Product Differentiation Research: A Critical Review

Eui Kyo Jeong(First Author)
Department of Business Administration,
Myongji University
(*ejeong@mju.ac.kr*)

Product differentiation has been an important field in industrial organization economics and has inspired theoretical and empirical research on competition in strategic management and marketing, among other disciplines. To better understand this important field, we review the literature in a critical manner. Here we have two purposes. First, we update some recent developments in the last decade or two. One interesting aspect of recent developments is an active incorporation of consumer heterogeneity, elastic demand in the model, two-side markets with network externalities, among others. Second, we assess the sensitivity of equilibrium outcomes on their assumptions.

A critical review of the literature allows us to argue that the assumptions of quadratic transportation costs, elastic demand, and concave consumer distribution are influential in determining the level of differentiation. These assumptions, individually or together, increase product differentiation, possibly to the maximum level, by making consumers quite sensitive to (even small) price changes. And we also argue that when we assume multiple products and asymmetric cost positions, we have results similar to those suggested by resource endowments argument in strategic management.

Based on the review, we offer several suggestions for future research. First, given the influential effect of the assumption of quadratic transportation costs, we suggest that researchers should make it clear why they choose to assume quadratic transportation costs over linear transportation costs. We believe this issue could be solved rather easily if researchers are more explicit about the applications of derived results rather than the derivation itself. Second, the impact of elastic demand on the degree of differentiation suggests that researchers should be particularly cautious in empirical research. Any condition that triggers price rigidity should be explicitly represented in the equation. Otherwise the degree of differentiation would not be properly estimated due to the endogeneity caused by the absence of this condition on the right side of the equation. Third, regarding unknown distribution of consumer density, researchers should be advised to include income distribution in their empirical model. Unlike unknown distribution of consumer heterogeneity, income distribution could be available if the target of the application of derived results is known. Lastly, it may prove to be quite fruitful if researchers build upon some of recent developments. Researchers may want to extend vertical differentiation in two-side markets with network externalities that may have interesting implications on on-demand economy or researchers may want to take up the notion of variable elasticity of substitution that could open up new possibilities of expanding research streams on supply-side (e.g., production costs) of product differentiation.

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Ⅰ. Introduction

The field of product differentiation in industrial organization economics started with Hotelling's (1929) seminal work on spatial competition. Since then, the advancement in this field has been a history of challenging Hotelling's (1929) conventional intuition and addressing some 'awkward facts' that we can easily find in the real world. These facts include (1) many industries produce large number of similar but differentiated products; (2) in most industries each firm produces a range of differentiated products; (3) two differentiated products produced by two different firms in the same industry are rarely, if ever, identical; (4) the set of products made by firms in any industry is a small subset of the set of possible products; (5) a consumer purchases a small subset of the products that are available from any one industry; (6) consumers perceive the differences among differentiated products to be real and there is often approximate agreement on which products are, or are not, close substitutes; and (7) tastes are revealed to vary among consumers because different consumers purchase different bundles of differentiated commodities and these differences cannot be fully accounted for by difference in their incomes (Eaton and Lipsey, 1989: 725-726).

In the course of challenging the conventional intuition and addressing the above awkward facts, a substantial amount of diverse research findings have been accumulated. These findings have inspired other disciplines such as strategic management and marketing that are concerned with competition through new product or service introductions vis-à-vis rivals. So our clear understanding on the state of product differentiation research can help further advance the relevant branch of research in strategic management and marketing. But, to our surprise, there are not many works that try to evaluate some of the recent developments in a critical manner and relate them to prior findings. This is what we intend to do.

We have two things in mind. First, as already mentioned, we would like to update some recent developments of product differentiation research in the last decade or two and see how these relate to the prior findings. One interesting aspect of recent developments is an active incorporation of consumer heterogeneity and elastic demand in the model, among others. We reserved a sufficient amount of space for these recent developments. For a comprehensive review on earlier developments, readers are referred to Beath and Katsoulacos (1991), Eaton and Lipsey (1989), Gabszewicz (1999), Gabszewicz and Thisse, (1986b), Greenhut, Norman, and Hung (1986), and Lancaster (1990), among others. Second, we would like to assess the sensitivity of equilibrium outcomes on their assumptions. Majority

of the works in product differentiation are mathematical modeling built on assumptions that are supposed to capture the essence of the 'awkward' facts. By addressing the meaning and implications of the assumptions that determine the outcomes of mathematical models, we hope to enhance our understanding on this important field of research, not just for industrial organization economics per se, but also for any disciplines that can derive inspiration from the findings. Strategic management is not an exception in this regard. The list of studies that we review is included in the appendix with their key assumptions and major findings.

We start with the introduction of Hotelling's (1929) seminal work on location choice. Here we describe the assumptions, major findings, and implications. Hotelling's conventional assumptions are described so that we can show how these assumptions have been relaxed or changed. And then we address new or relaxed assumptions one by one starting with the assumption on transportation costs. In the process we interpret the results in terms of the relaxed assumptions. Lastly, we discuss what we have learned and conclude with an overall assessment.

Ⅱ. Product Differentiation: Assumptions and Outcomes

2.1 Hotelling' seminal work

The literature on product differentiation practically started with Hotelling's (1929) model of spatial competition. The motivation came from the intuition that, contrary to conventional wisdom, a firm that charges a higher price over homogeneous products does *not* lose all of its sales instantaneously. He wanted to know whether price instability would disappear when products are differentiated.

To examine this intuition, he assumed several properties of a duopoly of homogeneous goods: (1) each firm *simultaneously* chooses a location on a line of finite length (say, a linear city), and then engage in Bertrand competition; (2) consumers are *uniformly* distributed along this *line* of finite length; (3) consumer demand is extremely *inelastic* (consumers consume one unit or zero per unit of time irrespective of the price); (4) a consumer incurs a transportation cost t per unit of distance between her location and the location chosen by a firm on the line (thus, total cost for a consumer consists of mill price and transportation cost); (5) consumers don't have any preference over either firm except for price and transportation cost; and (6) production cost is *zero*. And two firms choose price and

location in such a manner to maximize their profits.

Based on the above assumptions, Hotelling (1929) demonstrated that two firms would locate themselves at the center of the line (i.e., market) and split the market into two halves (each half for each firm): *principle of minimum differentiation*. Interestingly this equilibrium is not consistent with the social optimum that minimizes transportation costs for consumers: social optimum occurs when two firms locate at the first and the third quartiles.

The literature on product differentiation that started with Hotelling's seminal work has evolved around the original or now conventional assumptions. Researchers have tried to understand the various aspects of product differentiation by relaxing one or a few of the assumptions. The most striking result came out a half a century later by d'Aspremont, Gabszewicz and Thisse (1979) when conventional linear transportation costs were assumed away and replaced by quadratic transportation costs.

2.2 Quadratic transportation costs (vs. linear transportation costs)

The biggest challenge to Hotelling's principle of minimum differentiation came a half a century later by d'Aspremont, et al. (1979) that assumed quadratic transportation costs instead of linear transportation costs and demonstrated that *maximum differentiation* is the equilibrium. Before addressing the main results, an explanation on the difference between linear transportation costs and quadratic transportation costs is in order.

Along a line of finite length, consumers are uniformly distributed from one end to the other. Each consumer has her own location that represents her ideal taste along the line of tastes (distributed over the line), which is like having her own address (Archibald, Eaton, and Lipsey, 1986; Eaton and Lipsey, 1989). When a firm locates its product along this line, there is distance between the consumer's location (ideal taste or most preferred location) and the location of the product. This distance is captured by the notion of transportation cost. In Hotelling's beach model, the distance literally means the cost of transportation from the location of a consumer to the location of a vendor: the greater the location, the greater becomes the transportation cost. In a more general setting, transportation cost represents the value or importance that a consumer attaches to this distance. Different consumers may attach different values for the same distance. For some consumers the value will increase in a strictly proportional manner, whereas for other consumers, the value will increase dramatically as the distance gets longer.

Quadratic transportation costs model the latter case where costs increase by the multiple of squared distance, to be exact. In com-

parison with linear transportation costs of the former case, quadratic transportation costs imply that consumers are far more sensitive to the distance as it gets longer. Because consumers are quite sensitive to distance (i.e., attach far more value), they are willing to pay relatively *more* for a product that is close to their ideal location or preference.

Assuming quadratic transportation costs, d'Aspremont, et al. (1979) derive that Hotelling's (1929) equilibrium of minimum differentiation is not stable. When two firms are located very close to each other, at least one firm has an incentive to increase its profits by relocating its position (i.e., product) either (1) farther from the other and raising its price; or (2) infinitesimally closer to the competing product and undercutting its own price. Thus, the equilibrium outcome is not minimum differentiation but maximum differentiation that is supposed to relax price competition: *principle of maximum differentiation*.

Since d'Aspremont, et al. (1979), substantial amount of works have assumed quadratic transportation costs that amplify *strategic effect* (or price effect) – reduction of price competition by moving away from rival product(s) (e.g., Ansari, Economides, and Steckel, 1998; Correia-da-Silva and Pinho, 2011; Irmen and Thisse, 1998; Martinez-Giralt and Neven, 1988; Meagher and Zauner, 2005; Nero, 1999). In contrast, whenever linear transportation costs are assumed, we are more likely to derive decreasing product differentiation, possibly to the point of minimum differentiation (e.g., Ahlin and Ahlin, 2013; de Palma, Ginsburgh, Papgeorgiou, and Thisse, 1985). But it is not clear whether the assumption of linear transportation cost alone is influential in deriving decreasing differentiation or minimum differentiation. For example, when linear transportation costs are assumed with other rather strong assumptions, the influence becomes rather weak or negligible (e.g., Gehrig and Stenbacka, 2004; Smithies, 1941). This is not surprising given the fact that linear transportation costs are represented as a first-order linear term in the equation, which can be rather easily negated or overpowered by any addition of strong terms.

Regarding transportation costs, it is interesting to note that a few studies have included two types of transportation costs in the same model. Egli (2007) models the situation where consumers are either linear costs-type or quadratic costs-type. The equilibrium outcome depends on the proportion of one type relative to the other. If the proportion of consumers with linear transportation costs is less than one third of the total consumers, the equilibrium is maximum differentiation; whereas if the proportion is greater than one third, then firms are moving closer to each other. In an interestingly different way, Sajeesh and Raju (2010) assumed that consumers would incur both linear costs and quadratic costs, which

practically amplified the effects of transportation costs. In a 3-stage game, they demonstrated that the presence of variety seeking consumers reduced differentiation: high variety seeking made a positive demand effect to dominate a negative price effect. But we must point out that the implications of incorporating two types of transportation costs in the same equation still need to be clarified.

2.3 Vertical differentiation vs. horizontal differentiation

Unlike horizontal differentiation that addresses a firm's choice over a set of consumer *tastes* represented by a linear city, vertical differentiation addresses a firm's choice over a set of *qualities* that are rank-ordered from the highest to the lowest. People have different preferences over tastes, but they are quite agreed upon the rank-order of qualities and prefer the better quality, if all other things are equal.

As in horizontal differentiation, price competition is also a big concern for vertical differentiation (Gabszewicz and Thisse, 1979; Shaked and Sutton, 1982). In a 3-stage game (entry-quality-price), Shaked and Sutton (1982) demonstrate that market equilibrium occurs when duopolists maximally differentiate from each other. In a similar vein, Gabszewicz and Thisse (1979) also suggest that firms differentiate their products in terms of quality to relax price competition, from sufficient to maximum degree.

Then, in what sense horizontal and vertical differentiation relate to each other? Are they talking about two fundamentally different things? Or are they closer to each other than they look? It looks like they are more closely related to each other than we have thought (Anglin, 1992; Bester, 1998; Cremer and Thisse, 1991; Vogel, 2008).

Under mild assumptions on transportation cost, any Hotelling-type model is a *special case* of vertical product differentiation: the product locations in equilibrium in horizontal differentiation are the qualities in equilibrium in vertical differentiation (Cremer and Thisse, 1991). In a similar vein, Bester (1998) shows that vertical quality uncertainty could induce horizontal minimum differentiation. The opposite, we must say, does not necessarily hold (cf. Shaked and Sutton, 1983). Vogel (2008) and Vandenbosch and Weinberg (1995) also obtained the same level of differentiation both for vertical and horizontal differentiation, rendering support for the argument that these two are intertwined in a special way.

The close relationship between vertical and horizontal differentiation is probably because the decision rules underlying these two are practically the same (Anglin, 1992). The oft-cited difference between vertical and horizontal differentiation—all consumers agree on the ranking of qualities in a vertically differ-

entiated market, whereas they disagree in a horizontally differentiated market—is less important in most cases. And "[t]he interesting results in a vertically differentiated market do not arise from any agreement among consumers on the ranking of quality because any effect of such agreement can be offset by prices and the cost of production when consumers are concerned with price *and* quality." (Anglin, 1992: 12) Thus, the decision rules that consumers use in a vertically and a horizontally differentiated market are the same due to *income* and *substitution* effects that occur because of price changes.

Do the same decision rules yield equally stable equilibrium for both types of differentiation? Gabszewicz and Thisse (1986a) contend that it is not quite so. The reason lies in that there exist no stable price and location equilibrium under horizontal differentiation, whereas there always exists a stable price and location outcome under vertical differentiation. This is primarily due to the tendency that concavity of demand rarely holds under horizontal differentiation, whereas it typically holds under vertical differentiation. In other words, the difference of the shape of consumer demand makes equilibrium at vertical differentiation *inherently* more stable. The shape of consumer demand will be addressed in the next section.

In sum, we may argue that vertical differentiation and horizontal differentiation are quite closely intertwined with each other because they share practically the same decision rules (Anglin, 1992). These decision rules work in the same way because of the essentially same logic that underlies price effects or strategic effects in differentiation models (e.g., Cremer and Thisse, 1991; Shaked and Sutton, 1982). And this price effect is much more pronounced for vertical differentiation because the demand is much more concave than for horizontal differentiation, which makes the equilibrium for vertical differentiation more stable (Gabszewicz and Thisse, 1986a).

2.4 Consumer heterogeneity and elastic demand (vs. homogeneity and inelastic demand)

In addition to the type of transportation costs, the assumptions on consumer demand play a critical role in deriving equilibrium. Hotelling (1929) basically assumed that consumer demand is complete information: consumer demand is uniformly distributed all over the linear market and extremely inelastic. The former is concerned with the distribution of consumer preference or taste and its differentiability over the entire market, and the latter is about elasticity of demand to price changes. Hotelling's assumption of uniformly distributed consumers all over the market can be relaxed in the following two ways: (1) consumers are heterogeneous and each con-

sumer has her own taste unknown to firms; but the probability distribution of the consumers' location is known (e.g., de Palma et al., 1985), (2) consumers are homogeneous and the probability distribution of the consumers' location is unknown; but the expected probability distribution of the location is known (e.g., Aiura, 2010; Meagher and Zauner, 2005).

When consumers are sufficiently heterogeneous but uniformly distributed, de Palma, et al. (1985) showed that minimum differentiation at the center of the market is always an equilibrium outcome. Here equilibrium prices are positive proportional to the degree of heterogeneity. This result is a kind of sensitivity test of minimum differentiation against Hotelling's assumption of homogeneity of products and consumers. Minimum differentiation could be equilibrium even though the assumption on uniform consumer demand is relaxed, i.e., minimum differentiation is not so sensitive to Hotelling's consumers. But it should be noted that transportation costs were assumed to be linear, which has the tendency to reduce the degree of differentiation.

Under the same assumptions of quadratic transportation costs and uniform consumer distribution with the unknown exact location of this distribution (i.e., inelastic demand with incomplete information), Aiura (2010) and Meagher and Zauner (2005) derived different conclusions, minimum differentiation and sufficient-to-excessive differentiation, respectively. There are also several key differences in their research, one of which is the assumption of exogenous price.

Exogenous price is a very important element in Aiura's (2010) modeling of a sequential entry game where 3 firms choose one product attribute one by one without the knowledge of exact consumer location. When the uncertainty of consumer demand is high, first- and second- moving firms don't want to let the following entrants to know the location of consumers, so they locate at the center of the market one by one: minimum differentiation is the equilibrium outcome. However, if consumer demand is relaxed to be *elastic*, this minimum differentiation is hard to remain as equilibrium.

Unlike Aiura (2010) that addresses consumer demand uncertainty at the individual level, Meagher and Zauner (2005) deal with *aggregate* uncertainty over consumer preferences. They show that when *aggregate* uncertainty is large (small), we observe excessive (insufficient) differentiation. When aggregate uncertainty is large enough, the chances of capturing (new) consumer base may go up by moving away from its competitor, thereby weakening the potential negative effect of market share loss due to increasing differentiation.

Why do we observe the conflicting results? One possible explanation is that unlike aggregate demand uncertainty, individual consumer demand uncertainty under no aggregate

uncertainty (de Palma, et al, 1985; Aiura, 2010) may lead to less differentiation because the differentiation of individual tastes substitutes for differentiation in product location (Meagher and Zauner, 2005). In addition to this substitution effect that can happen only at the individual level, we can also point out that exogenous price assumption (de Palma, et al, 1985; Aiura, 2010) alleviates potential price competition, thereby weakening the forces to increase differentiation.

Relaxing Hotelling's (1929) inelastic demand and Bertrand competition, Smithies (1941) assumed conjectural variation and *identical (linear) elastic* demand. In a simultaneous duopoly game model, he demonstrated that the concern for conjectural variation – a competitor's reaction by changing price or by changing both price and location – would induce firms to locate toward the center while not to the point of minimum differentiation; and with elastic demand, firms have incentives not to move too much toward the center since this will result in the loss of consumers near the end of the market, which would mitigate the tendency toward minimum differentiation. Extending Smithies' (1941) assumption of linear elastic demand, Nero (1999) introduced reservation price in a model of 2-stage game (location-price). He shows that duopolists have incentives to relax price competition through maximum product differentiation when the *reservation price* is high enough. This result is not surprising since high reservation price coupled with elastic demand, it can be argued, is a recipe for (potential) price competition.

What happens if consumers are located in a symmetric manner? Common sense may imply a symmetric equilibrium to capture the symmetric demand. But under quadratic transportation costs and *elastic* consumer preference, even symmetric densities don't necessarily lead to (unique) symmetric equilibrium, but asymmetric equilibria (Anderson, Goeree, and Ramer, 1997; Benassi and Chirco, 2008). Assuming log-concave consumer density, Benassi and Chirco (2008) show that multiple asymmetric equilibria may arise even with symmetric densities of consumer preferences. Symmetric densities that are "too concave" may not have symmetric equilibrium but multiple asymmetric equilibria (Anderson, et al., 1997). High density of consumers at the center means that if firms position themselves at the center, they may end up with fierce price competition. Thus, firms have incentives to move away from the center and a unique symmetric equilibrium is not feasible, which is a bit counter-intuitive. A unique symmetric equilibrium can exist under very restricted conditions when the density is not "too concave" and not "too asymmetric." So it is not surprising that we are more likely to observe excessive differentiation.

The underlying forces that increase differentiation under symmetric densities may also work when the income distribution is assumed

to be concentrated in a duopoly vertical differentiation game (Benassi, Chirco, and Colombo, 2006); Gabszewicz and Thisse, 1979; Shaked and Sutton, 1982). The results for vertical differentiation are more consistent as argued in the previous section. Income concentration leads to more product differentiation as the concentration of consumers (here middle-class consumers) increases a potential for price competition that could be reduced by increasing the quality spread (Benassi, et al., 2006). Under the assumptions of identical tastes but different income levels, Gabszewicz and Thisse (1979) also derived the results that duopolists would have incentives to choose quality such that they maintain product differentiation from a sufficient to maximum degree. And it would be interesting to note that Shaked and Sutton's (1982) maximum differentiation came from the assumption of concentrated income distribution: the upper bound of income was assumed to be twice the lower-bound income.

Up to now we have addressed the situations where consumer demand is incomplete information to firms, but product attributes are known to consumers. What happens if consumers are not sure about the quality of a product before its use? As unknown consumer demand matters, so does unknown quality (Bester 1998; Orosel and Zauner, 2011). When the quality is uncertain and consumers rely on observed prices to ascertain the quality of products, the equilibrium outcome would be minimum differentiation under duopoly (Bester, 1998). This is because consumers' imperfect information about the quality characteristic of a product reduces a firm's incentives to horizontally differentiate its product. However, in a vertical differentiation, Orosel and Zauner (2011) offer different results. When multiple firms move simultaneously and a good's quality is not observable for consumers before use, maximum differentiation is the outcome. In other words, quality polarization happens such that we only observe the lowest and highest quality in the market.

These conflicting results may be due to the nature of price in Bester's (1998) model. The price is very rigid due to its quality signaling property. This argument is similar to that when price is exogenous. As prices become rigid due to signaling reasons, firms would enjoy positive profits and they become less motivated to relax price competition through product differentiation (even under quadratic transportation costs assumption).

2.5 Multiple dimensions (vs. single dimension)

When products are assumed to have two or more dimensions instead of Hotelling's single dimension of location, what would be the equilibrium? The results are surprisingly consistent: firms choose maximum and minimum differentiation in a single product at the same

time (Ansari, Economides, and Steckel, 1998; Irmen and Thisse, 1998; Vandenbosch and Weinberg, 1995).

Under the assumption of quadratic transportation costs, duopolists choose to maximize differentiation along the dominant characteristic (the characteristic with the largest or sufficiently large salience coefficient) but minimize differentiation on the other characteristics (Ansari, et al., 1998; Irmen and Thisse, 1998). In the case of minimum differentiation, firms cluster at the center of the characteristics in question. Almost identical result was derived by Vandenbosch and Weinberg (1995) in a 2-stage game (quality-price) with two-dimensions of product characteristics.

It is rather surprising that the results are so consistent. Why do we expect minimum-maximum differentiation at the same time here? One plausible explanation is that firms are trying to take advantage of both strategic effect and demand effect. By choosing maximum differentiation on the dominant dimension, firms can relax price competition for the very dimension that consumers are very sensitive to for any price changes, thereby increasing overall profitability. Regarding the other dimension(s) that consumers don't attach as high a value as the dominant dimension for the same distance, firms choose minimum differentiation to increase market share or demand, thereby increasing overall profitability. We might have different equilibrium outcome, if quadratic transportation costs are assumed away and replaced by linear transportation costs. Another explanation is that asymmetric weights attached to the dimensions could have affected the outcome. Mathematically this may be equivalent to assigning quadratic transportation costs to the dominant dimension and linear transportation costs to the other dimension(s).

2.6 Multiple products (vs. single product)

If we become more realistic and assume that firms introduce multiple products, as stated in the 'awkward' facts, are we going to see more realistic outcomes? We believe so. Before we are discussing the assumption of multiple products, we need to point out a new kind of differentiation: product differentiation vis-à-vis the firm's own product(s). So we must say that it gets more complex when we relax the assumption of single product.

One study that deserves a special attention is Brander and Eaton's (1984) modeling of product line rivalry in a duopoly where each firm produces four possible products in a three-stage game (scope-location-quantity). Among the four products, two products are close substitutes for each other and are distant substitutes for the other pair, which are themselves close substitutes for each other (say the pairs of (1,2) and (3,4) are close substitutes, whereas the pairs (1,3) or (2,4)

are more distant substitutes). Interestingly, they focus on differentiation vis-à-vis its own products rather than rival products, which is partly due to the construction of the model itself that assumes quantity competition at the 3rd stage. They demonstrate that firms have incentives to carve out their own segment in the market by choosing various degrees of differentiation vis-à-vis their own product(s) depending on market situations.

If a firm is guaranteed a monopoly over a range of products, it will seek to launch products that are *most* distant substitutes of its current product lines. But when a range of potential products is limited to a group of established competing firms, i.e., under intermediate levels of demand, each firm is more likely to seek to launch products that are *close* substitutes of its current products (segmented market structure). In so doing each firm expects to avoid intense price and output competition at a later stage. And when there exists a threat of entry by outsiders, each firm would seek to develop products that are *more* distant substitutes (interlaced market structure), which would increase competition that would deter potential entry. Thus, Brander and Eaton (1984) suggest that in a growing market, the market structure may evolve from a monopoly, through a segmented duopoly, and finally to an interlaced oligopoly.

This notion of segmenting the market through launching products with various degrees of differentiation was challenged by Martinez-Giralt and Neven (1988). They contend that when price competition is intense, the question of endogenous multiple outlets competition is void. In a two-stage game (location-price) of a duopoly with quadratic transportation costs, they demonstrated that firms would locate their outlets as close as possible to each other (and will optimally collapse the outlets into a single point), but as far away as possible from a rival outlet (maximum differentiation). This result holds both in a circular and a linear paradigm. Therefore, neither firm takes up the opportunity to open two outlets in order to relax price competition (no product line rivalry), i.e., the incentive to relax price competition dominates the incentive to segment the market. The assumption of quadratic costs and price competition at the 2nd stage seems to be crucial since this makes strategic effects much more pronounced.

With a slightly different assumption, we may derive a strikingly different result from Martinez-Giralt and Neven's (1988). From the recognition that the maximum differentiation was due to the assumption that firms are allowed to launch only two outlets, Gabszewicz and Thisse (1986b) addressed the case where duopolists are allowed to introduce as many outlets (in this case plants) as they want. They found that the equilibrium location is the one that duopolists differentiate their own outlets but locate their outlets next to their

competitors' outlets. This argument is in a sense consistent with Judd's (1985) notion of 'credible spatial preemption' in a circular market. When there are multiple products in the market, a potential entrant still can successfully enter if it can induce the incumbent to vacate one or more addresses—a strategy of predatory entry—by either matching its new product to a rival product or locating it between two rival products (cf. Brander and Eaton, 1984). Thus, credible spatial preemption implies lesser differentiation vis-à-vis rival products than its own products, rendering a counter-argument against Schmalensee's (1978) notion of brand proliferation for entry deterrence.

2.7 Multiple firms and finiteness property

Product differentiation has been traditionally modeled in a duopoly. Bensaid and de Palma (1994) contend that maximum differentiation may be due to this assumption of duopoly. If we allow three firms to locate up to two outlets, they argue that almost anything goes as equilibrium: reduced differentiation, maximum differentiation, and a variety of outcomes between these two extremes. In contrast, de Palma, et al., (1985) show that, under sufficient product and consumer heterogeneity, minimum differentiation at the center of the market is always an equilibrium outcome *regardless* of the number of firms in an industry. Airua (2010), Orosel and Zauner (2011), and Vogel (2008) also model multiple firms. But the results are not consistent: from maximum to minimum differentiation. So it looks like what is influential is not the number of firms per se, but other assumptions on product and consumer heterogeneity and price rigidity.

The number of firms that can exist in an industry is also an important issue in product differentiation because, under the assumption of a single-product firm, it determines the variety of products of an industry. When all qualities are produced and sold at marginal cost and consumers would buy the highest quality, Shaked and Sutton (1983) show that there can be at most a finite number of firms with positive market share in the industry since price competition among high-quality producers would drive prices down, which ultimately pushes low-quality producers out of the market (so called finiteness property). When the upper bound is reached, any entry will lead to an exit by an existing firm in an industry, thus the number of firms is maintained (Gabszewicz and Thisse, 1980). Shaked and Sutton (1982) even suggest that this upper bound is 3, otherwise no firm will enjoy positive profits since competition in quality would drive all firms to produce the same top level of quality permitted while prices and profits become zero.

It is worth noting that this finiteness property in vertical differentiation is different from

what we can find in horizontal differentiation. In horizontal differentiation, the equilibrium number of firms goes to infinity when entry cost becomes zero and the density of consumers tends to be infinite (see Tirole, 1988).

In a different vein, Arkolakis (2010) argues that market penetration costs, coupled with the assumption of heterogeneous productivity and constant returns to scale technology, are responsible for the existence of large numbers of *small* exporters in a foreign country. Here market penetration costs are a kind of marketing costs to reach individual consumers in a foreign country. In a typical differentiation model, these marketing costs are analogous to transportation costs where consumers have different transportation costs depending on their respective location over the market.

2.8 Production costs and demand-side costs

Among the conventional assumptions of Hotelling's location model, the assumption of production cost or marginal cost has rarely been relaxed. Regardless of horizontal or vertical differentiation, the cost has typically been assumed constant or zero across firms, which may pose an interesting dilemma. This is especially true for vertical differentiation since it concerns with different levels of qualities where high qualities typically command high production costs. For example, firms may incur position-dependent variable costs (Vandenbosch and Weinberg, 1995). So when quality is assumed costless, vertical differentiation practically becomes a *purely* demand-driven strategic choice (Benassi, et al., 2006).

Then what happens if the strict notion of costless production is relaxed? Prior studies show that incorporating asymmetric marginal costs (Vogel, 2008) or differentiation costs (Matsushima, 2004; Correia-da-Silva and Pinho, 2011) makes a difference. In a game where arbitrarily many heterogeneous firms with asymmetric marginal costs locate their product along a unit circumference, Vogel (2008) derives that the degree of differentiation between two firms is a function of the *average* marginal cost of these two. Low (high) average marginal cost increases (decreases) the product distance between the two firms. In other words, more productive firms are more likely to be 'isolated' and behave like a monopolist. In addition to the above-mentioned assumptions, the author assumes uniformly distributed demand over the entire market space, limited asymmetry between firms, and one taste in horizontal differentiation.

In a bit different vein, Correia-da-Silva and Pinho (2011) and Matsushima (2004) test the impact of differentiation costs. Here differentiation costs may represent the transportation cost of delivering the input purchased from a supplier located at the center of a linear city or the cost of modifying a standard product (located at the center) into a new product.

Under the assumption of quadratic costs both for differentiation cost and transportation cost, they show that product differentiation depends on the magnitude of differentiation costs relative to transportation costs. Low differentiation costs relative to transportation costs lead to maximum differentiation (Correia-da-Silva and Pinho, 2011; Matsushima, 2004), whereas sufficiently high differentiation costs induce firms to get closer to the center of the market, thereby partial differentiation (Correia-da-Silva and Pinho, 2011).

The former result is not surprising since no differentiation costs under quadratic transportation costs assumption would yield maximum differentiation. This result rather suggests that d'Aspremont, et al.'s (1979) maximum differentiation is robust to a certain extent of (asymmetric) production costs. The latter result implies that firms are better off differentiating their product *only* to the extent that differentiation costs cover the disutility borne by consumers, which is not surprising. So firms have incentives to get closer to each other (toward the center of the market), but only to the extent that price competition may not intensify.

In addition to supply-side costs, product differentiation is also affected by demand-side costs such as congestion costs (Ahlin and Ahlin, 2013) and switching costs (Gehrig and Stenbacka, 2004). Here congestion cost is a kind of disutility that arises when a firm experiences capacity constraint due to a large number of consumers patronizing this firm who, in turn, experience negative network externality. Under the assumption of linear transportation cost in a 3-stage game (location-price-consumer choice), Ahlin and Ahlin (2013) show that, if congestion costs are large relative to transportation costs, a firm has incentives to locate closer to the other firm and hence minimum differentiation could be reached.

However, even under Hotelling's assumptions, Gehrig and Stenbacka (2004) demonstrate that maximum differentiation could be an equilibrium outcome, if switching costs are large enough relative to transportation costs. High switching costs due to maximum differentiation practically deter any poaching attempts from the rival firm. It should be noted here that transportation costs occur in the 1st stage, whereas switching costs occur in 2nd stage. In other words, consumers choose a product out of their taste, but any later change along this dimension may trigger inconveniences.

These conflicting results may be due to the different nature of the costs in question and consequently the way that these costs are treated in the model. For example, congestion cost is another cost additional to transportation costs. So mathematically speaking, adding another linear term to existing linear transportation costs may not cause a lot of change. Instead, this result renders another piece of evidence to the stability of Hotelling's

equilibrium. In contrast, Gehrig and Stenbacka (2004) model the situation where consumers attach high value for the distance between their ideal location (probably adjusted after the purchase in the 1st stage) and the location of the already-purchased product. High switching costs relative to linear transportation costs imply that consumers may face quadratic transportation costs in the 2nd stage.

With regard to production cost, an interesting attempt has been undertaken by assuming variable elasticity of substitution and additively separable preferences across varieties (Zhelobodko, Kokovin, Parenti, and Thisse, 2012). When the elasticity of marginal utility (or relative love for variety) is increasing (decreasing) with consumption, the elasticity of substitution increases (decreases), which in turn helps more firms to decrease (increase) market prices. The price decreasing effect may imply that the level of product differentiation is also decreasing. What is noteworthy here for future research directions is the assumption of variable elasticity of substitution and additively separable preferences, which is more realistic and better represents the intricacies of products with a variety of attributes.

2.9 Sequential entry

Unlike simultaneous location choice, sequential choice or entry into the market puts firms at a different incentive scheme depending on the order of entry. For example, first movers can choose the best location, but they may have to move without the knowledge about consumer demand; followers may have better knowledge about consumer demand by having observed the first mover's behavior and outcomes, but they may be at a disadvantage in terms of location options.

Among many studies that have modeled sequential entry and product differentiation, Prescott and Visscher (1977) deserve our attention due to its broad scope and intuition. Under the assumption of foresighted sequential entry and costly relocation, they demonstrate the following results: (1) in location competition alone in a duopoly, i.e., conventional Hotelling-type model, the equilibrium is minimum differentiation at the center; for three firms, the equilibrium is that first two firms locate at the first and the third quartiles and the third firm locates between the two firms; (2) under endogenous entry, the first two firms will locate themselves symmetrically from the two ends of the market, respectively, and subsequent firms locate themselves sufficiently far away from the nearest firm until it is no longer profitable; (3) under location and price competition, i.e., true Hotelling (with some modification to guarantee the existence of an equilibrium), maximum differentiation is an equilibrium outcome for a duopoly and no equilibrium when there are

three firms (cf. Bensaid and de Palma, 1994); and (4) under higher fixed cost of entry, the second entrant has incentives to locate as far away as possible from the first entrant since higher-fixed cost of entry serves as a barrier to entry.

And under a Stackelberg framework, Anderson (1987) demonstrates that the first firm locates at the center of the market and the second firm locates itself close to one of the ends of the spectrum. Thus, the equilibrium location ends up asymmetric. But if firms don't know the location of consumer demand and price is exogenous, firms may end up locating right next to one another at the center of the market because preceding firms have incentives not to reveal the exact location of the demand to the following firms (Aiura, 2010; cf. Prescott and Visscher, 1977).

Ⅲ. Discussions and Conclusion

We have started with Hotelling's (1929) assumptions and principle of minimum differentiation, and then followed through the developments that basically challenge the seminal work either by relaxing the assumptions or by incorporating new assumptions in the model. Not surprisingly, each one of Hotelling's assumptions has met its share of challenge in various settings: (1) linear transportation costs vs. quadratic transportation costs, (2) known consumer demand preference all over the market vs. unknown consumer preference, (3) inelastic demand vs. elastic demand, (4) no production costs vs. asymmetric costs, (5) duopoly vs. multiple firms, (6) single dimension vs. multiple dimensions, (7) single product vs. multiple products. One striking conclusion of our critical review over the literature is that the results are quite sensitive to some of the assumptions, while rather insensitive to others.

Regarding the sensitivity of results to assumptions, it should be noted that whenever certain assumptions are included in the model, either individually or together, we are more likely to observe increasing differentiation from intermediate to maximum degree. These assumptions are quadratic transportation costs, elastic demand, and concave shapes of consumer density. All of these assumptions basically amplify strategic effects. Unlike these assumptions, the assumption of exogenous price or rigid price amplifies market share increasing effects, thereby decreasing product differentiation.

Since d'Aspremont, et al. (1979), quadratic transportation costs have been a standard feature in modeling differentiation, more than linear transportation costs have. Whenever this type of transportation costs is assumed in the model, product differentiation from rival product(s) is more likely to increase (Ansari, et al., 1998; Benassi and Chirco, 2008; Egli,

2007; Irmen and Thisse, 1998; Martinez-Giralt and Neven, 1988; Meagher and Zauner, 2005; Nero, 1998; Vandenbosch and Weinberg, 1995). Consumers with quadratic transportation costs are by definition more sensitive to price, which induce firms to increase profits by moving further away from rival product(s). In contrast, the chances of observing reduced differentiation or minimum differentiation go up when the transportation costs are assumed to be linear (Ahlin and Ahlin, 2013; de Palma, et al., 1985; Smithies, 1941). However, linear transportation costs alone may not lead to minimum differentiation (Gehrig and Stenbacka, 2004; Smithies, 1941).

Unlike quadratic transportation costs that seem to be influential in deriving maximum differentiation or sufficient differentiation, linear transportation costs don't seem like to be that influential in deriving minimum differentiation. When we observe minimum differentiation equilibrium outcome, linear transportation costs were assumed along with inelastic demand (Benassi, et al., 2006; de Palma, et al., 1985). When elastic demand is assumed along with linear transportation costs, the former seems to be dominating such that minimum differentiation is not an equilibrium outcome even though the degree of differentiation is decreasing (Smithies, 1941).

If the assumption of inelastic demand is relaxed to be *elastic*, then price or a change in price becomes an important factor in consumer choice due to its substitution effects. Increasing substitution effects imply a potential for intense price competition to draw more consumers, which may force firms to move away from their rival firm(s) to alleviate potential price competition. Prior studies demonstrate that elastic demand typically forces a firm to further differentiate (Aiura, 2010; Anderson, et al., 1997; Benassi and Chirco, 2008; Nero, 1998). But it should also be noted that elastic demand alone might not be sufficient to fully differentiate when consumers are identical and more willing to travel to consume their ideal product (cf. Smithies, 1941).

When consumers are not identical or identical but not distributed all over the market (i.e., the location of the distribution is not certain), the shape of the distribution matters in determining the degree of differentiation. What is counter-intuitive about the distribution of consumer demand is that concentration (i.e., concave distribution) does not necessarily lead to minimum differentiation. The opposite is rather typical (Anderson, et al., 1997; Benassi and Chirco, 2008; Benassi, et al., 2006; Gabszewicz and Thisse, 1986a; Shaked and Sutton, 1982) because demand concentration makes consumers quite sensitive to price, especially for vertical differentiation. What is noteworthy regarding modeling heterogeneous consumer demand is that we need to choose a distribution of consumer demand out of known family of distributions. For example,

log-concave distribution is indispensable in Benassi and Chirco's (2008) modeling of consumer heterogeneity. So an explanation for the choice of a specific distribution over others is in order.

In the above we have addressed the cases where the assumptions of uniform consumer distribution and inelastic demand were relaxed. What happens if we relax the rather implicit assumption of a market with finite length? If we assume that consumers could have an outside option, Bockem (1994) argues that, in equilibrium, neither minimum nor maximum differentiation would occur. If the market is not limited, demand-increasing effect of minimum differentiation and price-relaxing effect of maximum differentiation are no more than algebraic accidents. So the assumption of finite market scope is critical in deriving not only minimum differentiation (Aiura, 2010; Benassi and Chirco, 2008; Anderson, et al., 1997), but also maximum differentiation. In this sense, we may argue that if consumers are presented with opportunities of purchasing 'substitutes' produced in another industry, the whole notion of differentiation may not be insightful. This suggests that if we are dealing with an industry that is facing substantial threats from substitutes produced in another industry (cf. Porter, 1980), we may no longer have a clear guideline for the optimal level of product differentiation against rival products.

In contrast with the case of the existence of powerful substitutes or the assumption of a finite market, firms may also operate in markets that are complementary to each other. Gabszewicz and Wauthy (2014) address vertical product differentiation in two-sided markets where there exist positive cross-network externalities. In two-sided markets the quality of a product in one market is partly determined by the network size of the other market, i.e., realized qualities are endogenous to the outcomes of the other market. They demonstrate that, under the assumption of heterogeneous consumers in both of the markets over the payment for the network size, asymmetric equilibria emerge in both of the markets where both high- and low-ranked products (i.e., platforms) enjoy positive profits. Product differentiation in two-sided markets poses an interesting challenge and may open a new direction for further research.

The equilibrium outcome under the assumptions of multiple products in the market and asymmetric differentiation costs deserve a special attention with respect to strategic management and marketing literature on product differentiation. One critical difference between strategic management literature and IO economics on product differentiation is the recognition of asymmetric resource endowments among firms (Barney, 1986). Asymmetric resource endowments or dynamic capabilities, accumulated through a series of R&D or other learning activities, not only affect firm per-

formance in the short-run, but also shape the patterns of firm growth in the end (Lee, 2010). Resource endowments argument or resource-based view suggests that firms with similar resource endowments may end up introducing similar products to one another. In other words, symmetric resource endowments will lead to minimum differentiation. And consequently, firms with asymmetric resource endowments cannot help but increase product differentiation. This prediction is consistent with Vogel's (2008) argument of increasing differentiation between firms with asymmetric marginal costs and consequently the notion that a productive firm is more likely to be isolated from other less productive firms that, according to resource endowments argument, have resources inferior to the productive firm's. Thus, the degree of resource similarity between any two firms is inversely translated into the degree of product differentiation between them.

Resource endowments argument also suggests that firms typically locate their new product closer to their existing products because they want to leverage their resources for efficiency reasons. At the same time, resources work as constraints that don't allow firms to locate further away from their existing products. Because of these reasons, a firm is more likely to have minimum or less differentiation vis-à-vis its own products. However, a firm with productive resources can introduce a product that is quite distant from its existing products, let alone vis-à-vis rival products. This way it can expand their market scope and increase profits, which is consistent with Brander and Eaton's (1984) monopolist that introduces a new product that is most distant from its existing product(s).

In this respect, resource endowments argument or resource-based view suggests that any degree of product differentiation could happen vis-à-vis the firm's own products. So we may provide a plausible explanation for the *realized* degree of differentiation vis-à-vis the firm's own products after it has introduced a new product, whereas we cannot know in advance the *expected* degree of product differentiation. In other words, resource-based view fails to provide *a priori* knowledge on differentiation. One way to fix this problem is to impose strategic intent on a new product introduction, like entry deterrence (e.g., Judd, 1985; Schmalensee, 1978), market share increase, or profit maximization, among others. Once a specific strategic intent is imposed, we may test the feasibility of this intent regarding the degree of differentiation by resource endowments argument.

Using data on the U.S. automobile industry, Thomas and Weigelt (2000) found that firms are more likely to locate their new product closer to their existing products but further away from their rival products. This empirical finding is consistent with Martinez-Giralt

and Neven's (1988) maximum vis-à-vis rival products and minimum vis-à-vis own product(s), and renders support for Brandon and Eaton's (1984) derivation that firms better off launching a close substitute to their existing product in case of intermediate competition among a group of firms. These studies strongly suggest that the forces to move away from rival products to relax price competition are not just theoretical, but also empirical in nature.

Before presenting suggestions for future research, we would like to mention several studies that have been published in the country in recent years. By focusing on divisional domain and the overlap of divisional domain vis-à-vis sister divisions or rival divisions of competing firms, Jeong (2010, 2013) found that a division is more likely to locate new products closer to sister or rival divisions with which this division shares its divisional domain. In other words, the level of divisional domain overlap with other divisions lead the focal division to reduce product differentiation vis-à-vis these divisions. In the context of sequential quality decision, Chung (2013) demonstrates that the level of competition at the channel affects a firm's decision on product quality. The quality difference between two firms is decreasing when they sell their products using exclusive retailers respectively compared with the case when they have no retailors or use the common retailor. And in an empirical study, Yi and Muhn (2013) found that adding different attributes on utilitarian and hedonic products affected consumers' preferences, which may have interesting practical implications for developing mixed products.

Based on what we have reviewed and discussed, we would like to present several suggestions for future research on product differentiation. First, the influential effect of the assumption of quadratic transportation costs begs a question for future research. Since this choice alone can significantly shift the direction and magnitude of differentiation, researchers should make it clear why they choose to assume quadratic transportation costs over linear transportation costs. But researchers rarely provide a compelling reason for their choice. We believe this issue could be solved rather easily if researchers are more explicit about the applications of derived results rather than the derivation itself. The consumer types of an industry to which the results are supposed to be applied could provide a rationale for the choice. For example, if an industry consists of two types of consumers due to income distribution, geography, or age groups, we may better off modeling both types in the same model (cf. Egli, 2007). In sum, we suggest that researchers should be more application-oriented in the modeling.

Second, the impact of elastic demand on the degree of differentiation suggests that re-

searchers should be particularly cautious in empirical research. This is especially true when they deal with data from multiple industries. Demand in consumer goods industries is typically more sensitive to price changes in comparison with that in durable goods industries. So it is necessary to take this difference into account in model specification and subsequent interpretations. Related to inelastic demand, price rigidity deserves a special attention. Since majority of the models for product differentiation engage in price competition at the end, exogenous price can shift the equation toward less differentiation (e.g., de Palma, et al., 1985). For an empirical standpoint, any condition that triggers price rigidity should be explicitly represented in the equation. Otherwise the degree of differentiation would not be properly estimated due to the endogeneity caused by the absence of this condition on the right side of the equation. One such condition is quality uncertainty where price works as a signal for the unknown quality (Bester, 1998).

Third, regarding unknown distribution of consumer density, researchers should be advised to include income distribution in their empirical model. The shape of income distribution has been shown to be influential (e.g., Benassi, et al., 2006; Shaked and Sutton, 1982), and income effects due to price changes constitute decision rules that work for both horizontal and vertical differentiation (Anglin, 1992). And unlike unknown distribution of consumer heterogeneity, income distribution could be available if the target of the application of derived results is known. So we believe researchers should include a piece of information on income distribution in their empirical model.

Lastly, it may prove to be quite fruitful if researchers extend vertical differentiation in two-side markets where cross-network externalities are strong (Gabszewicz and Wauthy, 2014) or build upon the notion of variable elasticity of substitution (Zhelobodko, et al., 2012). By explicitly modeling network externalities we may better understand the endogenous nature of quality of a 'platform' that is becoming so important in on-demand economy. And the notion of variable elasticity of substitution may open up new possibilities of expanding research streams on supply-side (e.g., production costs) of product differentiation.

In conclusion, we have reviewed the current state of research on product differentiation. Product differentiation has been an important field in IO economics and has inspired theoretical and empirical research on competition in strategic management and marketing, among other disciplines. So we believe it is a meaningful work to review the literature in a critical manner so that we can better understand this important field. Here we have made contributions in the following two ways. First, we have updated some recent developments

in the last decade or two. For example, we have addressed some of the recent developments on consumer heterogeneity and elastic demand in the model, among others. Second, we have examined the evolution of this field by focusing on the assumptions and discussed the sensitivity of results to these assumptions. A critical review of the literature allowed us to argue that the assumptions of quadratic transportation costs, elastic demand, and concave consumer distribution were influential in determining the degree of differentiation. These assumptions, individually or together, would increase product differentiation, possibly to the maximum level, by making consumers quite sensitive to (even small) price changes. We discussed the implications of these assumptions for theoretical and empirical settings. And we have also suggested that when we would assume multiple products and asymmetric cost positions, we would have results similar to those suggested by resource endowments argument in strategic management.

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〈APPENDIX〉 Studies Reviewed: Key Assumptions and Major Results

Studies	Key Assumptions	Major Results
Hotelling(1929)	linear transportation cost; uniform and inelastic demand over the market; no production cost; homogeneous goods; one dimension (location); simultaneous move by duopolist	Minimum differentiation at the center of the linear market
Ahlin and Ahlin(2013)	linear transportation cost	High congestion costs relative to transportation cost reduces differentiation, possibly to minimum differentiation
Aiura(2010)	3 firms; one product dimension; uniform consumer distribution; uncertain about the location of the consumer distribution	Under exogenous prices, minimum differentiation; under elastic demand, minimum differentiation is hard to be reached
Anderson(1987)	sequential move; Stackelberg leadership	First firm locates at the center of the market, the second firm locates itself close to one of the ends of the market
Anderson, Goeree, and Ramer (1997)	quadratic transportation cost; elastic demand	A unique symmetric equilibrium when the density is not too concave and not too asymmetric; otherwise excessive differentiation
Ansari, Economides, and Steckel (1998)	quadratic transportation cost; 2 or 3 product dimensions	Maximum differentiation for one dimension that consumers put the highest weight and minimum differentiation for the other dimensions
Benassi and Chirco(2008)	quadratic transportation cost; elastic demand	Multiple asymmetric equilibria even with symmetric densities of preferences, along with the case with a high Gini coefficient
Benassi, Chirco, and Colombo(2006)	Duopoly; costless differentiation; distribution of income	Income concentration leads to more product differentiation
Bensaid and de Palma(1994)	3 firms where each can have two products	Anything goes as an equilibrium
Bester(1998)	quadratic transportation costs; quality is uncertain; price as signals for quality, duopoly	Minimum differentiation: (vertical) quality uncertainty could lead to horizontal minimum differentiation
Bockem(1994)	Consumers have an outside option outside the market (consumers′ choice set is expanded)	Neither minimum nor maximum differentiation (d′Aspremont et al.′s(1979) maximum differentiation is not stable)
Brander and Eaton (1984)	4 products; 3-stage game	Monopoly--launch the most distant substitutes of the current product lines; Intermediate level of demand--launch close substitutes of the current product lines; Under threat of entry--launch more distant substitutes

(Continued)

Studies	Key Assumptions	Major Results
Correia-da-Silva and Pinho (2011)	quadratic transportation cost; quadratic differentiation costs; horizontal differentiation	Low differentiation costs relative to transportation costs lead to maximum differentiation, sufficiently high differentiation costs induce firms to get closer to the center of the market, thereby partial differentiation
d′Aspremont et al.(1979)	quadratic transportation cost	Maximum differentiation (to relax price competition)
de Palma, Ginsburgh, Papgeorgiou, and Thisse(1985)	Consumer is heterogeneous; linear transportation cost	Large heterogeneity--minimum differentiation
Egli(2007)	two types of consumers with either linear transportation cost type or quadratic transportation cost type	Intermediate to maximum differentiation
Gabszewicz and Thisse(1979)	Consumers have identical tastes but different income levels; no production cost	From sufficient to maximum vertical differentiation
Gabszewicz and Thisse(1986a)	quadratic transportation costs; concavity of demand	No stable equilibrium for horizontal differentiation, stable equilibrium for vertical differentiation
Gabszewicz and Thisse(1986b)	quadratic transportation costs; launch as many outlets as duopolists want	Differentiation vis-à-vis one′s own outlets, but next to its rival′s outlets
Gabszewicz and Wauthy(2014)	two-sided markets; cross network externalities; heterogeneous consumers but uniformly distributed over the market	Asymmetric equilibria for each market with positive profits both for high- and low-ranked platforms
Gehrig and Stenbacka(2004)	Hotelling′s assumptions; 1 stage-transportation costs; 2-stage switching costs	High switching costs relative to transportation costs may lead to maximum differentiation
Irmen and Thisse(1998)	quadratic transportation cost; multiple product dimensions	Maximum differentiation for the dominant dimension and minimum differentiation for the other dimensions
Martinez-Giralt and Neven(1988)	quadratic transportation cost; linear and circular market; launch two outlets	Close to minimum differentiation among its own product, whereas maximum differentiation against a rival product
Matsushima(2004)	quadratic transportation cost; quadratic differentiation costs; horizontal differentiation	Low differentiation costs relative to transportation costs lead to maximum differentiation
Meagher and Zauner(2005)	quadratic transportation cost; uniform consumer distribution; uncertain about the location of the consumer distribution	Large (small) aggregate uncertainty over consumer preferences leads to excessive (insufficient) differentiation

(Continued)

Studies	Key Assumptions	Major Results
Nero(1998)	quadratic transportation costs; identical linear elastic preferences; reservation price; 2-stage	Maximum differentiation when the reservation price is high enough
Orosel and Zauner(2011)	Experience goods; multiple firms; simultaneous move	Maximum differentiation: Lowest and highest quality are offered
Prescott and Visscher(1977)	costly relocation; sequential entry	Conventional Hotelling--minimum differentiation for duopoly, for three firms, first two firms locate at the first and the third quartiles and the third locates between the two; Endogenous entry--the first two
Sajeesh and Raju(2010)	3-stage; both linear and quadratic transportation costs	Presence of variety seeking consumers reduces differentiation
Shaked and Sutton(1982)	3-stage vertical differentiation; the upper-bound of income is twice the lower-bound income	Maximum differentiation
Shaked and Sutton(1983)	produced and sold at marginal cost	Finite number of firms in vertical differentiation
Smithies(1941)	linear transportation cost; Conjectural variation; elastic demand	Conjectural variation--move to the center but no minimum differentiation; Elastic demand--move to the center, but not too much
Vandenbosch and Weinberg(1995)	2 product dimensions; vertical differentiation	Maximum differentiation on one dimension and minimum differentiation on the other for vertical differentiation (and for horizontal differentiation)
Vogel(2008)	multiple heterogeneous firms; asymmetric marginal costs; unit circumference	Average marginal cost between any two firms is positively related to the level of differentiation (Productive firms are more isolated) both for vertical and horizontal differentiation

제품차별화 연구: 비판적 고찰

정의교*

요 약

제품차별화(product differentiation)는 산업조직경제학의 중요한 연구 분야로, 경영전략 및 마케팅 분야에서 경쟁에 대한 이론적 혹은 경험적 연구를 수행할 때 많은 시사점을 제시해 왔다. 따라서 제품차별화에 대한 심도있는 이해는 해당 연구분야 그 자체에 대한 이해 뿐만 아니라, 경영전략 및 마케팅 분야에 대한 이해에도 큰 도움이 된다고 할 수 있다. 이에 본 연구에서는 제품차별화의 기존 연구를 비판적으로 고찰하여 해당 분야에 대한 이해를 높이고자 한다. 먼저, 근래에 이룩된 연구 성과를 소개하고 이전 연구와 어떤 관련이 있는지 고찰한다. 소비자 상이성과 수요탄력성의 가정을 바탕으로 한 연구 성과가 그 예가 될 수 있을 것이다. 둘째, 제품차별화에 대한 주요 연구 결과를 가정별로 정리해 봄으로써 연구 결과가 특정 가정에 민감한가를 검토한다.

비판적 고찰의 결과 이차항의 이동비용, 탄력적 수요, 그리고 오목모양의 소비자 분포도 가정이 차별화의 정도에 가장 큰 영향을 미치는 것으로 나타났다. 이 가정들은 소비자들을 가격에 아주 민감하게 만듦으로써 가격경쟁을 최소화하여 이윤을 극대화하기 위한 전략적 효과를 극대화하여, 차별화의 정도를 증가시키는데 최대수준의 차별화(maximum differentiation)까지 이르게 한다. 반면에 이러한 가정들이 없을 경우, 시장점유율을 높혀 이윤을 극대화하기 위해 차별화의 정도는 감소하게 되며 최소수준의 차별화(minimum differentiation)까지 이르게 된다. 이를 바탕으로 이 가정들이 향후 이론 및 경험 연구에 제시하고 있는 시사점을 제시한다. 이와 더불어 시장에 다수의 제품을 출시할 수 있고 기업간 생산비용의 차별화가 존재한다고 가정할 때, 제품차별화의 모델에서 비롯된 결과들은 경영전략의 경험적 연구결과와 아주 흡사하다는 점을 밝히고 있다.

주제어: 제품차별화, 전략적 효과, 가격경쟁

* 명지대학교 경영학과 경영전략 전공 부교수, 주저자

• 저자 정의교는 현재 명지대학교 경영학과 경영전략 전공 부교수로 재직 중이다. 서울대학교 경영대학 및 대학원 경영학과를 졸업하였으며, 미국 텍사스A&M 대학에서 경영학박사를 취득하였다. 이후 미국 볼링그린주립대학교 경영학과 조교수 및 성균관대학교 경영학부 조교수를 역임했다. 주요 연구분야는 사업부 수준에서의 경쟁, 협력과 경쟁의 역학 관계 등이다.