6-24-2007

Differentiation, Niche and Cost Leadership Strategies: A Hotelling Based Analysis

S Sajeesh

Jagmohan S. Raju
University of Pennsylvania

Differentiation, Niche and Cost Leadership Strategies: A Hotelling Based Analysis

Abstract

Costs are an important determinant of prices charged by firms. The primary purpose of this paper is to study the impact of costs associated with differentiation and niche strategies on firm's positioning and pricing decisions in a horizontally differentiated market. We analyze both sequential and simultaneous entry cases. In the sequential case, the cost of differentiation is an additional cost incurred by the second entrant and it depends on the degree of differentiation between itself and the first mover. The cost of following a niche strategy is a market level cost affecting both firms whereby firms incur a positive or negative cost if they want to make a niche product. Our analysis provide some surprising results, explains some conflicting empirical observations documented in previous research, and may also be useful for further empirical research in this area by providing sharper predictions about the impact of various types of costs on market outcomes. For example, we find that under some circumstances the cost disadvantaged firm can enjoy higher price-cost margins compared to the cost leader thereby suggesting that higher costs are a blessing in disguise. We also show analytically that a firm following differentiated or niche strategies charges a higher price than the cost leader if the cost of differentiated or niche strategy is sufficiently high and vice versa.

Keywords

game theory, pricing, differentiation, niche strategies, cost leadership, hotelling models

Disciplines

Business | Business Administration, Management, and Operations | Business Analytics | Business Intelligence | Marketing | Operations and Supply Chain Management | Organizational Behavior and Theory | Sales and Merchandising | Strategic Management Policy

Comments

This is an unpublished manuscript.

Differentiation, Niche and Cost Leadership Strategies: A Hotelling Based Analysis

S. Sajeesh*
Jagmohan S. Raju**

June 24, 2007

*PhD student, Department of Marketing, The Wharton School, University of Pennsylvania, PA 19104. E-mail: Sajeesh@wharton.upenn.edu; ** Joseph J Aresty Professor of Marketing, The Wharton School, University of Pennsylvania, PA 19104. E-mail: rajuj@wharton.upenn.edu

Differentiation, Niche and Cost Leadership Strategies: A Hotelling Based Analysis

Abstract

Costs are an important determinant of prices charged by firms. The primary purpose of this paper is to study the impact of costs associated with differentiation and niche strategies on firm's positioning and pricing decisions in a horizontally differentiated market. We analyze both sequential and simultaneous entry cases. In the sequential case, the cost of differentiation is an additional cost incurred by the second entrant and it depends on the degree of differentiation between itself and the first mover. The cost of following a niche strategy is a market level cost affecting both firms whereby firms incur a positive or negative cost if they want to make a niche product. Our analysis provide some surprising results, explains some conflicting empirical observations documented in previous research, and may also be useful for further empirical research in this area by providing sharper predictions about the impact of various types of costs on market outcomes. For example, we find that under some circumstances the cost disadvantaged firm can enjoy higher price-cost margins compared to the cost leader thereby suggesting that higher costs are a blessing in disguise. We also show analytically that a firm following differentiated or niche strategies charges a higher price than the cost leader if the cost of differentiated or niche strategy is sufficiently high and vice versa.

Keywords: Game Theory, Pricing, Differentiation, Niche Strategies, Cost Leadership, Hotelling Models.

1 Introduction

Costs are an important determinant of prices charged by firms. It has been argued that companies with lower costs gain competitive advantage by charging lower prices whereas the ability to differentiate allows companies to charge higher prices (Porter 1985). Furthermore, some companies are able charge higher prices by going after niche markets. While these three strategies make intuitive sense, the details of how one goes about executing with these strategies are not as unambiguous. One particular aspect that has been questioned is how a cost leader should use its cost advantage in pricing decisions. Tyagi (2001) argues that in horizontally differentiated markets, lower cost firms might find it advantageous to charge higher prices in equilibrium. Indeed, there are instances where a cost leader in a horizontally differentiated market might charge higher prices. For example, it is often argued that P&G is the cost leader in many categories but often charges higher prices in markets that typify horizontal differentiation. However, there is evidence in previous empirical research (as well as some anecdotal evidence) suggesting that cost leaders do charge lower prices even in a horizontally differentiated market. Noble and Gruca (1999) surveyed pricing practices of 270 managers and found that in competitive pricing situations, a cost advantaged firm (due to lower supplier cost) prices lower than the competitor.

It is quite likely that whether and how costs (and cost differences across firms) impact pricing decisions may depend on the type of costs that are being considered. Our objective in this study is to take a closer look at different types of costs and study their impact on optimal pricing, positioning, and profits in a competitive setting. Recognizing that the lists of costs that a firm incurs is numerous and it may be virtually impossible to include all types of costs in one study, as a starting point, we consider three types of costs.

1. **Cost associated with differentiating one's products from the competition:** Differentiation is the ultimate aim of many marketing strategies and is recognized as a source of competitive advantage (Porter 1985). However, like many other things, differentiation is usually not free. Hall (1980) in a study of 64 companies in eight major industries found that many of the most profitable firms had achieved either the lowest cost or the most differentiated positioning within their industry. Implicit in this notion is that it is more expensive to make differentiated products. Horsky and Nelson (1993) find some empirical evidence in the automobile market that a new entrant has an incentive to differentiate to maximize profits even though it is costly to differentiate. More specifically, we allow a component of cost to depend on the degree to which a firm wants to differentiate itself from its competitors.

2. **Cost of going after niche markets:** Many firms tailor their products and services to meet the needs of a narrow target segment. For example, organic products (e.g., organic milk) are preferred by niche consumers but are expensive to produce.[1] More specifically, we include a cost component that depends on how close is the product to the centre of gravity of the customer preference distribution. There may be instances where going after a niche consumer may be cheaper than going after the median consumer. Our model allows for this possibility also.[2]

[1] http://www.grist.org/advice/ask/2006/05/22/costs/

[2] For example, the Classmate PC manufactured by Intel is an education-specific feature set targeted at grade school students. The Classmate PC is cheaper to manufacture than the standard PC and satisfies the needs of this niche market by providing them with an affordable, collaborative learning environment. See http://www.intel.com/intel/worldahead/classmatepc/

3. **Exogenous Costs:** Finally, costs may also differ across firms due to one firm having access to a cheaper source of raw materials or labor. These differences are not related to how a firm positions its products relative to competition or relative to the preferences of the median consumer and have been studied in Tyagi (2000) and Tyagi (2001). We include these in the model to maintain continuity with previous research and also to examine how a cost advantage (or disadvantage) of this type interacts with the ones described in #1 and # 2.

While cost of Type 3 have been studied extensively, we are not aware of any studies that explicitly examine the impact of costs of Type 1 and Type 2. Our analysis separates out how each of these costs affects pricing, positioning, and profit outcomes in a competitive setting. Our analysis provide some surprising results, explains some conflicting empirical observations documented in previous research, and may also be useful for further empirical research in this area by providing sharper predictions about the impact of various types of costs on market outcomes. For example, we find that under some circumstances the cost disadvantaged firm can enjoy higher price-cost margins compared to the cost leader. Also, previous research considers only exogenous costs and shows that a firm with higher exogenous cost charges a lower price. It is only by accounting for the cost of differentiation or the cost of following niche strategies that we can explain the scenario where a firm with higher cost positions itself as a niche or differentiated product and charges a higher price. Specifically, in sequential games, we find that in markets where cost of differentiation, or cost of following niche strategies is sufficiently high, a second entrant prices higher than the first entrant even if the first entrant has a cost advantage in terms of exogenous costs where as if the cost of differentiation or cost of following niche strategies is low, a first entrant charges higher prices. We also show how cost of differentiation and cost of following niche strategies interact with exogenous costs in determining firm positioning and prices. Moreover, when such costs exists, we find conditions under which it is possible for both the cost leader as well as the cost disadvantaged firm to make higher profits. Hence, higher costs are a blessing in disguise.

The rest of the paper is organized as follows. We outline the key features of our competitive model in Section 2. In Section 3, we analyze a model where firms enter the market sequentially. In Section 4, we examine how the three types of costs affect pricing, positioning and profits when firms enter the market simultaneously. We conclude in Section 5 with a summary, the limitations of our research, and possible directions for future research.

2 The Model

We use the Hotelling framework (Hotelling 1929) and assume that the market consists of two firms A and B, each offering one product recognized by subscripts A and B respectively. Firms first choose locations, and then choose prices. Given the locations and prices, each consumer buys the product that maximizes their utility. We consider both sequential as well as simultaneous entry of the firms. The specific model assumptions are described below in greater detail.

1. We assume that the ideal points of consumers are distributed uniformly in the unit interval [-0.5, 0.5] and the total number of consumers is normalized to 1.

2. We assume that the consumer reservation price, denoted by V, is the same for both

products A and B. V is assumed to be sufficiently large so that all consumers buy one of the two products.

3. Following Tabuchi and Thisse (1995) and Tyagi (2001), firms are not restricted to locate within the interval of consumers' ideal points i.e. within [-0.5, 0.5].

4. We assume that Firm B is located to the right of Firm A and the equilibrium locations are denoted by $\widehat{x}_A$ and $\widehat{x}_B$ respectively. The equilibrium distance between the two firms is given by $\widehat{d} = \widehat{x}_B - \widehat{x}_A$.

5. Transportation cost is assumed to be quadratic with respect to distance. If a consumer buys a product positioned at a distance y away from their ideal point and priced at p, she gets a net utility of $V - p - ty^2$, where V is the reservation price of this consumer for the product and $t > 0$ is the transportation cost parameter.

6. We consider three components of cost that firms can potentially incur:

   (a) **Cost incurred to differentiate from its competitor**: We assume that the firm that wants to differentiate itself from competition bears a cost $H(d)$. We assume $H(d)$ to be a twice differentiable increasing function of d, the distance between the two firms. While some of our results are not dependent on the specific functional form of H, for much of our analysis we use a specific functional form, $H(d) = H(x_B - x_A)^2$ for mathematical tractability. This particular representation has two desirable properties: (i) cost of differentiation is zero if both firms have identical positioning in the market, and (ii) as the firms move away from each other, the cost of differentiation increases.

(b) **The extent to which a firm wants to position towards niche or mainstream consumers:** We assume that each firm incurs a cost to move away from (or closer to) the center of the consumer distribution. We represent this cost parsimoniously by using a quadratic functional form, Gx^2 where G is a constant and x is the distance of the firm from the center of consumer distribution. We allow G to be positive, negative, or zero.

(c) **Exogenous Costs**: We use F_A and F_B to represent all marginal costs that are incurred irrespective of the firms positioning.

7. Once firms' locations and prices are determined, we assume that the consumers have perfect information about prices and locations. The consumer's choice problem is to purchase one and only one product from the firm which provides the highest utility.

8. We also assume that firms have perfect information about costs (both their own as well as their competitors).

We start by focusing our attention on the sequential entry game. We later analyze the simultaneous entry case also.

3 Sequential Move Analysis

We use backward induction to solve for the sub-game perfect equilibrium in prices and locations. We can express market shares of Firms A and B by considering the marginal consumer, $\widetilde{x}$. The location of the marginal consumer is given by,

$$V - p_B - t\left(x_B - \widetilde{x}\right)^2 = V - p_A - t\left(\widetilde{x} - x_A\right)^2. \tag{1}$$

All consumers to the left of the marginal consumer buy from Firm A where as all consumers to the right of the marginal consumer buy from Firm B.

Let π_A and π_B represent the total profits of Firm A and Firm B respectively. The profits are given by,

$$\pi_A = [p_A - c_A]\left[\frac{1 + x_A + x_B}{2} + \frac{p_B - p_A}{2t\left(x_B - x_A\right)}\right], \tag{2}$$

$$\pi_B = [p_B - c_B]\left[\frac{1 - x_A - x_B}{2} - \frac{p_B - p_A}{2t\left(x_B - x_A\right)}\right]. \tag{3}$$

At the price competition stage, firms choose prices to maximize profits taking the equilibrium positions to be a given. Solving the first order conditions of profit maximization leads to the following prices,

$$p_A = \frac{1}{3}\left[2c_A + c_B + 3t\left(x_B - x_A\right) + t\left(x_B^2 - x_A^2\right)\right], \tag{4}$$

$$p_B = \frac{1}{3}\left[2c_B + c_A + 3t\left(b - a\right) - t\left(x_B^2 - x_A^2\right)\right]. \tag{5}$$

Incorporating the prices given by (4) and (5) into the profit functions (2) and (3) gives

$$\pi_A = \frac{1}{18t\left(x_B - x_A\right)}\left[\left(c_B - c_A\right) + 3t\left(x_B - x_A\right) + t\left(x_B^2 - x_A^2\right)\right]^2, \tag{6}$$

$$\pi_B = \frac{1}{18t\left(x_B - x_A\right)}\left[\left(c_B - c_A\right) - 3t\left(x_B - x_A\right) + t\left(x_B^2 - x_A^2\right)\right]^2. \tag{7}$$

At the product positioning stage, Firms A and B choose locations to maximize profits. Let us assume Firm A to be the first entrant and Firm B to be the second mover. Without loss of generality, we also assume that the second mover always enters to the right of the first mover.[3] Also, for simplicity, let us define $F_A = 0$ and $F_B = F$ (≥ 0). In other words,

[3]The analysis when the second mover enters to the left of the first mover is similar to the analysis of this section and has been omitted.

we restrict our analysis to the setting where the first mover is not cost disadvantaged. Let us begin by considering the two cases considered in previous literature:

- Tabuchi and Thisse (1995) examine a case where there are no differences in costs between the firms i.e. $F = 0$, $G = 0$, $H = 0$. In this case, the first entrant positions at the center ($\widehat{x} = 0$) and the second mover positions itself outside the distribution of consumers ($\widehat{x}_B = 1$) and the firm prices are given by

$$p_A = \frac{4t}{3} \text{ and } p_B = \frac{2t}{3}. \tag{8}$$

- Tyagi (2000) analyzes the case where only the exogenous sources of cost differences are considered. The analysis is restricted to $(F_B - F_A) < \frac{3}{4}t$, to make sure that the second firm is not so cost disadvantaged that it leaves the market. In such a setting, if the first entrant has a lower cost then it positions at the center and the second mover's positioning depends on the magnitude of cost disadvantage borne by the second mover. The firm prices are given by

$$p_A = \frac{1}{3}\left[\frac{4F}{3} + 2t + 4t\sqrt{\frac{1}{4} + \frac{F}{3t}}\right] \text{ and } p_B = \frac{1}{3}\left[\frac{5F}{3} + t + 2t\sqrt{\frac{1}{4} + \frac{F}{3t}}\right]. \tag{9}$$

In both cases above, **the second entrant charges a lower price in equilibrium.** Tyagi (2000) considers exogenous costs, yet the higher cost firm charges a lower price in equilibrium. So, the above models cannot explain the observed phenomenon in many markets where niche or differentiated products are priced higher. What we shall show is that once we allow for the fact that differentiation is expensive or that there is a cost to follow a niche strategy and explicitly account for these costs, later entrants may charge higher prices. We begin by accounting for the cost of differentiation.

3.1 Cost of Differentiation

We model the cost of differentiation in a parsimonious model by considering a scenario where the second mover's cost depends on how much it is differentiated relative to the competitor and study its impact on firm positioning, pricing and profits. Therefore, the second mover incurs an additional cost over and above the exogenous cost to differentiate its product from the first mover. We consider the cost of differentiation to be represented by a quadratic function i.e. $H(d) = H(x_B - x_A)^2$.

Let $F_B = F > 0$, $F_A = 0$. Hence, we are analyzing the case: $F \neq 0$, $G = 0$, $H \neq 0$. Using the first order conditions for profit maximization for the second entrant and the first entrant sequentially, the first entrant finds it optimal to position itself at the center of the consumer distribution (See Technical Appendix A).

$$\widehat{x}_A = 0. \tag{10}$$

Substituting, we can find the optimal position for the second mover, $\widehat{x}_B$, to be,

$$\widehat{x}_B = \frac{1}{6(t+H)}\left[3t + \sqrt{9t^2 + 12(t+H)F}\right] = \beta_H. \tag{11}$$

As $F > 0$ and $H > 0$, therefore, $\beta_H > 0$. The second mover positions closer to the center of the consumer distribution as the cost of differentiation increases. Using the equilibrium locations in (10) and (11) and simplifying, the firm prices are given by,

$$p_A = \frac{1}{3}\left[F + (H+t)\beta_H^2 + 3t\beta_H\right], \tag{12}$$

$$p_B = \frac{1}{3}\left[2F + 3t\beta_H - t\beta_H^2 + 2H\beta_H^2\right]. \tag{13}$$

Therefore, the difference in prices can be given by,

$$p_B - p_A = \frac{1}{3}\left[F + (H-2t)\beta_H^2\right]. \tag{14}$$

The firms differentiate less as H increases. As the second mover positions closer to the first mover, the first mover has an incentive to lower price in order to increase its market share. Hence, the first entrant prices lower.

Let us now consider the case where the firms have identical exogenous marginal cost i.e. $F = 0$.

$$\widehat{x}_A = 0, \tag{15}$$

$$\widehat{x}_B = \frac{t}{H+t}. \tag{16}$$

The differentiation between firms decreases as H increases. The prices are given by

$$p_A = \frac{4t^2}{3(t+H)}, \tag{17}$$

$$p_B = \frac{2t^2}{3(t+H)} + \frac{Ht^2}{(t+H)^2}. \tag{18}$$

This leads to the following proposition:

Proposition 1 *The second mover charges a higher price than the first mover if the cost of differentiation is sufficiently high* $(p_B - p_A > 0$ *if* $H > 2t)$.

Proof: Follows from (17) and (18).

If only exogenous costs were considered, then higher cost firms would charge lower prices in equilibrium. It is only by explicitly accounting for the cost of differentiation that we are able to find conditions under which a higher cost firm charges a higher price in equilibrium. Also, as we show later in the simultaneous move game, under some conditions, the firm which incurs the differentiation cost enjoys a higher price-cost margin compared to the cost leader.

3.2 Cost of Niche Strategies

The cost of following a niche strategy essentially implies that costs increase as firms' move away from the center of consumer distribution. Let $F_B = F(> 0)$, $F_A = 0$. Here, we are considering the case: $F \neq 0$, $G \neq 0$, $H = 0$. By setting $H = 0$,we have

$$c_A = Gx_A^2, \tag{19}$$

$$c_B = F + Gx_B^2. \tag{20}$$

The optimal positioning is given by (See Technical Appendix B),

$$\widehat{x}_A = 0, \tag{21}$$

$$\widehat{x}_B = \frac{1}{6}\frac{3t + \sqrt{(9t^2 + 12FG + 12Ft)}}{G + t} = \beta_G. \tag{22}$$

3.2.1 Case 1: Costly to go after Niche Consumers ($G > 0$).

Firms differentiate less if cost of following niche strategy increases i.e. $G > 0$. In this case, the differences in prices is given by

$$p_B - p_A = \frac{1}{3}\left[F + (G - 2t)\,\beta_G^2\right]. \tag{23}$$

If the firms have identical exogenous marginal cost ($F = 0$), then the optimal positioning is given by (See Technical Appendix B),

$$\widehat{x}_A = 0, \tag{24}$$

$$\widehat{x}_B = \frac{t}{G + t}. \tag{25}$$

The first entrant positions at the center of consumer distribution and the differentiation between firms decreases as G increases. The prices are given by,

$$p_A = \frac{4t^2}{3\,(t + G)}, \tag{26}$$

$$p_B = \frac{2t^2}{3(t+G)} + \frac{Gt^2}{(t+G)^2}. \quad (27)$$

This leads to the following proposition:

Proposition 2 *The second mover follows a niche strategy and charges a higher price than the first mover if the cost of following a niche strategy is sufficiently high ($p_B - p_A > 0$ if $G > 2t$).*

Proof: Follows from (26) and (27).

It is necessary to incorporate the cost of niche strategies in the analysis to explain the observed fact as to why a niche player might charge a higher prices in equilibrium. If we ignore the cost of niche strategy, then the first mover positions at the center and charges a higher price because of the positioning advantage that the first mover enjoys.

3.2.2 Case 2: Cheaper to go after Niche Consumers ($G < 0$).

In this case, the first entrant again positions at the center but the second entrant positions further away compared to the setting where the cost of going after mainstream or niche consumers is identical. The first entrant always charge a higher price than the second entrant in equilibrium.

4 Simultaneous Move Analysis

We now analyze a game where firms enter the market and choose locations simultaneously and then choose prices simultaneously. We again use backward induction to solve for the sub-game perfect equilibrium in prices and locations. The firm profits in terms of the firm locations are given in equations (6) and (7). We also assume that $F_B > F_A$ in the analysis of the simultaneous game. Therefore, in the simultaneous model, Firm A is the cost leader in terms of the exogenous costs.[4]

The case $G = 0$ and $H = 0$ is equivalent to the case analyzed in Tyagi (2001). In this case, the cost difference between a leader and its competitor is driven only by exogenous factors and there is no dependence of either firms cost on its position within the market. For sake of completeness, we can solve for the equilibrium location to be the following (See Technical Appendix C):

$$\widehat{x}_A = -\frac{3}{4} + \frac{F_B - F_A}{3t}, \tag{28}$$

$$\widehat{x}_B = \frac{3}{4} + \frac{F_B - F_A}{3t}. \tag{29}$$

Given the above locations, we can solve for the difference in prices between the two firms to be the following:

$$p_A - p_B = \frac{F_B - F_A}{3} > 0. \tag{30}$$

If the cost advantage is exogenous in nature, Tyagi (2001) shows that in a horizontally differentiated market, a cost leader prices higher than the competitor. We now include the cost of differentiation and cost of following a niche strategy and study its impact on pricing and profits in a simultaneous move game.

4.1 Cost of Differentiation

As earlier, we model cost of differentiation in a parsimonious model by considering a scenario where cost leader's advantage depends on how much it is differentiated relative

[4]We restrict attention to $F_B - F_A < \frac{9t}{4}$, so that the cost disadvantaged firm doesn't leave the market completely.

to the competitor and study its impact on firm positioning, pricing and profits. Therefore, the cost disadvantaged firm incurs an additional cost over and above the exogenous cost to differentiate its product from the cost leader. Mathematically, we have $G = 0$ and $H > 0$ in our cost function i.e. let us assume $c_B = F_B + H(d)$ and $c_A = F_A$.

In this case, the first order conditions of profit maximization leads to the following equilibrium locations.

$$\widehat{x}_A = -\frac{3}{4} + \frac{(F_B - F_A)}{3t} + \frac{H\left(\widehat{d}\right)}{3t} + \frac{1}{t}\left[\frac{dH(d)}{dx_A}\right]_{x_A = \widehat{x}_A}, \tag{31}$$

$$\widehat{x}_B = \frac{3}{4} + \frac{(F_B - F_A)}{3t} + \frac{H\left(\widehat{d}\right)}{3t} - \frac{1}{t}\left[\frac{dH(d)}{dx_B}\right]_{x_A = \widehat{x}_B}. \tag{32}$$

Also, $\left[\frac{dH(d)}{dx_B} + \frac{dH(d)}{dx_A}\right] = 0$ for any function $H(d)$ which depends on the distance $(x_B - x_A)$. Therefore, the differentiation between firms is independent of the cost of differentiation i.e. $\widehat{x}_B - \widehat{x}_A = \frac{3}{2}$. The intuition for this surprising result is that the positioning of the cost disadvantaged firm is driven by two opposing factors: (i) Price competition increases at it comes closer (ii) Cost of differentiation increases as firm moves away from the competitor. As differentiation costs increase, the cost disadvantaged firm comes closer to the center of distribution. The cost leader finds it more profitable to move away from the center in order to reduce price competition and increase its profits. Therefore, the differentiation between firms remain the same.

Using the equilibrium locations in (31) and (32) and simplifying, the difference in the equilibrium prices charged by the two firms is given by (See Technical Appendix C),

$$p_B - p_A = \frac{1}{3}\left[-(F_B - F_A) - H\left(\widehat{d}\right) + 6\left(\frac{dH\left(\widehat{d}\right)}{dx_B}\right)\right]. \tag{33}$$

Thus, we have the following proposition.

Proposition 3 *If differentiation costs constitutes a large fraction of total costs, then the firm incurring the differentiation cost prices higher than its competitor. If exogenous costs constitutes a large fraction of the total cost, then the firm with higher exogenous costs prices lower than its competitor* $\left(p_B - p_A \gtreqqless 0 \textit{ for } 6\left(\frac{dH(\hat{d})}{dx_B}\right) - H\left(\hat{d}\right) \gtreqqless (F_B - F_A)\right)$.

Proof: Follows from (33).

We now take the simple functional form $H(d) = H(x_B - x_A)^2$and solve for the cost leaders' pricing strategy as given in (33). Then equation (33) can be simplified to the following:

$$p_B - p_A \gtreqqless 0 \text{ for } \frac{63}{4}H \gtreqqless F_B - F_A. \tag{34}$$

Therefore, a cost leader's pricing strategy depends on which type of cost dominates. If the cost is driven by cost of differentiation, then the cost disadvantaged firm has a tendency to come closer to the center of the consumer distribution in equilibrium and hence the cost leader has an incentive to charge lower prices in equilibrium.

Margin and Profit Comparison For the chosen functional form, $H(d) = H(x_B - x_A)^2$, the price-cost margins of the cost disadvantaged firm is higher than the cost leader if $H > \frac{4}{9}(F_B - F_A)$. So if the cost of differentiation is sufficiently high, then a cost disadvantaged firm enjoys a higher margin (See Technical Appendix D). As mentioned earlier, when the cost of differentiation increases, it dominates the price competition effect and the cost disadvantaged firm comes closer to the center of the distribution. This, in turn, forces the firm with lower costs to move away. So, a firm which incurs the differentiation cost is able to charge a higher price and enjoy higher price-cost margins..

The profits of the firms are given by,

$$\pi_A = \frac{1}{27t}\left[2(F_B - F_A) + \frac{9t}{2} - \frac{9}{2}H\right]^2, \tag{35}$$

$$\pi_B = \frac{1}{27t}\left[-2(F_B - F_A) + \frac{9t}{2} + \frac{9}{2}H\right]^2. \tag{36}$$

This leads to the following proposition.

Proposition 4 *In a horizontally differentiated market, the cost disadvantaged firm can make higher profits than the cost leader if the cost of differentiation is sufficiently high* $\left(\frac{4}{9}(F_B - F_A) < H < \frac{4}{9}(F_B - F_A) + t\right)$.

Proof: See Technical Appendix D.

As H increases, both the margin and the market share of Firm B increases, and hence Firm B's profits increase. For $\frac{4}{9}(F_B - F_A) < H < \frac{4}{9}(F_B - F_A) + t$, both firms make positive profits but Firm B makes higher profits than Firm A. For $H > \frac{4}{9}(F_B - F_A) + t$, Firm A is driven out of the market (See Technical Appendix D).

4.2 Cost of Niche Strategies

We now analyze the impact of including the cost of niche strategies on firm positioning, prices and profits when firms enter simultaneously. By setting $H = 0$, we have

$$c_A = F_A + Gx_A^2, \tag{37}$$

$$c_B = F_B + Gx_B^2. \tag{38}$$

4.2.1 Case 1: Costly to go after Niche Consumers ($G > 0$).

$G > 0$ represents the situation where it is more expensive to follow a niche strategy. We can solve for the equilibrium location of the two firms (See Technical Appendix E). We find that as the cost of following a niche strategy increases, firms differentiate less in the market but the differentiation between the firms is independent of the differences in exogenous costs. Even when exogenous costs are high, the higher cost of following niche strategies forces firms to reduce differentiation when the exogenous costs are identical.

$$\widehat{x}_A = -\frac{3t}{4(t+G)} + \frac{(F_B - F_A)}{3t}, \tag{39}$$

$$\widehat{x}_B = \frac{3t}{4(t+G)} + \frac{(F_B - F_A)}{3t}, \tag{40}$$

$$\widehat{x}_B - \widehat{x}_A = \frac{3t}{2(t+G)}. \tag{41}$$

Solving for the equilibrium prices, we find that the difference in the prices charged by the cost leader and the competitor is given by

$$p_A - p_B = \frac{1}{3}\left[\frac{t-2G}{t+G}(F_B - F_A)\right]. \tag{42}$$

This leads to the following proposition.

Proposition 5 *In a horizontally differentiated market, the cost disadvantaged firm charges a higher price in equilibrium and follows a niche strategy if the cost to follow a niche strategy is higher than a threshold* $\left(p_B - p_A > 0 \ if \ G > \frac{t}{2}\right)$.

Proof: Follows from (42).

Our intuition for the above result is as follows: As G increases, firms make more mainstream products. And as the cost disadvantaged firm comes closer to the center of the consumer distribution, the cost leader gains higher profits by pricing lower and capturing a greater market share. Therefore, when $G > \frac{t}{2}$, the cost leader has an incentive to price lower. Note that when firms have identical exogenous costs, then firms charge identical prices in equilibrium. So, the cost of niche strategy plays a role in the firms pricing decision only when there exists an asymmetry between the firms exogenous costs. This is an example of how cost of different types interact with each other in determining optimal positioning and prices.

Profit Comparison The firm profits are given by

$$\pi_A = \frac{(t+G)}{27t^2}\left[2(F_B - F_A) + \frac{9t^2}{2(t+G)}\right]^2, \tag{43}$$

$$\pi_B = \frac{(t+G)}{27t^2}\left[-2(F_B - F_A) + \frac{9t^2}{2(t+G)}\right]^2. \tag{44}$$

Note that the cost leader always makes higher profits than the competitor. But a more interesting case is to compare the profits of the firms in a market where firms follow niche strategies against the corresponding profits of firms when cost of following niche strategies are ignored. Technical Appendix F shows the profit comparisons for both the cost leader and for the cost disadvantaged firm. This leads to the following proposition.

Proposition 6 *If* $\frac{9t}{4}\left(\frac{t}{t+G}\right)^{1/2} < (F_B - F_A) < \frac{9t}{4}$, *then both the cost leader as well as the cost disadvantaged firm makes higher profits in markets where cost of niche strategies exists compared to a benchmark setting where cost of niche strategies are not considered.*

Proof: See Technical Appendix F.

The intuition for the results is as follows. If $G > 0$, decisions are driven by two opposing factors. Cost decreases as firms make more mainstream product but price competition increases as they come closer. So, firms' decision depends on the relative impact of these two factors. When the differences in exogenous costs are low, each firm tries to reduce its cost by moving closer to the center of the distribution of consumer preferences. This leads to more intense price competition which reduces firm profits. As the differences in exogenous cost increase, the fear of price competition that each firm faces dominates the decrease in cost associated with making a mainstream product as they come closer. So, it requires the differences in exogenous sources of cost to be larger for the cost disadvantaged firm to stay away, which in turn results in lower price competition. Consequently the profits of both firms increase compared to the case where cost of niche strategies are not considered.

4.2.2 Case 2: Cheaper to go after Niche Consumers ($G < 0$).

$G < 0$ represents the case where it is cheaper to follow a niche strategy.[5] Using equation (41), we can see that as G becomes more and more negative, not surprisingly, firm differentiation increases. From Equation (42) it can be readily seen that the cost leader always charges a higher price in equilibrium. Also, for $-t < G < 0$, both firms make higher profits compared to the setting where $G = 0$.

5 Conclusions

The primary purpose of this paper has been to study the impact of the cost of differentiation and the cost of following a niche strategy on positioning and pricing decisions in a horizontally differentiated market. We analyze both simultaneous and sequential entry cases. The cost of differentiation is an additional cost incurred by a second entrant and it depends on the degree of differentiation between itself and the first mover. The cost of following a niche strategy is a market level cost factor affecting both firms whereby firms incur a positive or negative cost if they want to make a niche product. In sequential

[5] We restrict our attention to $G > -\frac{t}{2}$, so that $c_B > c_A$.

games, we find that in markets where cost of differentiation, or cost of following niche strategies is high, a first entrant prices lower than the second entrant even if the first entrant has a cost advantage in terms of exogenous costs. In simultaneous games, our results are consistent with the results obtained under sequential setting in the sense that incorporating a cost of differentiation or a cost of following niche strategies forces a cost leader to charge a lower price whenever the cost of differentiation or the cost of following niche strategies is high.

We find that in simultaneous games, it is possible that both the cost leader as well as the cost disadvantaged firm makes higher profits in settings where the cost of niche strategies exist than when these costs don't exist. We also find that if differentiation costs are sufficiently high, then the cost disadvantaged firm enjoys higher price-cost margins. In other words, higher costs are a blessing in disguise. Unlike previous research, we are able to show analytically that a firm which follows a niche or differentiated strategy actually charges a higher price in equilibrium and also attains higher price cost margins. Our model might be a good starting point for further empirical research in this area by providing sharper predictions about the impact of various types of costs on market outcomes.

Our model has a number of limitations. We model the cost of differentiation as well as the cost of following niche strategies using a specific functional form. We also allow each firm to manufacture a single product, but firms may use a product line to reach mainstream as well as niche markets. Extending the analysis to general functional form of cost or analyzing the setting where firms have the ability to have multiple products are interesting avenues for future research. Finally, we have restricted our attention to a one dimensional product attribute space but firms can differentiate their products along multiple dimensions. It might also be useful to extend the analysis into such settings in future research.

References

Besanko, D., D. Dranove, M. Shanley. 2001. Exploiting a Cost Advantage and Coping with a Cost Disadvantage. *Management Science.* **47**(2), 221-235.

Hall, W. K. 1980. Survival strategies in a hostile environment. *Harvard Business Review.* **58**(5), 75-85.

Horsky, D., P. Nelson. 1992. New Brand Positioning and Pricing in an Oligopolistic Market. *Marketing Science.* **11**(2), 133-153.

Hotelling, H. 1929. Stability in competition. *Economic Journal.* **39**, 41-57.

Noble, P. M., T. S. Gruca. 1999. Industrial Pricing: Theory and Managerial Practice. *Marketing Science* **18**(3), 435-454.

Porter, R. 1985. Competitive Advantage: Creating and Sustaining Superior Performance. Free Press, New York.

Tabuchi, T., J. F. Thisse. 1995. Asymmetric Equilibria in Spatial Competition. *International Journal of Industrial Organization.* **13**(2), 213-227.

Tyagi, R. K. 2000. Sequential Product Positioning Under Differential Costs. *Management Science.* **46**(7), 928-940.

Tyagi, R. K. 2001. Cost Leadership and Pricing. *Economic Letters.* **72**, 189-193.

Technical Appendix

Appendix A

In this Appendix, we consider the sequential entry of firms. The second entrant not only has a higher exogenous cost, it also faces a cost of differentiation i.e. $F \neq 0$, $G = 0$, $H \neq 0$. Therefore, $c_B = F +\ H\left(x_B - x_A\right)^2$ and $c_A = 0$.

$\pi_B = \frac{1}{18t(x_B - x_A)}\left[F + H\left(x_B - x_A\right)^2 - 3t\left(x_B - x_A\right) + t\left(x_B^2 - x_A^2\right)\right]^2$

$\frac{d\pi_B}{dx_B} = 0$, implies

$-2\left(H + t\right)\left(x_B - x_A\right)^2 + 2F = H\left(x_B - x_A\right)^2 - 3t\left(x_B - x_A\right) + t\left(x_B^2 - x_A^2\right) + F$

Simplifying, we have

$3\left(H + t\right)x_B = 3t + \left(t + 3H\right)x_A + \frac{F}{x_B - x_A}$. Solving, the profit is maximized at

$$\widehat{x}_B = \frac{1}{6\left(t + H\right)}\left[3t + \left(6H + 4t\right)a + \sqrt{\left(3t - 2ta\right)^2 + 12\left(t + H\right)F}\right]. \tag{A.1}$$

Following the steps outlined in Appendix D, we find the FOC which maximizes the first movers profits. Setting $\frac{d\pi_A}{dx_A} = 0$, we find that Firm A's profits is maximized at

$$\widehat{x}_A = 0. \tag{A.2}$$

Substituting, we have

$$\widehat{x}_B = \frac{1}{6\left(t + H\right)}\left[3t + \sqrt{9t^2 + 12\left(t + H\right)F}\right] = \beta_H \tag{A.3}$$

Incorporating these equilibrium locations, the difference in prices is,

$$p_B - p_A = \frac{1}{3}\left[F + \left(H - 2t\right)\beta_H^2\right]. \tag{A.4}$$

Substituting $F = 0$, $\widehat{x}_A = 0$ and $\widehat{x}_B = \frac{t}{t+H}$ and $p_B - p_A = \frac{1}{3}\left[H - 2t\right]\left[\frac{t}{t+H}\right]^2$.

Appendix B

In this Appendix, we consider the sequential entry of firms. The second entrant not only has a higher exogenous cost, it also faces a cost of making a niche product i.e. $F \neq 0$, $G \neq 0$, $H = 0$. Therefore, $c_B = F + Gx_B^2$ and $c_A = Gx_A^2$.

$\pi_B = \frac{1}{18t(x_B - x_A)} \left[F - 3t(x_B - x_A) + (G+t)(x_B^2 - x_A^2)\right]^2$

$\frac{d\pi_B}{dx_B} = 0$, implies

$$36t\left[2Gx_B - 3t + 2tx_B\right]\left[c_B - c_A - 3t(x_B - x_A) + t(x_B^2 - x_A^2)\right] = 18t\left[c_B - c_A - 3t(x_B - x_A) + t(x_B^2 - x_A^2)\right]^2$$

Therefore, $4Gx_B - 6t + 4tx_B = \frac{F}{x_B - x_A} - 3t + (G+t)x_A$

Simplifying, $3(G+t)x_B = \frac{F}{x_B - x_A} + 3t + (G+t)x_A$. Solving,

$$x_B = \frac{1}{6(t+G)}\left(3t + 4(t+G)x_A - \Delta\right), \tag{B.1}$$

The profits for the second mover is maximized at $\widehat{x}_B = \frac{1}{6(t+G)}\left(3t + 4(t+G)x_A + \Delta\right)$ where $\Delta = \sqrt{(3t - 2(G+t)x_A)^2 + 12(G+t)F}$.

$$\pi_A = \frac{4}{243t(G+t)} \frac{\left[6(G+t)F + \left[3t + (G+t)x_A\right]\left[3t - 2(G+t)x_A + \Delta\right]\right]^2}{\left[3t - 2(G+t)x_A + \Delta\right]}. \tag{B.2}$$

The profit is maximized for the FOC of profit maximization yields the following:

$$\widehat{x}_A = 0 \tag{B.3}$$

Substituting the value of $\widehat{x}_A$ into the expression for x_B, we get,

$$\widehat{x}_B = \frac{1}{6}\frac{3t + \sqrt{(9t^2 + 12FG + 12Ft)}}{G+t} = \beta_G. \tag{B.4}$$

Substituting the values of $\widehat{x}_A$ and $\widehat{x}_B$ into the differences of prices, we get

$$p_B - p_A = \frac{1}{3}\left[F + (G-2t)\beta_G^2\right]. \tag{B.5}$$

Substituting $F=0$, $\widehat{x}_A = 0$ and $\widehat{x}_B = \frac{t}{t+G}$ and $p_B - p_A = \frac{1}{3}[G-2t]\left[\frac{t}{t+G}\right]^2$.

Appendix C

Let $c_A = F_A$ and $c_B = F_B + H\left(\widehat{d}\right)$ where $H\left(\widehat{d}\right)$ is a twice differentiable function. The firm profits are given by

$$\pi_A = \frac{1}{18t(x_B - x_A)}\left[(F_B - F_A) + H\left(\widehat{d}\right) + 3t(x_B - x_A) + t\left(x_B^2 - x_A^2\right)\right]^2, \tag{C.1}$$

$$\pi_B = \frac{1}{18t(x_B - x_A)}\left[-(F_B - F_A) - H\left(\widehat{d}\right) + 3t(x_B - x_A) - t\left(x_B^2 - x_A^2\right)\right]^2 \tag{C.2}$$

Setting the derivative of π_A w.r.t a to zero and setting the derivative of π_B w.r.t b to zero, and solving the FOC's for profit maximization we get

$$\widehat{x}_A = -\frac{3}{4} + \frac{(F_B - F_A)}{3t} + \frac{H\left(\widehat{d}\right)}{3t} + \frac{1}{t}\left[\frac{dH\left(\widehat{d}\right)}{dx_A}\right], \tag{C.3}$$

$$\widehat{x}_B = \frac{3}{4} + \frac{(F_B - F_A)}{3t} + \frac{H\left(\widehat{d}\right)}{3t} - \frac{1}{t}\left[\frac{dH\left(\widehat{d}\right)}{dx_B}\right]. \tag{C.4}$$

Therefore,

$$\widehat{x}_B - \widehat{x}_A = \frac{3}{2} - \frac{1}{t}\left[\frac{dH\left(\widehat{d}\right)}{dx_B} + \frac{dH\left(\widehat{d}\right)}{dx_A}\right] \tag{C.5}$$

Also, $\left[\frac{dH\left(\widehat{d}\right)}{dx_B} + \frac{dH\left(\widehat{d}\right)}{dx_A}\right] = 0$ for any function $H\left(\widehat{d}\right)$ which depends on the distance $(\widehat{x}_B - \widehat{x}_A)$ which leads to $\widehat{x}_B - \widehat{x}_A = \frac{3}{2}$.

Substituting the values of the equilibrium locations, the difference in prices

$$p_B - p_A = \frac{1}{3}\left[(c_B - c_A) - 2t\left(x_B^2 - x_A^2\right)\right] \tag{C.6}$$

can be simplified to

$$p_B - p_A = \frac{1}{3}\left[-(F_B - F_A) - H(\widehat{x}_B - \widehat{x}_A) + 6\left[\frac{dH\left(\widehat{d}\right)}{dx_B}\right]\right]. \tag{C.7}$$

Appendix D

For the functional form $H(d) = H(x_B - x_A)^2$, we have $c_B = F_B + H(x_B - x_A)^2$ and $c_A = F_A$. The equilibrium prices are given by

$$p_A = \frac{2}{3}(F_B - F_A) + \frac{3t}{2} - \frac{3H}{2}, \tag{D.1}$$

$$p_B = \frac{(F_B - F_A)}{3} + \frac{3t}{2} + \frac{15H}{4}. \tag{D.2}$$

The condition for the price-cost margins of the cost disadvantaged firm to be greater than that of the cost leader is given by

$$-2(F_B - F_A) + \frac{9t}{2} + \frac{9H}{2} > 2(F_B - F_A) + \frac{9t}{2} - \frac{9H}{2}, \text{ i.e.} \tag{D.3}$$

$$F_B - F_A < \frac{9H}{4}. \tag{D.4}$$

The market share of the two firms is given by:

$$\text{Market Share Firm } A = \frac{1}{2} - \frac{2(F_B - F_A)}{9t} - \frac{H}{2t}, \tag{D.5}$$

$$\text{Market Share Firm } B = \frac{1}{2} + \frac{2(F_B - F_A)}{9t} + \frac{H}{2t}. \tag{D.6}$$

For both market shares to be positive, $H < \frac{4}{9}(F_B - F_A) + t$.

Appendix E

Let $c_A = F_A + Gx_A^2$ and $c_B = F_B + Gx_B^2$

Now firms A and B will choose locations to maximize firm profits.

$$c_B - c_A = (F_B - F_A) + G\left(x_B^2 - x_A^2\right)$$

$$\frac{d\pi_A}{dx_A} = \frac{36t(x_B - x_A)\left[(F_B - F_A) + (G+t)\left(x_B^2 - x_A^2\right) + 3t(x_B - x_A)\right][-2Gx_A - 3t - 2x_A t] + 18t\left[(F_B - F_A) + (G+t)\left(x_B^2 - x_A^2\right) + 3t(x_B - x_A)\right]^2}{[18t(x_N - x_A)]^2}$$

$$\frac{d\pi_B}{dx_B} = \frac{36t(x_B - x_A)\left[(F_A - F_B) - (G+t)\left(x_B^2 - x_A^2\right) + 3t(x_B - x_A)\right][-2Gx_B + 3t - 2x_B t] - 18t\left[(F_A - F_B) - (G+t)\left(x_B^2 - x_A^2\right) + 3t(x_B - x_A)\right]^2}{[18t(x_B - x_A)]^2}$$

Setting the derivative of π_A w.r.t a to zero and setting the derivative of π_B w.r.t b to zero, and solving the FOC's for profit maximization we get

$$x_A = -\frac{3t}{4(t+G)} + \frac{F_B - F_A}{3t}, \tag{E.1}$$

$$x_B = \frac{3t}{4(t+G)} + \frac{F_B - F_A}{3t}. \tag{E.2}$$

Substituting these expressions into the pricing function, we get

$$p_A - p_B = \frac{1}{3}\left[(c_A - c_B) + 2t\left(x_B^2 - x_A^2\right)\right] \text{ i.e.} \tag{E.3}$$

$$p_A - p_B = \frac{1}{3}\left[\frac{(2t - G)}{t+G}(F_B - F_A) - (F_B - F_A)\right] \tag{E.4}$$

The profit functions are the following:

$$\pi_A = \frac{(t+G)}{27t^2}\left[2(F_B - F_A) + \frac{9t^2}{2(t+G)}\right]^2, \tag{E.5}$$

$$\pi_B = \frac{(t+G)}{27t^2}\left[-2(F_B - F_A) + \frac{9t^2}{2(t+G)}\right]^2 \tag{E.6}$$

Substituting $G = 0$ into (A.1), (A.2) and (A.4) gives (11), (12) and (13).

Appendix F

Profit comparisons:

Case 1: $G > 0$:

We compare the profits of the cost leader when we account for the cost of following niche strategy against the profits of the cost leader when such costs are ignored. We see that profits under the former case is higher than the latter when,

$$\frac{(t+G)}{27t^2}\left[2\left(F_B-F_A\right)+\frac{9t^2}{2\left(t+G\right)}\right]^2 > \frac{1}{27t}\left[2\left(F_B-F_A\right)+\frac{9t}{2}\right]^2, \tag{F.1}$$

$$2\left(F_B-F_A\right)\left[1-\left(\frac{t}{t+G}\right)^{1/2}\right] > \frac{9t}{2}\left(\frac{t}{t+G}\right)^{1/2}\left[1-\left(\frac{t}{t+G}\right)^{1/2}\right], \tag{F.2}$$

$$F_B-F_A > \frac{9t}{4}\left(\frac{t}{t+G}\right)^{1/2} \tag{F.3}$$

Now let us consider the profits of the cost disadvantaged firm. We consider two cases:

Case 1: $F_B - F_A < \frac{9t^2}{4(t+G)}$

Then, for the cost disadvantaged firm to make higher profits, the inequality to be satisfied is,

$$\frac{9t^2}{2\left(t+G\right)}-2\left(F_B-F_A\right) > \left(\frac{t}{t+G}\right)^{1/2}\left[-2\left(F_B-F_A\right)+\frac{9t}{2}\right] \text{ i.e.,} \tag{F.4}$$

$$\frac{9t}{2}\left(\frac{t}{t+G}\right)^{1/2}\left[\left(\frac{t}{t+G}\right)^{1/2}-1\right] > 2\left(F_B-F_A\right)\left[1-\left(\frac{t}{t+G}\right)^{1/2}\right]. \tag{F.5}$$

As can be readily seen, there are no values of $F_B - F_A$ in the range that we have considered, such that the above inequality is satisfied. So, a cost disadvantaged firm makes lower profits than when we ignore cost of following niche strategy.

Case 2: $\frac{9t^2}{4(t+G)} < F_B - F_A < \frac{9t}{4}$

Then, for the cost disadvantaged firm to make higher profits, the inequality to be satisfied is,

$$2\left(F_B - F_A\right) - \frac{9t^2}{2\left(t+G\right)} \;>\; \left(\frac{t}{t+G}\right)^{1/2}\left[-2\left(F_B - F_A\right) + \frac{9t}{2}\right] \text{ i.e.,} \tag{F.6}$$

$$\left(F_B - F_A\right) \;>\; \frac{9t}{4}\left(\frac{t}{t+G}\right)^{1/2} \tag{F.7}$$

Therefore, a cost disadvantaged firm also makes higher profits when $\frac{9t}{4}\left(\frac{t}{t+G}\right)^{1/2} < \left(F_B - F_A\right) < \frac{9t}{4}$.