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Abstract
We study competitive positioning and pricing strategies in markets where consumers seek variety. Variety seeking behavior is modeled as a decrease in the willingness to pay for the product purchased on the previous purchase occasion. Using a three-stage Hotelling-type model, we show that the presence of variety seeking consumers reduces product differentiation offered in equilibrium, thereby explaining some otherwise counterintuitive findings in empirical research. We find that firms charge higher prices in Period 1 and lower prices in Period 2. The lower price in Period 2 represents the price incentive that firms need to offer to prevent the variety seeking consumers from switching. Furthermore, we find that the observed switching in a market may not fully capture the true magnitude of the underlying variety seeking tendencies among consumers. Finally, we show that the presence of variety seeking consumers leads to lower firm profits and a higher consumer surplus. Surplus increases for variety seeking consumers as well as regular consumers. Therefore, the presence of variety seeking consumers benefits everyone in the market.

Keywords
variety seeking, positioning, pricing, differentiation, hotelling models

Disciplines
Business | Business Administration, Management, and Operations | Business Analytics | Business Intelligence | Marketing | Organizational Behavior and Theory | Sales and Merchandising

Positioning and Pricing in a Variety Seeking Market

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Abstract

We study competitive positioning and pricing strategies in markets where consumers seek variety. Variety seeking behavior is modeled as an increase in the willingness-to-pay for the product not purchased on the previous purchase occasion. Using a three stage Hotelling type model, we show that the presence of variety seeking consumers reduces product differentiation offered in equilibrium. Furthermore, we find that the observed switching in a market may not fully capture the true magnitude of the underlying variety seeking tendencies among consumers. Finally, we show that the presence of variety seeking consumers leads to lower firm profits and a higher consumer surplus. Non-variety seeking consumers also gain from the presence of variety seeking consumers.

Keywords: Variety-Seeking, Positioning, Differentiation, Hotelling Models

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1 Introduction

Observed brand choice behavior suggests that some consumers avoid changes whereas others prefer variety. Preference for variety, observed even in the absence of stock outs and promotions (Bass, Pessemier and Lehmann 1972), is believed to indicate the presence of a *variety seeking trait* (e.g., Givon 1984, Lattin and McAllister 1985), and these consumers get satiated with the same product over time. Satiation with the most recent purchase may lead to an increase in the attractiveness of the competing brand at the next purchase occasion (McAlister 1982).

Marketing has a rich tradition of empirical research that allows us to estimate the extent of variety seeking in a market (e.g., Kahn, Kalwani and Morrison 1986, Trivedi, Bass and Rao 1994), its impact on market share (Feinberg, Kahn and McAlister 1992), and how companies could adapt their promotional strategies in the presence of consumers who seek variety (e.g., Kahn and Raju 1991, Zhang, Krishna and Dhar 2000). More recently, analytic modelers have also begun to examine how the presence of variety seeking customers affects pricing decisions, and ultimately firm profits, in a competitive equilibrium (Seetharaman and Che 2006).

We extend this tradition by developing a model that allows firms to also make positioning decisions (along with pricing decisions) in the context of a consumer behavior model that we believe is somewhat less restrictive than the consumer models previously used in this stream of research. Consequently, our analysis allows us to answer questions that could not be addressed in the context of previous models. For example, one such question is whether the presence of variety seeking consumers results in greater or lesser product variety in equilibrium. While, it may appear that the presence of variety seeking consumers should result in more product variety, we find that this need not always be the case when one considers a competitive context explicitly. Furthermore, while previous research notes that the presence of variety seeking consumers might result in higher prices and profits, we find that prices and profits are lower if there are enough consumers who seek variety. This seems reasonable because in the absence of loyalty (consumer inertia), one should intuitively expect the firms to make lower profits.

Klemperer (1987) uses switching costs to model variety. Seetharaman and Che (2006) look at variety seeking in terms of staying cost. We model variety seeking (satiation) through a relative reduction in the reservation price (willingness to pay) of the previously purchased brand. Our model is different from Klemperer (1987) and Che and Seetharaman (2006) on two additional dimensions.

- We do not restrict firms to locate at the extremes of the market. We model the location decisions of the firm endogenously and solve for the equilibrium firm locations.

- Seetharaman and Che (2006) model variety seeking through a change in location. Some consumers located at x in the first period changes location to $(1 - x)$ in the second period. Klemperer (1987) assumes that preferences of a fraction of consumers in Period 2 is independent of their preferences in Period 1. In contrast, in the model proposed here, the maximum willingness to pay changes for a fraction of consumers but each consumer is located at the same position on the Hotelling line across both the time periods.

In the context of our model, we show that when some consumers seek variety, the degree of product differentiation reduces in equilibrium, and firm prices are lower in Period

2 and higher in Period 1. Van Trijp, Hoyer and Inman (1996) find that variety seeking behavior is more likely to occur in situations where the perceived differences among the alternatives are small. Our model suggests that this association may be observed due to the fact that firms differentiate less in the presence of variety seeking consumers. The prediction regarding prices is different than what has been obtained in Klemperer (1987) and Seetharaman and Che (2006). We recognize however that ultimately which prediction is more robust in what context can only be determined through a thorough empirical analysis. However, it is worthwhile noting that there are instances where recommendations from prior research and observed firm behavior are consistent with our model predictions. For example, our results resonate with the idea that rear-loaded promotions are superior to front-loaded promotions in the presence of variety seeking customers (Zhang, Krishna and Dhar, 2000). The rear loaded promotion effectively reduces the price that a consumer needs to pay for a previously purchased brand making the competing brand less attractive during the second period purchase. In terms of observed behavior, we have noted that Newsweek magazine subscription prices to new consumers are higher than the renewal prices paid by existing consumers (See Table 1). Reader's Digest is another magazine where renewal prices are lower than initial subscription prices. Renewal prices for many software subscriptions are also often lower than the initial subscription prices. One such example is Microsoft Developer Network. Microsoft manages its relationships with developers through its Microsoft Developer Network (MSDN). MSDN offers its Operating Systems initial subscription at \$699 where as the renewal price is only \$499.[1].

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 the model and derive our main

[1]Source:http://www.microsoft.com/presspass/press/2005/mar05/03-21VS2005PR.mspx

results and outline the intuition behind the results. Section 4 presents the conclusions, limitations and possible avenues for future research.

2 The Model

We use the Hotelling framework (Hotelling 1929) and assume that the market consists of two symmetric firms A and B, each offering one product recognized by superscripts A and B respectively. Consider the following sequence of decisions. In Period 0, firms choose locations simultaneously. In Period 1, firms choose first period prices, p_1^A and p_1^B and consumers buy the product that maximizes their utility. In Period 2, firms choose second period prices, p_2^A and p_2^B and each and every consumer again decides to buy the product that maximizes their utility. Multi-period models have been used extensively in marketing literature (e.g. Desai and Purohit 1999, Kim, Shi and Srinivasan 2001). 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 in Period 1, consumer reservation price is denoted by V, and 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 in Period 1.

3. For a fraction θ consumers in the market, second period reservation prices increase by ℓ for the product they did not buy in Period 1. Parameters θ and ℓ are assumed to be exogenous to the model. These θ consumers are the variety seeking consumers. More specifically, θ fraction of the consumers believe that the competing product

will provide them with incremental utility ($U_A - V = U_B - V = \ell > 0$ where U_A and U_B represent the higher reservation price for the competing brand which they did not purchase in the first period) in Period 2 over their choice in Period 1. These θ consumers are distributed uniformly on the line segment [-0.5, 0.5].

4. The remaining $(1 - \theta)$ consumers see both products to have identical reservation prices in Period 2 as in Period 1. These consumers are also distributed uniformly on the line segment [-0.5, 0.5].

5. Every consumer in the market buys one and only one unit from the firm which provides them with the highest utility in that period.

6. Following Tabuchi and Thisse (1995) and Tyagi (2000), firms are not restricted to locate within the interval of consumers' ideal points i.e. within [-0.5, 0.5]. Firms choose locations simultaneously. Thus our analysis, excludes the possibility of any first mover advantage. We assume that Firm A is located to the left of Firm B and these locations are denoted by a and b respectively.

7. The production cost for both firms is assumed to be identical and constant and is assumed to be zero without loss of generality.

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

9. Firms have rational expectations and discount second-period revenues by a factor δ in first-period terms. They cannot store the product between periods. Once firms' locations and prices are determined, the consumers have perfect information about them. Consumers are rational in the sense that each consumer's choice problem is to purchase one product from either firm in each time period which maximizes utility in that period, but we do not model the consumers to be forward looking.

3 Analysis

Because it is a multistage game, we use the concept of sub-game perfect equilibrium and analyze the decisions of firms and consumers in the reverse order to solve for the equilibrium in prices and locations.

3.1 Case 1: $\theta = 0$

Note that $\theta = 0$ represents absence of variety seeking (a situation where consumer willingness to pay in Period 2 is not based on what they bought last period). These results are the benchmark against which our results must be compared. Let p^A and p^B be the prices charged by the firms (same in both periods). For $\theta = 0$, the model can be solved to derive the following results. The details are provided in Appendix A.

$$p^A = p^B = \frac{3}{2}t. \tag{1}$$

The equilibrium locations are at

$$a = -\frac{3}{4}, \tag{2}$$

$$b = \frac{3}{4}. \tag{3}$$

The equilibrium locations are symmetric so each firm captures half the market. The equilibrium firm profits are,

$$\pi^A = \pi^B = \frac{3}{4}t. \tag{4}$$

3.2 Case 2: $\theta > 0$

We have a three period game (Period 0, 1 and 2). In Period 0, firms choose locations. In Period 1, the consumers purchase the product which provides them with the highest utility. Based on the utility of consumers, we can find the market share for Firm A and Firm B by considering the marginal consumer, $\widetilde{x}$. The location of the marginal consumer is given by,

$$V - p_1^B - t\left(b - \widetilde{x}\right)^2 = V - p_1^A - t\left(\widetilde{x} - a\right)^2, \tag{5}$$

where a and b are the equilibrium locations of the two firms. In Period 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. In Period 2, Firm A sales comes from three types of consumers:

- Type 1: Among the consumers whose reservation prices for the two products does not change, consumers will buy from Firm A if buying from Firm A provides them with higher utility in Period 2. These consumers equal $(1-\theta)\left(\frac{1}{2} + \frac{a+b}{2} + \frac{p_2^B - p_2^A}{2t(b-a)}\right)$.
- Type 2: Variety seeking consumers who purchased from Firm B in Period 1 and whose utility is higher in Period 2 by buying from Firm A. This fraction of consumers equal $\theta\left(\frac{\ell + p_2^B - p_2^A}{2t(b-a)} - \frac{p_1^B - p_1^A}{2t(b-a)}\right)$ [2].

[2] We restrict our analysis to $\ell < 1.47t$, so that the marginal consumers are located within the distribution of consumers for all values of θ.

- Type 3: Variety seeking consumers who do not gain utility by buying from Firm B and continue to buy from Firm A. These consumers equal $\theta\left(\frac{1}{2}+\frac{a+b}{2}+\frac{-\ell+p_2^B-p_2^A}{2t(b-a)}\right)$.

Adding the demand from these three different types of consumers, total Firm A sales in Period 2 denoted by q_2^A is given by,

$$q_2^A=\left[\frac{1}{2}+\frac{a+b}{2}-\frac{\theta\left(p_1^B-p_1^A\right)}{2t\left(b-a\right)}+\frac{\left(1+\theta\right)\left(p_2^B-p_2^A\right)}{2t\left(b-a\right)}\right]. \tag{6}$$

Similarly, Firm B sales in Period 2 can be expressed as,

$$q_2^B=\left[\frac{1}{2}-\frac{a+b}{2}+\frac{\theta\left(p_1^B-p_1^A\right)}{2t\left(b-a\right)}-\frac{\left(1+\theta\right)\left(p_2^B-p_2^A\right)}{2t\left(b-a\right)}\right]. \tag{7}$$

In the second period, firms choose p_2^A and p_2^B to maximize firm profits assuming locations and Period 1 prices to be given. As shown in Appendix B, we find p_2^A and p_2^B to be as follows.

$$p_2^A = \left[\frac{t\left(b-a\right)}{\left(1+\theta\right)}+\frac{t\left(b^2-a^2\right)}{3\left(1+\theta\right)}-\frac{\theta\left(p_1^B-p_1^A\right)}{3\left(1+\theta\right)}\right], \tag{8}$$

$$p_2^B = \left[\frac{t\left(b-a\right)}{\left(1+\theta\right)}-\frac{t\left(b^2-a^2\right)}{3\left(1+\theta\right)}+\frac{\theta\left(p_1^B-p_1^A\right)}{3\left(1+\theta\right)}\right]. \tag{9}$$

Working backwards, each firm will choose its Period 1 prices and locations to maximize total profits, π^i_{Total} :

$$\pi^i_{Total}=\pi^i_1+\delta\pi^i_2, \qquad \forall \;\; i=A,B. \tag{10}$$

Solving we get (the details are in Appendix B),

$$b^* = \frac{3}{4}-\frac{1}{4}\left(\frac{\delta\theta}{1+\theta}\right)\left[\frac{(9+6\theta-2\delta\theta^2-3\theta^2)}{(27+27\theta+27\delta+24\delta\theta-4\delta^2\theta^2-6\delta\theta^2)}\right], \tag{11}$$

$$a^* = -\frac{3}{4}+\frac{1}{4}\left(\frac{\delta\theta}{1+\theta}\right)\left[\frac{(9+6\theta-2\delta\theta^2-3\theta^2)}{(27+27\theta+27\delta+24\delta\theta-4\delta^2\theta^2-6\delta\theta^2)}\right]. \tag{12}$$

The equilibrium locations are symmetric. For all $0 < \theta \leq 1$, and $0 < \delta \leq 1$ the distance between the equilibrium locations of the firms is less than the equilibrium location between the firms when there are no variety seeking consumers present ($\theta = 0$ case). This leads to our first proposition:

Proposition 1 *If $\theta > 0$, then $b < \frac{3}{4}$ and $a > \frac{-3}{4}$. In other words, the presence of variety seeking consumers, the firms differentiate less in the market.*

Proof: See Appendix B.

Our results are consistent with the experimental findings in Van Trijp, Hoyer and Inman (1996) who find support for the hypothesis that variety seeking behavior is more likely to occur in situations where the perceived differences among the alternatives are small. Our model suggests that this association may be observed due to the fact that firms differentiate less in the presence of variety seeking consumers.

Kim and Serfes (2006) also find that differentiation reduces in equilibrium but they analyze a model where some consumers buy from both firms in the same time period (i.e., buy a bundle). Said differently, they assume that some consumers treat both products to be very similar. It therefore follows that firms also do not differentiate as much. We analyze a model where consumers buy one product in each time period but get satiated with what they bought earlier. Therefore variety seeking behavior results in differences in willingness to pay where differences did not exist otherwise. Furthermore, we believe that our formulation is more in line with the definition of variety seeking described in the consumer behavior literature (e.g., McAlister 1982, Kahn, Kalwani and Morrison 1986).

We can now solve for Firm A and B prices in Period 1 and Period 2 in terms of θ and δ.

$$p_1^A = p_1^B = \frac{2tb^*}{(1+\theta)}\left[1+\theta+\frac{2}{3}\delta\theta\right], \tag{13}$$

$$p_2^A = p_2^B = \frac{2tb^*}{(1+\theta)}, \tag{14}$$

where b^* (in terms of θ and δ is given by the equation 11). This leads to our second proposition:

Proposition 2 *In a symmetric duopoly, if $\theta > 0$, then $p_1^i > p^i$ and $p_2^i < p^i$ $\forall$ $i = A, B$. Also, $\frac{p_1^i+p_2^i}{2} < p^i$ $\forall$ $i = A, B$.*

Proof: See Appendix C.

This result is consistent with the notion that rear-loaded promotions may be more beneficial to the firms in a variety seeking market (Zhang, Krishna, and Dhar, 2000). In our model, even if a few customers seek variety (willingness to pay for the competing product increases in Period 2), the equilibrium prices are lower in Period 2 than prices in an identical market with no variety seeking consumers. As θ increases, prices in Period 2 decrease further. The primary reason is that firms realize that once consumers have made their purchase in Period 1, the variety seeking consumers become "attractive targets" to the competing firm. So, firms lower prices in Period 2 to decrease the attractiveness for the competitor's product and retain as many of the variety seeking consumers as possible. Based on our previous two propositions, one may wonder as to why we observe both lower differentiation and increased price competition in Period 2. The reason is that firms can increase market share by either moving closer (by lowering differentiation) or by lowering prices of their product. As one firm comes closer, its market share increases but the increased market share is coupled with an intensifying price competition. In our model, as firms have the ability to charge different prices in the next period, firms use both the mechanisms. But the extent to which firms use pricing or positioning changes to attract consumers depends on the relative impact of these two opposing forces. Note that the equilibrium location of each firm is still outside the unit interval within which consumer preferences are uniformly distributed which seems to suggest that firms use lower prices in Period 2 to a greater extent than decreasing differentiation to attract consumers.

We note that the effect of the presence of variety seeking consumers is not limited to Period 2. It also affects the firms' pricing decision in Period 1. Given that market share in Period 1 is positively correlated with own sales in Period 2 in the presence of variety seeking consumers, firms resort to lower price competition in Period 1 because firms recognize that they have the flexibility to reduce prices in Period 2. Therefore, higher prices in equilibrium are sustained in Period 1 as compared to the prices in an identical market with no variety seeking consumers. Also, as the fraction θ increases, Period 1 prices increase further. These results are represented graphically below.

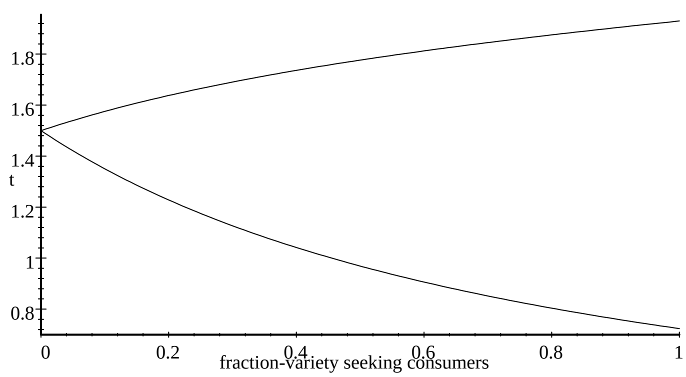

Figure 1: p_1^i (above) & p_2^i (below) as θ goes from 0 to 1 for $i = A, B$.

The price decrease in Period 2 is greater than the increased prices that firms can sustain in the market in Period 1. Therefore, the average price paid by the consumer across the two time periods is lower than in a market without variety seeking consumers. This is to be expected. When consumers exhibit less inertial tendencies (higher variety seeking), we expect firm prices to reduce.

These results are different from those obtained in previous research. In both Klemperer (1987) and Seetharaman and Che (2006), there is lower price competition in Period 2. In the models presented in these papers, firms take advantage of the fact that the first period provides an installed base of own customers and charge higher prices in Period 2.

3.2.1 Firm Profits

Another key question is what happens to firm profits and consumer surplus in the presence of variety seeking consumers. Substituting equations (13) and (14) into equation (10) and recognizing that each firm captures half of the market,

$$\pi^i_{Total} = \frac{1}{2}\left[p^i_1 + \delta p^i_2\right], \tag{15}$$

$$\pi^i_{Total} = \frac{1}{2}\frac{2tb^*}{(1+\theta)}\left[1+\theta+\delta+\frac{2}{3}\delta\theta\right]. \tag{16}$$

We show in Appendix D that π^i_{Total} is less than the profits obtained by the firm in the absence of variety seeking consumers. This leads to the following proposition:

Proposition 3 *In a symmetric duopoly, the presence of variety seeking consumers in the market, reduces firm profits and increases consumer surplus.*

Proof: See Appendix D.

From the firms perspective, the presence of variety seeking consumers reduces the market power of the firms to charge higher prices. The lower prices in Period 2 more than offset the profits gained due to higher Period 1 prices. The presence of variety seeking consumers also has a beneficial effect of increasing the aggregate consumer surplus. This increase in consumer surplus is not restricted only to the variety seeking consumers but is experienced by all consumers and therefore, the presence of variety seeking consumers in any market is valuable to even those consumers who do not seek variety.

3.2.2 Variety Seeking vs. Observed Switching

Note that θ represents the fraction of variety seeking consumers. But all consumers who seek variety do not actually purchase from different firms across the two time periods. In other words, the level of switching observed in the market might be lower than the inherent tendency among consumers to seek variety because firms can use their pricing and positioning strategies to restrict variety seeking consumers from switching.

Let θ_s represent the fraction of consumers who actually buy from two different firms across the two purchase occasions. We calculate θ_s (See Appendix E.) to be

$$\frac{\theta_s}{\theta} = \left[\frac{\ell}{t}\right]\left[1 - \frac{(27 + 33\delta\theta + 6\delta\theta^2 + 54\theta + 27\theta^2 + 27\delta - 4\delta^2\theta^2)}{(2\delta\theta + 3\theta + 3\delta + 3)\,(27 + 27\theta - 4\delta\theta^2)}\right] \tag{17}$$

This leads to our final proposition:

Proposition 4 *Not all variety seeking consumers in the market switch brands in equilibrium ($\frac{\theta_s}{\theta} \leq 1$).*

Proof: See Appendix E.

An increase in ℓ spurs more of the variety seeking consumers to become switchers. Although firms tries to prevent variety seeking consumers from switching in Period 2 by lowering prices, firms' pricing is less effective in preventing switching as ℓ increases. This leads to higher observed brand switching. We can also represent $\frac{\theta_s}{\theta}$ by the following.

$$\frac{\theta_s}{\theta} = \frac{\ell}{t\,(b^* - a^*)}, \tag{18}$$

which implies that as actual differentiation in equilibrium decreases, observed switching increases. Note that a lower t is also indicative of lower differentiation between the two firms and leads to higher observed switching. The intuition for this result is that as differentiation decreases, variety seeking consumers require a lower threshold in incremental utility to purchase from the competing firm and consequently switching increases among those who seek variety. Proposition 4 cautions that the observed switching behavior may not fully capture the inherent variety seeking tendency.

4 Summary, Limitations and Future Research

We study competitive positioning and pricing strategies in markets where consumers seek variety. Variety seeking behavior is modeled as an increase in the willingness-to-pay for the product not purchased on the previous purchase occasion. Using a three stage Hotelling type model, we show that the presence of variety seeking consumers reduces product differentiation offered in equilibrium. Furthermore, we find that the observed switching in a market may not fully capture the true magnitude of the underlying variety seeking tendencies among consumers. We also show that the presence of variety seeking consumers leads to lower firm profits and a higher consumer surplus. Another key idea presented in this paper is that in the presence of variety seeking consumers, price competition is different than what has been suggested in previous research. We show that price competition is lower in Period 1 and it is higher in Period 2 and the intensity of price competition depends on the fraction of the variety seeking consumers.

We made a number of simplifying assumptions. We assumed that consumers are not forward looking. Forward looking consumers might be able to rationally exploit the marketing tactics of firms to increase consumer surplus further. We assumed that the incremental utility that a consumer gains is independent of the previous purchase choice. We assumed symmetric firms, but in the real world firms differ in their ability to make their products more attractive to the competitor's customers. We also assumed that fraction of variety seeking consumers are exogenous to the model. There is some evidence in the literature that variety seeking tendency among consumers is affected by marketing mix variables like in-store display (Simonson and Winer 1992) or featured advertisements (Seetharaman, Ainslie and Chintagunta 1999). Relaxing these assumptions is likely to provide interesting opportunities for future research.

Magazine Name	# of issues/year	Subscription Price	Renewal Price
Reader's Digest	12	$13.62	$9.98
Children's Technology Review	12	$96.00	$64.00
Newsweek	51	$20.00	$18.99
Public Utilities Fortnightly	26	$169.00	$84.50

Table 1: Subscription and Renewal Prices[3]

[3] Subscription and renewal prices are from official websites and not from third party resellers. Excludes trial period.

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Technical Appendix

Appendix A

For $\theta = 0$, we have a two stage model. The marginal consumer is located at $\frac{p^B - p^A + b^2 - a^2}{2t(b-a)}$.
Using this, Firm A market share $= \left[\frac{1}{2} + \frac{p^B - p^A + b^2 - a^2}{2t(b-a)}\right]$ and Firm B market share $= \left[\frac{1}{2} - \frac{p^B - p^A + b^2 - a^2}{2t(b-a)}\right]$.

Firm A profits are given by $\pi^A = p^A \left[\frac{1}{2} + \frac{p^B - p^A + b^2 - a^2}{2t(b-a)}\right]$. Firm A will choose p^A to maximize profits. Therefore, $\frac{d\pi^A}{dp^A} = 0$. Similarly, $\frac{d\pi^B}{dp^B} = 0$.

Solving these simultaneously, we get

$$p^A = \frac{t}{3}\left[3(b-a) + \left(b^2 - a^2\right)\right] \tag{A.1}$$
$$p^B = \frac{t}{3}\left[3(b-a) - \left(b^2 - a^2\right)\right] \tag{A.2}$$

Substituting the equilibrium prices into the firms profit function and realizing that firms choose locations to maximize profits, we have $\frac{d\pi^A}{da} = 0$. Similarly, $\frac{d\pi^B}{da} = 0$. Solving we get, $a = -\frac{3}{4}$ and $b = \frac{3}{4}$. Substituting the equlibrium locations into (A.1) and (A.2), we get $p^A = p^B = \frac{3}{2}t$. Therefore, $\pi^A = \pi^B = \frac{3}{4}t$.

Appendix B

For $\theta > 0$, we can write the Firm A profits in Period 2 as follows:

$$\pi_2^A = \left(p_2^A\right)\left(q_2^A\right) = p_2^A\left[\frac{1}{2} + \frac{a+b}{2} + \frac{\left(p_2^B - p_2^A\right)(1+\theta)}{2t(b-a)} - \frac{\theta\left(p_1^B - p_1^A\right)}{2t(b-a)}\right] \tag{B.1}$$

Firm A will choose p_2^A to maximize Firm A profits in Period 2. Therefore, $\frac{d\pi_2^A}{dp_2^A} = 0$. Solving, we get

$$p_2^A = \frac{t(b-a)}{2(1+\theta)} + \frac{t(b^2-a^2)}{2(1+\theta)} + \frac{p_2^B}{2} - \frac{\theta\left(p_1^B - p_1^A\right)}{2(1+\theta)} \tag{B.2}$$

Similarly,

$$\pi_2^B = \left(p_2^B\right)\left(q_2^B\right) = p_2^B\left[\frac{1}{2} - \frac{a+b}{2} - \frac{\left(p_2^B - p_2^A\right)(1+\theta)}{2t\,(b-a)} + \frac{\theta\left(p_1^B - p_1^A\right)}{2t\,(b-a)}\right] \tag{B.3}$$

Firm B will choose p_2^B to maximize Firm B profits in Period 2. Therefore, $\frac{d\pi_2^B}{dp_2^B} = 0$. Solving, we get

$$p_2^B = \frac{t\,(b-a)}{2\,(1+\theta)} - \frac{t\,(b^2-a^2)}{2\,(1+\theta)} + \frac{p_2^A}{2} + \frac{\theta\left(p_1^B - p_1^A\right)}{2\,(1+\theta)} \tag{B.4}$$

Solving the expressions for p_2^A and p_2^B simultaneously, we get

$$p_2^A = \frac{t\,(b-a)}{(1+\theta)} + \frac{t\,(b^2-a^2)}{3\,(1+\theta)} - \frac{\theta\left(p_1^B - p_1^A\right)}{3\,(1+\theta)} \tag{B.5}$$

$$p_2^B = \frac{t\,(b-a)}{(1+\theta)} - \frac{t\,(b^2-a^2)}{3\,(1+\theta)} + \frac{\theta\left(p_1^B - p_1^A\right)}{3\,(1+\theta)} \tag{B.6}$$

In the first period, firms will also choose p_1^A and p_1^B to maximize total profits π_{ATotal} and π_{BTotal}.

Now,

$$\pi_{ATotal} = p_1^A\left[\frac{1}{2} + \frac{a+b}{2} + \frac{p_1^B - p_1^A}{2t\,(b-a)}\right] + \delta\pi_2^A \tag{B.7}$$

where

$$\pi_2^A = \left[\frac{t(b-a)}{(1+\theta)} + \frac{t\left(b^2-a^2\right)}{3(1+\theta)} - \frac{\theta\left(p_1^B-p_1^A\right)}{3(1+\theta)}\right]\left[\frac{1}{2} + \frac{a+b}{2} - \frac{\theta\left(p_1^B-p_1^A\right)}{2t(b-a)} + \frac{(1+\theta)}{2t(b-a)}\left(\frac{2\theta\left(p_1^B-p_1^A\right)}{3(1+\theta)} - \frac{2t\left(b^2-a^2\right)}{3(1+\theta)}\right)\right]$$

Solving, $\frac{d\pi_A}{dp_1^A} = 0$, we get

$$p_1^A = \frac{1}{2}\frac{\left(9tb+9tb\theta-9ta-9ta\theta-9ta^2-9ta^2\theta+9tb^2+9tb^2\theta+9p_1^B+9\theta p_1^B+6\delta\theta tb-6\delta\theta ta-2\delta\theta ta^2+2\delta\theta tb^2-2\delta\theta^2 p_1^B\right)}{(9+9\theta-\delta\theta^2)}$$

Similarly, solving, $\frac{d\pi_{BTotal}}{dp_1^B} = 0$, we get

$$p_1^B = \frac{1}{2}\frac{\left(9tb+9tb\theta-9ta-9ta\theta+9ta^2+9ta^2\theta-9tb^2-9tb^2\theta+6\delta\theta tb-6\delta\theta ta+9p_1^A+9\theta p_1^A-2\delta\theta^2 p_1^A+2\delta\theta ta^2-2\delta\theta tb^2\right)}{(9+9\theta-\delta\theta^2)}$$

Solving these simultaneous equations, we can get p_1^A and p_1^B in terms of a, b, θ and δ. As firms also choose locations endogenously, we also have $\frac{d\pi_{ATotal}}{da} = 0$ and $\frac{d\pi_{BTotal}}{db} = 0$.

Substituting the value of p_1^A and p_1^B and solving for the symmetric equilibrium, we get

$$b^* = \frac{1}{4} \frac{(2\delta\theta + 3\theta + 3\delta + 3)(27 + 27\theta - 4\delta\theta^2)}{(\theta + 1)(27 + 27\theta + 27\delta + 24\delta\theta - 4\delta^2\theta^2 - 6\delta\theta^2)} \quad \text{(B.8)}$$

$$a^* = -\frac{1}{4} \frac{(2\delta\theta + 3\theta + 3\delta + 3)(27 + 27\theta - 4\delta\theta^2)}{(\theta + 1)(27 + 27\theta + 27\delta + 24\delta\theta - 4\delta^2\theta^2 - 6\delta\theta^2)} \quad \text{(B.9)}$$

which can be rearranged to get equations (11) and (12).

Now

$$b^* - a^* = \frac{3}{2} - \frac{1}{2}\left(\frac{\delta\theta}{1+\theta}\right)\left[\frac{(9 + 6\theta - 2\delta\theta^2 - 3\theta^2)}{(27 + 27\theta + 27\delta + 24\delta\theta - 4\delta^2\theta^2 - 6\delta\theta^2)}\right] \quad \text{(B.10)}$$

As can be clearly seen, $(b^* - a^*) < \frac{3}{2}$ for $0 < \delta \leq 1$ and $0 < \theta \leq 1$. So equilibrium firm differentiation decreases. The variation in differentiation as the fraction of variety seeking consumers increases is represented graphically below:

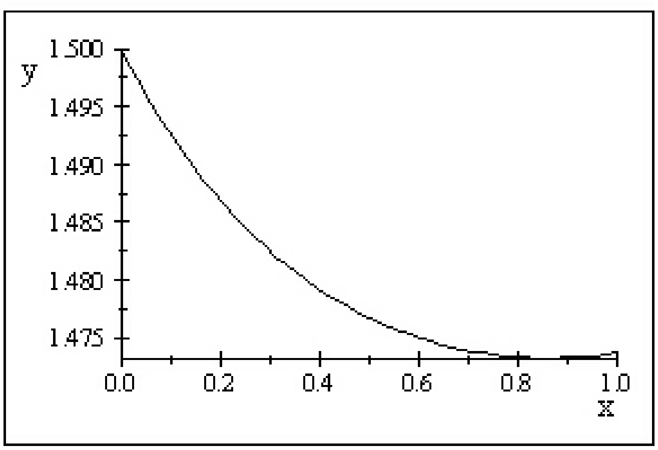

Fig 2: $(b - a)$ as a function of θ (for $\delta = 1$)

Appendix C

Substituting the equilibrium locations into the expressions for p_1^A and p_1^B we can solve for p_1^A and p_1^B in terms of θ and δ. Simplifying, we get

$$p_1^A = p_1^B = \frac{1}{6}\frac{t\left(2\delta\theta+3\theta+3\right)\left(2\delta\theta+3\theta+3\delta+3\right)\left(27+27\theta-4\delta\theta^2\right)}{\left(\theta+1\right)^2\left(27+27\theta+27\delta+24\delta\theta-4\delta^2\theta^2-6\delta\theta^2\right)} \tag{C.1}$$

We have to show that $p_1^i > p^i$ for $i = A, B$.

Now $p^i = \frac{3}{2}t$ and $p_1^i = \frac{2tb^*(2\delta\theta+3\theta+3)}{3(1+\theta)}$. We have to show that $\frac{2tb^*(2\delta\theta+3\theta+3)}{3(1+\theta)} > \frac{3}{2}t$

i.e. $b^*\left(2\delta\theta+3\theta+3\right) > \frac{9}{4}\left(1+\theta\right)$

i.e. $3\left(b^*-\frac{3}{4}\right)+3\theta\left(b^*-\frac{3}{4}\right)+b^*\left(2\delta\theta\right)$

which is always true for $0 < \delta \le 1$ and $0 < \theta \le 1$.

Similar to above, we can substitute the equilibrium locations and solve for p_2^A and p_2^B in terms of θ and δ. Simplifying, we get

$$p_2^A = p_2^B = \frac{t}{2}\frac{\left(2\delta\theta+3\theta+3\delta+3\right)\left(27+27\theta-4\delta\theta^2\right)}{\left(\theta+1\right)^2\left(27+27\theta+27\delta+24\delta\theta-4\delta^2\theta^2-6\delta\theta^2\right)} \tag{C.2}$$

We have to show that $p_2^i < p^i$ for $i = A, B$.

Now $p^i = \frac{3}{2}t$ and $p_2^i = \frac{2tb^*}{(1+\theta)}$. We have to show that $\frac{2tb^*}{(1+\theta)} < \frac{3}{2}t$.

i.e. $\left(\frac{3}{4}-b^*\right)+\frac{3}{4}\theta > 0$

which is always true for $0 < \delta \le 1$ and $0 < \theta \le 1$.

Let us now look at the average prices.

Average prices in a variety seeking market $= \frac{p_1^i+p_2^i}{2} = \frac{tb^*}{(1+\theta)}\left[2+\theta+\frac{2}{3}\delta\theta\right]$

Average prices in a market with no variety seeking $= \frac{3}{2}t$

To show that the average prices are lower in a variety seeking market, we have to show that

$$\frac{tb^*}{(1+\theta)}\left[2+\theta+\frac{2}{3}\delta\theta\right] < \frac{3}{2}t \tag{C.3}$$

i.e. $(2+\theta)\left(\frac{3}{4}-b^*\right)+\theta\left[\frac{3}{4}-\frac{2}{3}\delta b^*\right]>0$

which is always true for $0<\delta\leq 1$ and $0<\theta\leq 1$.

Appendix D

Using (10), the equilibrium firm profits in a variety seeking market is given by

$$\pi^i_{Total}=\frac{tb^*}{(1+\theta)}\left[1+\theta+\frac{2}{3}\delta\theta\right]+\delta\frac{tb^*}{(1+\theta)} \tag{D.1}$$

In a market with no variety seeking, firm profits $=\frac{3}{4}t(1+\delta)$. To show that equlibrium firm profits are lower in a variety seeking market, we have to show that

$$\frac{tb^*}{(1+\theta)}\left[1+\theta+\delta+\frac{2}{3}\delta\theta\right]<\frac{3}{4}t(1+\delta) \tag{D.2}$$

i.e. $(1+\theta+\delta)\left(\frac{3}{4}-b^*\right)+\delta\theta\left(\frac{3}{4}-\frac{2}{3}b^*\right)>0$

which is always true for $0<\delta\leq 1$ and $0<\theta\leq 1$. Also, as firm make lower profits in equilibrium, consumer surplus increases.

Appendix E

By looking at the marginal consumer, the fraction of consumers who purchase from Firm B in Period 1 and purchase from Firm A in Period 2 is given by $\theta\left(\frac{\ell+p_2^B-p_2^A}{2t(b-a)}-\frac{p_1^B-p_1^A}{2t(b-a)}\right)$. Again, by looking at the marginal consumer, the fraction of consumers who purchase from Firm A in Period 2 and purchase from Firm B in Period 2 is given by $\theta\left(\frac{\ell+p_2^B-p_2^A}{2t(b-a)}-\frac{p_1^B-p_1^A}{2t(b-a)}\right)$. Therefore the total fraction of observed switchers is given by $2\theta\left(\frac{\ell+p_2^B-p_2^A}{2t(b-a)}-\frac{p_1^B-p_1^A}{2t(b-a)}\right)$. Recognizing that $p_1^B=p_1^A$ and $p_2^B=p_2^A$ in equilibrium, we get

$$\frac{\theta_s}{\theta}=\frac{\ell}{t(b^*-a^*)} \tag{E.1}$$

Substituting, the values for the equilibrium locations and rearranging, we get (17). As $(b^*-a^*)<\frac{3}{2}$ and for $\ell<1.47t$, we will have $\frac{\theta_s}{\theta}<1$.