. As was noted above, two shops use the same beans, the most important factor input in their products.⁴ Also, there is no reason to expect significant differences in wages or rents paid by the shops.

This paper offers a simple framework where phenomena like the one just given can arise. The key is related to the fact that two shops (or the services rendered by two shops) are not perfect substitutes, the most important difference

² A group of undergraduate students in my intermediate micro class brought this story to my attention. They studied simpler versions of the model in this paper and took interviews with staffs at both shops to learn more about their practices. Their findings are reported in their term paper. A few other groups were also investigating behaviors of other campus stores, usually comparing prices of identical or similar items. The story of coffee shops had more twists than others, as will be explained shortly.

³ Apparently, both shops are separate business concerns. There is no evidence of collusion between them.

⁴ In fact, according to the students' finding from interviews, the incumbent is getting a better deal for the same coffee beans. So other (supply-side) factors being equal, we can expect the entrant's price to be higher. In the model below, we suppress supply side differences by assuming $MC = 0$ for both.

being their geographical locations. If the products were perfectly substitutable (or the market were characterized by a non-cooperative oligopoly with homogeneous product), the entry would lead to a lower equilibrium price in general⁵ and the equilibrium would be symmetric. So we immediately suspect this must be a case of differentiated products, but it is not obvious how such result comes about as an equilibrium. We will show that it can happen when there is some (demand side) asymmetry between the products.

More generally, we consider the behaviors of an incumbent and an entrant engaged in a post-entry duopoly game when their products are horizontally differentiated and the entrant faces some sort of 'disadvantage' compared to the incumbent's existing product.⁶ Our ultimate interest in this paper is whether we can derive meaningful welfare results, i.e. under what circumstances the new product is desirable in terms of consumers' surplus and social welfare. A companion paper (Kim, 2005) treats the separate issue of when the price increase can happen.

We build on a basic model where the new product *without any disadvantage* is socially undesirable because its social benefit is less than the cost of providing it. To the basic model, we introduce 'disadvantage' associated with the new product and derive an equilibrium where the entrant charges a lower price than the incumbent. The question is: Is there any difference in welfare consequences when the disadvantage is introduced? The bottomline answer is as follows: In terms of social welfare, it is even worse *if* the new product with disadvantage is indeed introduced, because the disadvantage is modelled as actual cost on consumers. But with disadvantage, the incentive to introduce the new product is lessened, which is socially better. However, the entrant is too aggressive in the sense that it may enter even under circumstances where the incumbent would not offer the new product by itself.

⁵ See the introduction in Kim (2005) and references cited there, especially Satterthwaite (1979). On the other hand, a recent work by Amir and Lambson (2000) offers a case where price can increase even in "Cournot" markets.

⁶ This disadvantage may be viewed as vertical differentiation, in addition to the horizontal differentiation. But in the model below, the disadvantage is not something the firms choose (as is the case with quality level in typical *vertical* differentiation models), so we will use a rather casual term of 'disadvantage.'

II. NEW PRODUCT WITH *NO* DISADVANTAGE

We first consider the case when the new product is identical to the existing one. While the results can be easily derived from the model with disadvantage (presented in the next section) by simply setting the disadvantage to zero, briefly skimming through this baseline case will help fix the intuition.⁷

2.1 Consumers and monopolist's initial product

We take the simplest standard approach to modelling horizontal product differentiation via linear city à la Hotelling (1929). We build on an example given in Tirole (1988, Exercise 2.3, p.105).

Consumers are uniformly distributed on the unit interval $[0,1]$, each having unit demand and facing transportation cost t per distance travelled to purchase a product. They enjoy identical gross surplus s from consuming one unit.

A monopolist offers a product located at point 0.⁸ Marginal cost of producing the product is zero. So if the market were unbounded towards the right, the firm will have chosen its price so that marginal revenue is zero (= marginal production cost). However, we assume s is sufficiently large, so that a monopolist can cover the entire market with even higher price.⁹

Assumption 1. $s > 2t$

Under Assumption 1, profit-maximizing monopolist charges $p = s - t$, extracting all the surplus of the marginal consumer located at point 1.

2.2 Monopolist offers a second product

Now the monopolist contemplates offering a differentiated second product. New

⁷ This section draws from Kim (2004) but also contains new materials.

⁸ We are not concerned with strategic choice of locations by firms. The designated location of product may be due to regulation, for example, as is suggested by Tirole (1988). In fact, for qualitative results, the locations need not be at extreme points. What is required is for the monopolist not to move the existing product to another location in response to the new product.

⁹ This assumption, originally made by Tirole (1988), implies that additional offer of a differentiated product does not affect the total demand as its total mass is always 1. This assumption is crucial for the level of equilibrium prices, see Kim (2005).

product is identical to the existing one (i.e. gives the same surplus s to consumers), except for its location. We require it be located at point 1. Introducing a new product requires a fixed investment cost of amount f .

With two products offered at the opposite endpoints of the city, the marginal consumer is the one in the middle at point $1/2$. Monopolist maximizes profit by extracting all the surplus of this marginal consumer, hence charges $(s - t/2)$ for both products.

Proposition 1. (Social and private benefits of the new product)

- (1) *The maximum social benefit of the new product is $t/4$.*
- (2) *The private benefit to the firm (i.e. profit increase) is $t/2$.*

Proof. (1) The only social benefit is that half of the consumers now travel less. The total savings in transportation cost are calculated as follows:

$$\int_{0.5}^1 [ty - t(1 - y)]dy = t \int_{0.5}^1 [2y - 1]dy = t/4$$

(2) The profit increase is equal to the price increase because the total demand is inelastic at 1: $(s - t/2) - (s - t) = t/2$. ■

The following is Tirole's (1988) assumption on f .

Assumption 2. $\frac{t}{4} < f < \frac{t}{2}$

Under Assumption 2, Proposition 1 immediately implies that the monopolist will offer the second product and social welfare will decrease by the offer. (See Table 1 below.)

2.3 When an entrant offers a new product

Now suppose, instead of the incumbent, an entrant enters the market by offering a product at point 1. For transparent comparison, suppose the entrant also has to incur the same fixed cost f . After entry, the incumbent and the entrant engage in a noncooperative game with price as the strategic variable.¹⁰

Suppose the incumbent charges p_0 and the entrant charges p_1 . The location

¹⁰ We ignore dynamic strategic interactions such as entry deterrence.

of the marginal consumer who is indifferent between the existing and the new products is given by $y_m = \frac{1}{2} - \frac{p_0 - p_1}{2t}$.

If each firm maximizes its profit given the other's choice, it is easy to show that the Nash equilibrium is $(p_0, p_1) = (t, t)$ and the marginal consumer is at $y_m = 1/2$. Since the entrant does *not face any disadvantage*, the (post-entry) duopolists divide the market equally and the symmetric equilibrium prevails. The price is lower than in single-product case ($t < s - t$ by Assumption 1), so the competition will drive both prices down.

The following table (taken from Kim (2004)) compares one product monopoly, two product monopoly and post-entry duopoly, offering a concise overview of market outcomes when there is no disadvantage associated with the new product.

[Table 1] When new product is without disadvantage

Cases	One product monopoly (§2.1)	Two product monopoly (§2.2)	Duopoly (§2.3)
prices	$p_0 = s - t$	$p_0 = p_1 = s - \frac{t}{2}$	$p_0 = p_1 = t$
y_m	$y_m = 1$	$y_m = \frac{1}{2}$	$y_m = \frac{1}{2}$
profit	$\pi_0 = s - t$	$\pi_0 = s - \frac{t}{2} - f$ $\Delta \Pi = \frac{t}{2} - f$	$\pi_0 = \frac{t}{2}, \pi_1 = \frac{t}{2} - f$ $\Delta \Pi = -s + 2t - f$
consumer surplus	$CS = \frac{t}{2}$	$CS = \frac{t}{4}$ $\Delta CS = -\frac{t}{4}$	$CS = s - \frac{5}{4}t$ $\Delta CS = s - \frac{7}{4}t$
welfare	$W = s - \frac{t}{2}$	$\Delta W = \frac{t}{4} - f$	$\Delta W = \frac{t}{4} - f$

Notes: (1) y_m = location of marginal consumer, (2) π_i = firm i 's profit, (3) $\Pi = \pi_0 + \pi_1$, (4) Comparisons (Δ) are against "one product monopoly", (5) $\Delta W = \Delta \Pi + \Delta CS$

Notice that the overall welfare effects are identical for two product monopoly and duopoly. In other words, diversity is over-provided regardless of the market structure. But due to the competitive nature of duopoly, there is a difference from consumers' point of view. Because of competition, duopolists together transfer part of the previous monopoly profit to consumers as shown by $\Delta \Pi = -s + 2t - f < 0$ (by Assumption 1).

Proposition 2. *Under Assumptions 1 and 2, and with no disadvantage associated with the new product*

(1) (Overprovision of diversity) *Socially optimal number of products is 1, but 2 products are offered, regardless of whether the market structure is*

monopoly or duopoly.

(2) (Consumers prefer “diversity with competition”) *Consumer surplus is the highest for duopoly, and the lowest for two-product monopoly.*

Proof. (1) Necessary calculations are already provided in Table 1. That monopolist overprovides was established with Proposition 1. In duopoly case, the social benefit is again $t/4$ (consumers’ savings in transportation). The profit to the entrant turns out to be $t/2 - f$, because it takes the half of the market with the price t .

(2) The magnitudes of consumer surplus are ordered as follows: $s - 5t/4$ (duopoly) $> t/2$ (one product monopoly) $> t/4$ (two product monopoly), where the first inequality follows from Assumption 1. ■

III. NEW PRODUCT WITH DISADVANTAGE

We now extend the analysis by introducing ‘disadvantage’ to the model. It is in order that we discuss briefly the nature of this ‘disadvantage.’ Kim (2001) introduced a positive ‘search cost’ to the basic setup of Section 2.1 and interpreted the analysis as comparing online and offline markets, under the presumption that in online markets consumers do not face any search cost for finding out about newly offered products, while in offline markets consumers do face a positive search cost to learn about and buy the new offering. Hence, the disadvantage was presented in the form of search cost, which was modelled simply as a one-shot payment of $c > 0$ that a consumer must incur before purchasing any new product.¹¹

In fact, whether small or zero search cost is a defining characteristic of online markets is an empirical question. Furthermore, even in theoretical models whether reduced search cost implies an ideal (perfectly competitive) market is subject to argument. For example, Bakos (1997) presented a circle model of horizontal differentiation with buyer search cost and claimed that as search cost diminishes the firms’ equilibrium prices approach marginal cost. Harrington (2002) then argued that the results should be taken with caution. Major theoretical difficulty seems to lie with specific modelling assumptions regarding the structure of search cost in determining buyers’ and firms’ equilibrium

¹¹ Presumably consumers have already paid a similar search cost in the past when the existing product was first introduced.

decisions. One novelty of Bakos's (1997) approach is that he distinguished between search for price and for product location (*i.e.* differentiated characteristics). Indeed, it can be argued that in online commerce, searching for price (and other easily "digitized" information) is relatively easy but learning about exact product characteristics (and other more "analog" information) is more difficult. However, Harrington (2002) basically showed that without specifying how these different search costs are combined, the equilibrium choices of firms are difficult to pin down.

In this paper, rather than tackling that conceptually and technically difficult issue, we take a more abstract notion of disadvantage to characterize the costs consumers face for purchasing a new product. Consumers may face various forms of obstacles in purchasing a new differentiated product. They simply may not be aware of the availability without some effort (search cost), may have made some product-specific investments in the existing product (switching cost), or face some psychological resistance to trying out a new product (something like inertia). So depending on contexts, the model with disadvantage may be more suitable for online markets or offline markets, for example.

To anticipate main results: as disadvantage is conceived as a real cost on consumers, when a new product is introduced the social welfare can be even lower than when there is no disadvantage. However, the disadvantage works against the incentives of the firms to supply the new product in the first place. What is brought out below is that unlike in the no-disadvantage case the incumbent and the entrant behave somewhat differently in their product offer decisions.

3.1 Two product monopolist with disadvantage

Let us first consider the case of two product monopolist. Again, monopolist selling product 0 at price p_0 plans to introduce a new product 1 at price p_1 . Consumers located near point 1 are interested in the new product, but they must pay $c > 0$ before purchasing it.

Hence, a consumer compares between the surplus from sticking to product 0 ($= s - ty - p_0$) and the surplus from overcoming disadvantage and buying product 1 ($= s - t(1 - y) - p_1 - c$). The location of the marginal consumer is obtained by equating the two expressions, or

$$s - ty_m - p_0 = s - t(1 - y_m) - p_1 - c \Leftrightarrow y_m = \frac{1}{2} + \frac{c}{2t} - \frac{p_0 - p_1}{2t} \quad (1)$$

Given the location of the marginal consumer, the monopolist maximizes its profit:

$$\Pi = p_0 \cdot y_m + p_1 \cdot (1 - y_m) \quad (2)$$

The resulting prices and other relevant information is collected in Table 2 in the next subsection in comparison with duopoly case. Here we offer intuitive sketches of the results.

When there was no disadvantage, the monopolist simply raised price after introducing a new product. But with disadvantage, monopolist has to subsidize buyers of the new offering. So, he will charge $c/2$ less for the new product. Because consumers of new product must incur the cost c , they in effect pay $c/2$ more than consumers of existing product. Existing product consumers, on the other hand, are charged $c/4$ less than in the no-disadvantage case. So the seller gives more *nominal* discount to new product consumers, but existing product consumers are real beneficiaries.¹²

3.2 Entry with disadvantage

Now consider the entrant's decision. The incumbent's product is well established, but the entrant's product requires consumers' attention. Consumer either has to actively learn about the product (search cost) or has to give up some benefits from incumbent (switching cost) or simply will not easily switch to an unfamiliar product (inertia).

As before, after entry, the incumbent and the entrant engage in noncooperative price competition. Denote the incumbent's price by p_0 and the entrant's price by p_1 . Then a consumer at location $y \in [0, 1]$ enjoys surplus of $(s - ty - p_0)$ if she buys from the incumbent and $(s - t(1 - y) - c - p_1)$ if she buys from the entrant. The location of the marginal consumer y_m has the same formula (Equation (1)) as in two-product monopoly case.

¹² If, for any reason, prices are required to be equal for both products (*i.e.* if price discrimination is impossible), the seller uniformly subsidizes both groups of consumers by charging the average of two (discriminating) prices. See Kim (2001).

In equilibrium, each firm maximizes its profit given the other's choice. Hence, the incumbent solves

$$\max_{p_0} \pi_0 = p_0 y_m = p_0 \left(\frac{1}{2} + \frac{c}{2t} - \frac{p_0 - p_1}{2t} \right) \quad (3)$$

while the entrant solves

$$\max_{p_1} \pi_1 = p_1 (1 - y_m) - f = p_1 \left(\frac{1}{2} - \frac{c}{2t} + \frac{p_0 - p_1}{2t} \right) - f \quad (4)$$

which leads to the following first-order conditions:

$$\frac{\partial \pi_0}{\partial p_0} = \frac{1}{2} + \frac{c}{2t} - \frac{p_0}{t} + \frac{p_1}{2t} = 0 \quad (5)$$

$$\frac{\partial \pi_1}{\partial p_1} = \frac{1}{2} - \frac{c}{2t} + \frac{p_0}{2t} - \frac{p_1}{t} = 0 \quad (6)$$

[Table 2] When new product is associated with disadvantage

Cases	One product monopoly (§2.1)	Two product monopoly with disadvantage (§3.1)	Duopoly with disadvantage (§3.2)
prices	$p_0 = s - t$	$p_0 = s - \frac{t}{2} - \frac{c}{4}$ $p_1 = s - \frac{t}{2} - \frac{3c}{4}$	$p_0 = t + \frac{c}{3}$ $p_1 = t - \frac{c}{3}$
y_m	$y_m = 1$	$y_m = \frac{1}{2} + \frac{c}{4t}$	$y_m = \frac{1}{2} + \frac{c}{6t}$
profit	$\pi_0 = s - t$	$\pi_0 = s - \frac{t}{2} - \frac{c}{2} + \frac{c^2}{8t} - f$ $\Delta \Pi = \frac{t}{2} - \frac{c}{2} + \frac{c^2}{8t} - f$	$\pi_0 = \frac{1}{18t} (c + 3t)^2$, $\pi_1 = \frac{1}{18t} (c - 3t)^2 - f$ $\Delta \Pi = -s + 2t + \frac{c^2}{9t} - f$
consumer surplus	$CS = \frac{t}{2}$	$CS = \frac{t}{4} + \frac{c^2}{16t}$ $\Delta CS = -\frac{t}{4} + \frac{c^2}{16t}$	$CS = s - \frac{5t}{4} - \frac{c}{2} + \frac{c^2}{36t}$ $\Delta CS = s - \frac{7t}{4} - \frac{c}{2} + \frac{c^2}{36t}$
welfare	$W = s - \frac{t}{2}$	$\Delta W = \frac{t}{4} - \frac{c}{2} + \frac{3c^2}{16t} - f$	$\Delta W = \frac{t}{4} - \frac{c}{2} + \frac{5c^2}{36t} - f$

Notes: (1) y_m = location of marginal consumer, (2) π_i = firm i 's profit, (3) $\Pi = \pi_0 + \pi_1$,

(4) Comparisons (Δ) are against "one product monopoly", (5) $\Delta W = \Delta \Pi + \Delta CS$

Combining (5) and (6) we find that the Nash equilibrium is $(p_0, p_1) = (t + \frac{c}{3}, t - \frac{c}{3})$. Compared to the no-disadvantage case, the entrant must offer discount to survive the competition while the incumbent can charge a higher price. The next table presents a summary of market outcomes when the new product faces some disadvantage.

3.3 Comparison between 2-product monopoly and post-entry duopoly

3.3.1 When is the second product offered?

Without disadvantage, the welfare outcomes were identical whether it was the incumbent or the entrant who offered the new product. But the presence of disadvantage affects the incentives of the firms such that they behave differently as to when to offer the new product.

First consider the incumbent's decision to offer a new product. The location of the marginal consumer y_m for two product monopoly is given by $\frac{1}{2} + \frac{c}{4t}$. Since the marginal consumer must belong to the population $[0,1]$ (otherwise, the second product fails to attract any buyers), the monopolist will offer the second product only when $\frac{c}{4t} < \frac{1}{2}$ or $c < 2t$. It is easy to check, for instance, that the monopolist's choice of new product price p_1 is positive under this condition. For future references, let us denote this necessary condition for incumbent's offer as (M).

$$c < 2t \tag{M}$$

On the other hand, the entrant faces a different decision criterion. The marginal consumer's location in duopoly equilibrium is $\frac{1}{2} + \frac{c}{6t}$, so the entrant has positive demand when $c < 3t$. (The entrant's price will be positive under this condition.) Again for future references, denote this necessary condition for entry as (E).

$$c < 3t \tag{E}$$

Clearly, the entrant is likely to be more aggressive than the incumbent in the sense that the entrant expects to have demand at higher levels of disadvantage c (for a given level of t). Of course, the actual entry will occur only when it

leads to a positive *profit* for the entrant. This depends on the magnitudes of f , c and t all considered together. The next proposition summarizes the instances of a second product being offered by the incumbent or the entrant.

Proposition 3. *When the new product faces disadvantage (i.e. buyers incur positive cost c to purchase the new product),*

(1) *(offered when costs are small) if both disadvantage c and fixed investment f are sufficiently small, the second product will be offered either by the incumbent or the entrant.*

(2) *(fixed investment has to be lower with disadvantage) the upper bound on f for which the new product is offered is lower than in the no-disadvantage case.*

(3) *(entrant is more aggressive) whenever the incumbent finds it profitable to introduce the second product, the entrant also finds it profitable to enter, but not the other way around—the entrant may enter when the incumbent chooses not to offer a second product.*

Proof. (1) As explained above, if $c < 2t$, then the demand for the incumbent's second product exists. The incumbent finds it profitable to offer it when $f < t/2 - c/2 + c^2/8t (\equiv \bar{f}_M)$. On the other hand, the entrant enters if $c < 3t$ and $f < (1/18t)(c - 3t)^2 (\equiv \bar{f}_E)$.

(2) Incumbent finds the new product profitable if $f < \bar{f}_M$. Now $\bar{f}_M = t/2 - c/2 + c^2/8t = t/2 + (c/8t)(-4t + c) < t/2 + (c/8t)(-4t + 2t) < t/2$, with the second last inequality following from (M). Similarly for the entrant, $f < \bar{f}_E = (1/18t)(c - 3t)^2 = (1/18t)(c^2 - 6ct + 9t^2) = (c/18t)(c - 6t) + t/2 < t/2$, the last inequality following from (E).¹³ Hence, (naturally) the presence of disadvantage shortens the range of f values wherein the second product is offered. (In other words, the latter half of Assumption 2 has to be strengthened for an overprovision of diversity result, compared to the no-disadvantage case.)

(3) The entrant will enter as long as (E) holds and the corresponding upper bound on f is satisfied ($f < \bar{f}_E$). It is easy to check that $\bar{f}_M < \bar{f}_E$ if (M) holds. (More precisely, the upper bound for the incumbent is lower if $c < 12/5t$.) Therefore, the entrant will always find it profitable to enter when the

¹³ Obviously, $c < 2t$ is also sufficient. See the next item of Proposition.

incumbent would have found it profitable to offer a new one. The converse may not hold. ■

3.3.2 Welfare comparisons

Social welfare can increase as the result of the introduction of new product by the incumbent if $f < t/4 - c/2 + 3c^2/16t$. If the last two terms combine for a positive number, socially desirable diversity is possible (otherwise, f is less than $t/4$ violating the first half of Assumption 2). This condition reduces to $c > 8t/3$, but this contradicts (M) required for the incumbent's offer. Hence, the offer by the incumbent is always welfare-reducing.

On the other hand, post-entry welfare change is $\Delta W = t/4 - c/2 + 5c^2/36t - f$. So the entry is socially warranted if $f < t/4 - c/2 + 5c^2/36t$. Similar calculation shows that for this condition not to violate Assumption 2, we should have $c > 18t/5$, which contradicts (C) needed for the entrant's offer. Therefore, entry is also welfare-reducing if it happens. We have just proved that, as in the no-disadvantage case, the market will offer too much diversity, regardless of the market structure.

Proposition 4. (Overprovision of diversity) *When a second product with disadvantage is offered, welfare decreases regardless of whether the incumbent or the entrant offers.*

The proposition shows that if the new product is offered, then welfare decreases. However, the presence of disadvantage does help mitigate the problem because the new product with disadvantage is less likely to be offered (especially if f is sufficiently large).

In the no-disadvantage case, the welfare decrease in case of duopoly arose from the reduced profit for the incumbent, while consumers actually benefited. In the current case, this may or may not hold depending on the size of s compared to t . The following proposition explains that depending on the size of s , the welfare loss may be burdened on either consumers or incumbent.

Proposition 5. *When an entrant offers the second product with disadvantage,*

(1) *if consumers' gross surplus of consumption s is sufficiently small, consumers are worse off.*

(2) if consumers' gross surplus of consumption s is sufficiently large, the incumbent is worse off.

Proof. (1) Changes in consumer surplus when entry occurs is

$$\begin{aligned}
 & s - \frac{7t}{4} - \frac{c}{2} + \frac{c^2}{36t} \\
 &= s - \frac{7t}{4} + \frac{c}{36t}(c - 18t) \\
 &< s - \frac{7t}{4} - \frac{5t}{4} \\
 &= s - 3t
 \end{aligned}$$

Hence, if $s < 3t$, then the consumer surplus decreases after entry.

(2) Profit change for the incumbent firm when entry occurs is

$$\begin{aligned}
 & \frac{1}{18t}(c + 3t)^2 - (s - t) \\
 &= -s + \frac{3t}{2} + \frac{c}{3} + \frac{c^2}{18t} \\
 &< -s + \frac{3t}{2} + t + \frac{t}{2} \\
 &= -s + 3t
 \end{aligned}$$

Hence, if $s > 3t$, then incumbent's profit decreases after entry. ■

IV. CONCLUDING REMARKS

In this paper, we analyzed the welfare implications of product diversity, offered either by incumbent monopolist or entrant, with or without disadvantage for the new product. Major findings are as follows:

- When there is no disadvantage for the new product, product diversity can be overprovided (*i.e.* diversity reduces social welfare). Welfare loss is equal regardless of whether the new product is offered by the incumbent monopolist or an entrant. But the way welfare is lost is different: diversity by monopolist reduces consumer surplus, while diversity by entrant reduces the incumbent's profit and consumers actually gain.

- When there is disadvantage for the new product (*i.e.* consumers must

incur positive cost for purchasing the new product), the social welfare is even worse if the new product is offered. But due to disadvantage, it is less likely to be offered. From social viewpoint, whether the incumbent or the entrant should offer the new product depends on relevant parameters, *i.e.* gross surplus s , transportation cost t and disadvantage c . The entrant can be overly aggressive in offering the product, but if the gross surplus s is large, consumers may benefit from entry.

Some of the limitations of our results are rather obvious. Let us here point out potential modifications and extensions that might be interesting. The linear city setup is not as restrictive as it may appear, as basic insights are likely to extend to more general setup as long as (i) the locations are fixed and (ii) the total demand is inelastic to price. Naturally, allowing for strategic choice of locations is one possible extension. However, the literature is already quite rich on strategic location decisions in Hotelling model (Beath and Katsoulacos (1991, chapter 2) provides a succinct survey) and at this point, it is difficult to see how allowing location decisions will affect our conclusions in meaningful directions.

On the other hand, allowing the total demand to be responsive to price can change the results in important ways. Kim (2004) considers the no-disadvantage case when demand is elastic in a limited sense, more specifically when the opposite of Assumption 1 above ($s > 2t$) holds. Even in no-disadvantage case, the welfare conclusions are altered. Market structure does matter in this case, favoring the incumbent's offer of new product. In other words, entry always reduces welfare, but incumbent can sometimes increase welfare by offering another product. With disadvantage and elastic demand, welfare calculations are difficult to summarize. Hence, rather than going through elaborate computations and condition, it might be instructive if we go back to the beginning and finish the story.

If our campus can be represented by the unit interval, and if the student population is homogeneous in tastes for coffee (s) and opportunity cost of time spent in walking to the shop (t) but is uniformly scattered on campus between two shops (these are indeed big *ifs*), and if we place two coffee shops at each end of the interval (this is a modelling convenience), both of the observations (i) the incumbent raised prices and (ii) the incumbent now charges higher price than the entrant lead us to conclude that there must be some kind of disadvantage for the entrant. If we literally apply our simple model to this story,

the following restrictions can be placed on parameters:

$$\text{[incumbent's old price]} \quad s - t = 1000 \quad (7)$$

$$\text{[incumbent's new price]} \quad t + \frac{c}{3} = 1300 \quad (8)$$

$$\text{[entrant's (new) price]} \quad t - \frac{c}{3} = 1000 \quad (9)$$

Solving for these equations yields: $s=2150$, $t=1150$, and $c=450$. In words, our students probably value a cup of cafe latte at 2150 Won, the time to walk from one shop to the other at 1150 Won, and face a cost of 450 Won for the same cup at the new place, for whatever reason. These figures violate Assumption 1, $s > 2t$, so we can infer that the total demand *has* changed. When the opposite of Assumption 1 holds, the incumbent's pre-entry price is $s/2$ instead of $s - t$. So the equation (7) has actually to read:

$$\text{[incumbent's old price]} \quad s/2 = 1000 \quad (10)$$

Hence, $s=2000$, with other parameters remaining identical.

On the other hand, the numbers satisfy Condition (E), $c < 3t$ (the entry was not an irrational act). In fact, c is so low that they also satisfy (M), $c < 2t$. The old shop could have opened another branch itself, if whatever this disadvantage c is were the same for the old shop's new branch.

We cannot tell whether the new shop increased overall welfare (students' surplus plus shops' profits) because we do not know the value of f . But we can at least check effect on consumers' surplus. If Assumption 1 were to hold, because s is not so high as to satisfy $s > 3t$ (the condition favoring consumers in Proposition 5), consumers are worse off. With the opposite of Assumption 1, the expression for consumer surplus changes and it can be easily shown (Kim, 2004, 2005) that the consumer surplus unambiguously decreases. Our students are worse off than before. Many students (including those who brought this story to the author) probably agree with this claim.

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