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Price Competition in Markets with Consumer Variety Seeking

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We investigate price competition between firms in markets characterized by consumer variety seeking. While previous research has addressed the effect of consumer inertia on prices, there exists no research on the effects of variety seeking on price competition. Our study fills this gap in the literature. Using a two-period duopoly framework as in Klemperer's analysis of inertial markets, we show that the noncooperative pricing equilibrium in a market with consumer variety seeking may be the same as the collusive outcome in an otherwise identical market without variety seeking. Specifically, our variety-seeking model implies tacit collusion between firms in *both* periods, unlike the inertia model of Klemperer that implies tacit collusion between firms only in the *second* period but implies fierce price competition in the first period. When consumers are assumed to have rational expectations about future prices, the implied first-period prices increase further, which is consistent with what Klemperer finds in an inertial market. To summarize, while our variety-seeking analyses support two key results (pertaining to second-period prices and rational expectations) previously derived for inertial markets by Klemperer, they depart from one key result (pertaining to first-period prices).

Key words: variety seeking; pricing; oligopoly; staying cost; attribute satiation
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1. Introduction

Variety seeking is a pervasive phenomenon in many markets. For example, consumers go to different restaurants from one dining occasion to the next. They go to different vacation spots from one holiday to the next and to different tourist attractions from one day to the next within a holiday spell. Consumers buy different brands of cereals on different purchasing trips at the grocery store for the same reason. These markets are said to be characterized by consumer *variety seeking*, on account of the costs incurred by consumers (due to satiation with attributes consumed in the past; see McAlister 1982) from consuming the same product on consecutive purchase occasions.

Recently, using a laboratory experiment, Ratner et al. (1999) showed that consumers alternate between more-preferred and less-preferred options in a search for variety. The actual extent of such variety seeking in a local market can be influenced, for example, by firms' product design choices. A family who eats out every Saturday may try a different ethnic menu each week (e.g., Italian, Chinese, Indian, etc.). However, even if the different restaurants offer functionally identical products (e.g., if all restaurants in the neighborhood had identical menus and quality levels), the family may still switch between the restaurants from week to week to get some subjective satisfaction from "trying something different." In other words, variety seeking can arise simply out of the consumer's *boredom* from staying with the same product from one period to the next. An experimental study in social psychology by Brickman and D'Amato (1975) explains subjects' variety seeking among alternatives using the notion of consumer boredom that sets in after exposure to a given stimulus. In another experimental study, Zuckerman (1979) develops a sensation-seeking scale (SSS) that includes a stable and reliable consumer factor called *boredom susceptibility* (BS), which measures consumer aversion for repetitive experiences of any kind. This scale has been used by consumer behaviorists to explain consumer variety seeking among familiar alternatives (see, e.g., Raju 1980). Givon (1984), in an empirical analysis of consumer variety seeking among brands, argues that change is rewarding in and of itself to the consumer, regardless of the object from which or to which one changes. Defined in this manner, *variety seeking* can be said to capture *staying costs* for the consumer, as opposed to *inertia* capturing *switching costs* as in Klemperer (1987a).

In this paper, we examine the implications of consumer variety seeking for the competitiveness of markets. Previous research has addressed the effect of consumer inertia on prices (see Klemperer 1987a, b; Wernerfelt 1991; Chintagunta and Rao 1996; Villas-Boas 2004), but there exists no research on the effects of variety seeking on price competition. Our study fills this gap in the literature. We define variety seeking in two ways: in terms of a *staying cost* that consumers incur from consuming the same product on successive purchase occasions, and in terms of changing consumer preferences for underlying product attributes.[1] Using a two-period duopoly framework, we find that variety seeking makes each individual firm's demand more inelastic in both periods and so reduces rivalry between firms. The intuition for this finding is as follows: In the first period, the market segments into two submarkets. Each submarket contains consumers who have bought from a particular firm. These consumers are, in effect, ripe targets for the competing firm in the second period on account of variety-seeking effects. The existence of this "installed base" (i.e., customers of the competing firm from the previous period) for each firm makes each firm charge higher prices in the second period than in the absence of variety-seeking effects. In the first period, firms anticipate this second-period effect, i.e., that their first-period market shares will benefit the other firm in the second period. This reduces their incentive to keep the first-period prices low, which ends up sustaining higher prices for both firms than in the absence of variety-seeking effects. Therefore, the resulting noncooperative subgame perfect equilibrium for firms' prices in the two periods ends up looking similar to the collusive equilibrium in an otherwise identical market with no variety seeking.

Interestingly, while our second-period implications are not unlike those in Klemperer's (1987a) analysis of inertial markets, our first-period implications depart importantly from those derived for inertial markets. Specifically, the inertia model of Klemperer (1987a) predicts fierce price competition in the first period that may even undo, from a profitability standpoint, the benefits of tacit collusion in the second period. In our variety-seeking model, however, firms' prices and profits increase in both periods. When consumers are assumed to have rational expectations about future prices, the implied first-period prices increase further, which is consistent with what Klemperer (1987b) finds in an inertial market (our explanation for why this finding obtained in the variety-seeking case is subtly different from that in the inertia case and will be explained later when we discuss our model). To summarize, although our variety-seeking analyses support two key results (pertaining to second-period prices and rational expectations) derived for inertial markets by Klemperer (1987a, b), they depart from one key result (pertaining to first-period prices).

Our model provides one explanation,[2] for example, for why theme parks owned by competing firms within a given tourist city such as Orlando do not compete fiercely on prices, especially during the holiday season, to draw greater traffic to their parks. The rationale for such "mutual forebearance" could be the companies' recognition that the swarm of tourists who are going to spend an extended holiday in Orlando, spanning possibly a week or more, will seek variety in their entertainment options from one day to the next.

The rest of the paper is organized as follows. In §2, we provide some background literature on the prevalence of variety seeking in consumer markets. In §3, we analyze a two-period pricing model for an undifferentiated duopoly, first analyzing the collusive nature of the equilibrium in the second period when consumers have already bought products in the first period, and then analyzing the collusive nature of the equilibrium in the first period. This model, based on the Klemperer (1987a) setup, is sufficient to illustrate firms' incentives to collude in prices when consumers seek variety between products that are functionally undifferentiated.[3] In §4, we analyze a two-period pricing model that allows the two products to be functionally differentiated, again solving for a subgame perfect equilibrium. This model, based on the Klemperer (1987b) setup, additionally shows that if we allow consumers to be rational, i.e., consumers can anticipate second-period pricing behavior conditional on first-period market shares of firms, prices in the first period turn out to be more collusive than if consumers are myopic. Concluding remarks are made in §5.

2. Background Literature on Consumer Variety Seeking

Variety seeking refers to consumers' intertemporal switching between different consumption substitutes in the absence of any change in characteristics pertaining to the consumption substitutes. Such variety-seeking behavior by consumers has been empirically

[1] The *staying cost* definition views consumer variety seeking as the opposite of consumer *inertia*. The preference-based definition views variety seeking as a consequence of consumers' *attribute satiation*. We expand on this in the next section.

[2] This is not necessarily the only explanation for this phenomenon.

[3] The motivation for variety seeking in undifferentiated products may appear to be somewhat contrived. However, the information in §3 provides an understanding of key results to help the reader move to §4, which deals with a more realistic setting of differentiated products.

documented across a wide range of consumption contexts in the consumer behavior literature (for a review of the variety-seeking literature, see Kahn 1995).

One explanation for such variety-seeking behavior, proposed by Jeuland (1978), is that prior experience with a brand decreases the consumer's utility for the brand.[4] This explanation has governed the subsequent development of a number of statistical models of variety seeking (see Givon 1984; Kahn et al. 1986; Bawa 1990; Trivedi et al. 1994; Roy et al. 1996; Seetharaman et al. 1999; Seetharaman 2003, 2004). An alternative explanation of variety-seeking behavior provided by McAlister (1982) is that consumers become satiated after exposure to some attributes and seek alternatives that offer some other attributes.[5] This explanation, unlike that of Jeuland (1978), is predictive of not only the consumer's tendency to *switch away from* the most recently consumed brand, but it is also predictive of the brand the consumer will *switch to*. This explanation has governed the subsequent development of a number of statistical models of variety seeking (see Lattin and McAlister 1985, Lattin 1987, Feinberg et al. 1992, Erdem 1996, Seetharaman and Chintagunta 1998, Che et al. 2007).

Given the widespread use of empirical models that are based on these two alternative explanations, we use them to assist in our operationalization of the variety-seeking construct in the theoretical models we develop in the ensuing sections.[6]

Taking the view of Jeuland (1978), variety seeking is operationalized as a *staying cost* incurred by a consumer from repeat purchasing a previously consumed brand. Taking the view of McAlister (1982), variety seeking is operationalized as changing consumer preferences for attributes consumed in the past. In §3, we use the staying cost operationalization only because we deal with a market for functionally undifferentiated products. In the differentiated products case, analyzed in §4, we simultaneously allow for both operationalizations, i.e., staying cost and changing consumer preferences, of variety seeking. We find that the pricing implications obtained with the staying cost operationalization of §3 are consistent with the pricing implications obtained with the changing preferences operationalization of §4 (for a study on the implications of variety seeking on front-loaded versus rear-loaded promotions, see Zhang et al. 2000).[7] It is useful to note that our model does not apply to markets where consumers seek variety *within* purchase occasions by buying portfolios of products from different firms at the same time (as in Farquhar and Rao 1976, McAlister 1979, Walsh 1995, Kim et al. 2002). Our model only applies to the *discrete choice* situation where consumers buy one unit of product at a purchase occasion but seek variety *across* purchase occasions by buying products from different firms over time. Such markets are widespread in nature and have largely been the focus of the variety-seeking literature discussed above.

3. Duopoly Pricing Model—Functionally Undifferentiated Products

Consider two firms, A and B, producing functionally undifferentiated products in a market with M consumers. We consider these M consumers' choices as well as the two firms' pricing decisions within a two-period framework. In the first period, consumers have no choice history with either firm; i.e., consumers have not bought either product in the past. However, second-period "staying costs" (on account of consumers' variety-seeking tendencies) are created for consumers on account of their first-period choices. Consumer i's utility function in period t is assumed to be as follows:

$$U_{iAt} = -p_{At} - s_i I_{iAt-1}, \tag{1}$$

$$U_{iBt} = -p_{Bt} - s_i I_{iBt-1}, \tag{2}$$

$$U_{i0t} = -r_{0i}, \tag{3}$$

where U_{ijt} stands for consumer i's ($i = 1, \ldots, M$) utility for product j ($j = A, B$) in period t ($t = 1, 2$), U_{i0t} stands for consumer i's reservation utility for the product category (i.e., utility obtained by the consumer from buying the outside good), p_{jt} stands for the price of product j in period t, I_{ijt-1} is an indicator variable that takes the value 1 if consumer i bought product j in period $t-1$ and 0 otherwise, s_i is a parameter that captures consumer i's staying cost of repeat purchasing the product he bought in the previous period,[8] and r_{0i} is a parameter that represents consumer i's reservation price in the product

[4] This explanation is consistent with the boredom explanation espoused by Brickman and D'Amato (1975), Raju (1980), and others.

[5] This explanation is consistent with single-peaked preference functions that have been uncovered in physiological psychology experiments; see Coombs and Avrunin (1977).

[6] There are other explanations for observed variety-seeking behavior of consumers, as detailed in the taxonomies developed by McAlister and Pessemier (1982) and Kahn (1995). We focus on these two explanations from the modeling standpoint for the sake of parsimony. Furthermore, these two explanations have been shown to have good empirical validity in several categories of consumer packaged goods.

[7] The modeling frameworks in §§3 and 4 resemble those in Klemperer (1987a, b) very closely.

[8] The staying cost operationalization, consistent with the variety-seeking definition of Jeuland (1978), captures the idea that a consumer's utility decreases from repeat purchasing the previously consumed brand. For a recent application of this operationalization of variety seeking, see Seetharaman et al. (1999).

category. The consumer's choice problem is to choose the alternative that maximizes his utility function. In other words,

$$I_{iAt}=1 \quad \text{iff } U_{iAt}>U_{iBt} \text{ and } U_{iAt}>U_{i0t}, \tag{4}$$

$$I_{iBt}=1 \quad \text{iff } U_{iBt}>U_{iAt} \text{ and } U_{iBt}>U_{i0t}, \tag{5}$$

$$I_{i0t}=1 \quad \text{iff } U_{i0t}>U_{iAt} \text{ and } U_{i0t}>U_{iBt}, \tag{6}$$

represent the first-order conditions of the consumer's product choice problem. We assume consumers to be heterogeneous in terms of both their staying costs s_i as well as their reservation prices r_{0i}. Specifically, we assume that $\Gamma(s)$ stands for the percentage of customers whose staying costs are $\le s$ (with $\Gamma(0)=0$), and $\gamma(s)=\partial\Gamma(s)/\partial s \ge 0$ stands for the corresponding density function of the staying costs. We assume that $h(r)$ stands for the fraction of consumers whose reservation prices are greater than or equal to r.

The two firms' single-period profit functions are assumed to be as follows:

$$\pi_{At}=p_{At}q_{At}-c_{At}, \tag{7}$$

$$\pi_{Bt}=p_{Bt}q_{Bt}-c_{Bt}, \tag{8}$$

where π_{At} (π_{Bt}) stands for firm A's (B's) profits in period t, c_{At} (c_{Bt}) stands for firm A's (B's) total cost in period t, and q_{At} (q_{Bt}) stands for firm A's (B's) demand in period t.

Under the above-mentioned primitives of utility maximization of consumers and profit maximization by firms, we will first analyze firms' pricing decisions in the second period and locate a symmetric equilibrium in a general model where variety-seeking tendencies are heterogeneously distributed across consumers. Then, we will analyze firms' pricing decisions in the first period, explicitly taking into account the dependence of firms' second-period profits on their first-period sales.

3.1. Period Two

Let σ_{A1} and σ_{B1} ($=1-\sigma_{A1}$) represent the firms' respective shares of the first-period's sales. Without loss of generality, let $p_{A2}\le p_{B2}$. Under the consumer utility primitives laid out earlier, the equilibrium sales for the two brands in period 2 can be shown to be (see also the appendix)

$$q_{A2}=\sigma_{B1}h(p_{A2})+\sigma_{A1}h(p_{B2})\Gamma(p_{B2}-p_{A2}) + \sigma_{A1}\int_{r=p_{A2}}^{p_{B2}}\Gamma(r-p_{A2})\,[-dh(r)], \tag{9}$$

$$q_{B2}=\sigma_{A1}[1-\Gamma(p_{B2}-p_{A2})]h(p_{B2}), \tag{10}$$

where firm B sells only to A's customers with staying costs $\ge (p_{B2}-p_{A2})$ and reservation prices $\ge p_{B2}$. Firm A, on the other hand, sells to all B's customers with reservation prices $\ge p_{A2}$ (the first term of Equation (9)), to its own customers with reservation prices $\ge p_{B2}$ and staying costs $\le (p_{B2}-p_{A2})$ (the second term of Equation (9)), and to its own customers with reservation prices in the range (p_{A2}, p_{B2}) and staying costs $\le (r-p_{A2})$ (the third term of Equation (9)).

Taking the second-period profit functions of firms as those yielded by plugging $t=2$ into Equations (7) and (8), and making the assumption of Bertrand price competition, firm A's first-order condition is as follows:

$$\frac{\partial\pi_{A2}}{\partial p_{A2}}=q_{A2}+\left[p_{A2}-\frac{\partial c_A}{\partial q_{A2}}\right]\frac{\partial q_{A2}}{\partial p_{A2}}=0. \tag{11}$$

Substituting from Equation (9) in Equation (11) yields

$$\sigma_{B1}h(p_{A2})+\sigma_{A1}\Gamma(p_{B2}-p_{A2})h(p_{B2}) + \sigma_{A1}\int_{r=p_{A2}}^{p_{B2}}\Gamma(r-p_{A2})\,[-dh(r)]+T=0, \tag{12}$$

where

$$T=\left(p_{A2}-\frac{\partial c_A}{\partial q_{A2}}\right)\left\{\sigma_{B1}h'(p_{A2})-\sigma_{A1}\gamma(p_{B2}-p_{A2})h(p_{B2}) + \sigma_{A1}\int_{r=p_{A2}}^{p_{B2}}-\gamma(r-p_{A2})\,[-dh(r)]\right\}.$$

At a symmetric equilibrium, $p_{A2}=p_{B2}=p$ and $\sigma_{A1}=\sigma_{B1}=\frac{1}{2}$, which implies that

$$\frac{1}{2}\left\{h(p)+\left(p-\frac{\partial c_A}{\partial q_{A2}}\right)[h'(p)-\gamma(0)h(p)]\right\}=0. \tag{13}$$

If $\gamma(0)=0$ (which represents a market where all consumers seek variety), then Equation (13) can be rewritten as

$$p-\frac{\partial c}{\partial q}=\frac{-h(p)}{h'(p)}, \tag{14}$$

where $q=2q_{A2}=h(p)$, and we have assumed that $c_A(\cdot)=c_B(\cdot)$. Equation (14) is just the first-order condition for a monopolist (or collusive oligopoly) in a market without variety seeking.

As $\gamma(0)\to\infty$ (which represents a market where no consumer seeks variety), then Equation (13) can be rewritten as

$$p-\frac{\partial c}{\partial q}=\frac{-h(p)}{h'(p)-\gamma(0)h(p)}\to 0 \quad \text{as } \gamma(0)\to\infty. \tag{15}$$

Equation (15) shows that the market price approaches the competitive price (i.e., firms' marginal cost) as we approach the case of no variety seeking.

With $\gamma(0)$ between these extreme cases, the equilibrium is between the competitive and collusive equilibrium given above. Therefore, in a symmetric pure strategy equilibrium, the only information about the distribution of variety seeking in the market that matters is the density of consumers who do not seek

variety, $\gamma(0)$. These are the marginal consumers who are sensitive to a small deviation in one firm's price from its competitor's price.[9]

3.2. Period One

Firm A chooses its first-period price p_{A1} to maximize its total discounted future profits,

$$\pi_A = \pi_{A1}(p_{A1}, p_{B1}) + \lambda\pi_{A2}[\sigma_{B1}(p_{A1}, p_{B1})], \tag{16}$$

taking B's first-period price p_{B1} as given. Under the Bertrand pricing equilibrium, firm A's first-order condition is given by

$$\frac{\partial \pi_A}{\partial p_{A1}} = \frac{\partial \pi_{A1}}{\partial p_{A1}} + \lambda \frac{\partial \pi_{A2}}{\partial p_{A1}} = 0, \tag{17}$$

which can be rewritten as

$$\frac{\partial \pi_{A1}}{\partial p_{A1}} + \lambda \frac{\partial \pi_{A2}}{\partial \sigma_{B1}} \frac{\partial \sigma_{B1}}{\partial p_{A1}} = 0. \tag{18}$$

In the above equation, because $\partial\sigma_{B1}/\partial p_{A1} > 0$ and the second-period analysis shows that $\partial\pi_{A2}/\partial\sigma_{B1} > 0$, it must follow that $\partial\pi_{A1}/\partial p_{A1} < 0$. Because a lower market share makes the firm better off in the second period, firms A and B choose their first-period price higher than that which maximizes first-period profits given the opponent's behavior. In other words, in the presence of consumer variety seeking, firms price higher than Nash-Bertrand in the first period to lose market share that will be valuable to them in the second period. On average, firms end up with no less market share as a result of this behavior. Because they price higher, their first-period profits increase (to collusive levels)!

This shows that the existence of consumer variety seeking leads to monopoly rents not only in a mature market but also in the early stages of the market's development. Next, we derive the implications of variety seeking in a differentiated products market.

4. Duopoly Pricing Model—Functionally Differentiated Products

Consider two firms, A and B, producing functionally differentiated (i.e., differentiated by attributes) products, represented as end points of a Hotelling line of length L, in a market with M consumers. We consider these M consumers' choices as well as the two firms' pricing decisions within a two-period framework. Consumer i's utility function in period t is assumed to be as follows:

$$U_{iAt} = -p_{At} - x_{it} - s_i I_{iAt-1}, \tag{19}$$

$$U_{iBt} = -p_{Bt} - (L - x_{it}) - s_i I_{iBt-1}, \tag{20}$$

$$U_{i0t} = -r_{0i}, \tag{21}$$

where x_{it} stands for the distance of consumer i's ($i = 1, \ldots, M$) (possibly time-varying) ideal point in period t ($t = 1, 2$) from the position of product A on the Hotelling line (which makes $L - x_{it}$ the distance of consumer i's ideal point in period t from the position of product B), and the remaining variables are as explained under Equations (1)–(3). The consumer's choice problem is one of choosing the alternative that maximizes his utility function, as in Equations (4)–(6). We assume that there are three discrete consumer types among the M consumers in the market, where each type's ideal points x_{it} are uniformly distributed on the Hotelling line of length L: (1) A fraction ν that enters the product market during a given period and leaves the market at the end of the period; (2) a fraction μ that stays in the market during both periods but whose tastes for product attributes in the second period are independent of tastes in the first period, i.e., the second-period location x_{i2} is independent of the first-period location x_{i1}; and (3) a fraction $(1 - \nu - \mu)$ who stay in the market during both periods, but have perfectly changing tastes for the underlying product characteristics in the sense that a consumer located at x_{i1} in the first period is located at $(L - x_{i1})$ in the second period. In other words, this fraction's second-period tastes are "mirror images" of its first-period tastes.[10] Which of the above three types a consumer belongs to is assumed to be independent of the consumer's position along $(0, L)$ in the first period, unaffected by the consumer's first-period decision, and unknown to the consumer until after the consumer's first-period purchase. Further, we assume that all consumers have the same reservation price and staying cost; i.e., $r_i = r \ \forall\, i = 1, \ldots, M$ and $s_i = s \ \forall\, i = 1, \ldots, M$.[11]

The two firms' single-period profit functions are assumed to be as in Equations (7) and (8), with the additional assumptions that there are no fixed costs and both firms have the same marginal cost c. In other words, $c_{At} = cq_{At}$ and $c_{Bt} = cq_{Bt}$. Both firms and consumers are assumed to have rational expectations

[9] We provide more discussion on the solution and uniqueness of the symmetric pure strategy equilibrium in the Technical Appendix, which can be found at http://mktsci.pubs.informs.org.

[10] This operationalization of changing consumer preferences for attributes is consistent with the variety-seeking definition of McAlister (1982) and captures the idea that a consumer satiates on attribute consumption and shifts preferences toward attributes untried in the previous consumption occasion.

[11] It is useful to note that in the market without variety seeking, $\nu = 1$, $\mu = 0$.

and discount second-period revenues and costs by a factor λ in first-period terms. They cannot store the product between periods. In first-period equilibrium, all consumers to the left of $\sigma_{A1}L$ buy from A and all those to the right buy from B, so that the outcome of the first period is fully captured by the firms' market shares.

4.1. Period Two

The equilibrium sales for the two brands in the second period can be derived by adding up the equilibrium sales from the three consumer types, as shown below.[12]

1. Among the fraction ν of second-period consumers who were not in the market in the first period, a consumer at x_{i2} buys from A if $p_{A2} + x_{i2} < p_{B2} + (L - x_{i2})$ and $p_{A2} + x_{i2} \le r$. Thus, A sells to a mass $\nu((L + p_{B2} - p_{A2})/2)$ of the new consumers, provided that $r \ge ((L + p_{B2} + p_{A2})/2)$, which condition ensures that the marginal consumer prefers buying from A to not buying at all, and provided that $|p_{B2} - p_{A2}| \le L$. If $(p_{B2} - p_{A2}) > L$, A sells to all of the new consumers; if $(p_{B2} - p_{A2}) < -L$, A sells to none of them.

2. Among the fraction μ of second-period consumers whose tastes have changed from the first period, a subfraction $\mu\sigma_{A1}$ have bought from A in the first period and a subfraction $\mu\sigma_{B1}$ have bought from B in the first period. Both of these subfractions have consumers whose second-period tastes are uniformly distributed along the line segment $(0, L)$. Let us consider the first subfraction. Among these $\mu\sigma_{A1}$ consumers, A sells to a mass $\mu\sigma_{A1}((L + p_{B2} - p_{A2} - s)/2)$ provided $r \ge ((s + L + p_{B2} + p_{A2})/2)$ so that the marginal consumer buys from some firm and provided $|p_{B2} - p_{A2} - s| \le L$. If $(p_{B2} - p_{A2} - s) > L$, A sells to all of this subfraction of consumers; if $(p_{B2} - p_{A2} - s) < -L$, A sells to none of them. Now let us consider the second subfraction. Among these $\mu\sigma_{B1}$ consumers, A sells to a mass $\mu\sigma_{B1}((L + p_{B2} - p_{A2} + s)/2)$ provided $r \ge ((s + L + p_{B2} + p_{A2})/2)$ so that the marginal consumer buys from some firm and provided $|p_{B2} - p_{A2} + s| \le L$. If $(p_{B2} - p_{A2} + s) > L$, A sells to all of this subfraction of consumers; if $(p_{B2} - p_{A2} + s) < -L$, A sells to none of them.

3. Within the fraction $(1 - \nu - \mu)$ of consumers whose tastes have changed from the first period, a subfraction $(1 - \nu - \mu)\sigma_{A1}$ have bought from A in the first period and a subfraction $(1 - \nu - \mu)\sigma_{B1}$ have bought from B in the first period. The first subfraction's tastes are uniformly distributed along $(0, \sigma_{A1}L)$, while the second subfraction's tastes are uniformly distributed along $(\sigma_{B1}L, L)$. All of the first subfraction will purchase from B if $p_{A2} + \sigma_{A1}L + s \ge p_{B2} + \sigma_{B1}L$ and $p_{B2} + \sigma_{B1}L \le r$, while all of the second subfraction will purchase from A provided $p_{A2} + \sigma_{A1}L \le p_{B2} + \sigma_{B1}L + s$ and $p_{A2} + \sigma_{A1}L \le r$.[13]

Adding up demand from the three groups, as derived above, A's total second-period sales are

$$q_{A2} = \nu\left(\frac{L + p_{B2} - p_{A2}}{2}\right) + \mu\left[\sigma_{A1}\left(\frac{L + p_{B2} - p_{A2} - s}{2}\right) + \sigma_{B1}\left(\frac{L + p_{B2} - p_{A2} + s}{2}\right)\right] + (1 - \nu - \mu)\sigma_{B1}$$

provided that $r \ge (p_{A2} + p_{B2} + L + 2s)/2$ and $|(p_{A2} + \sigma_{A1}L) - (p_{B2} + \sigma_{B1}L)| \le s \le L - |p_{B2} - p_{A2}|$. This equation can be simplified to

$$q_{A2} = \tfrac{1}{2}\{(\sigma_{B1} - \sigma_{A1})[(1 - \nu - \mu)L + \mu s] + L + (\nu + \mu)(p_{B2} - p_{A2})\}. \quad (22)$$

B's total second-period sales can be symmetrically derived.

It follows that

$$\frac{\partial q_{A2}}{\partial p_{A2}} = -\frac{\nu + \mu}{2}, \quad (23)$$

$$\frac{\partial \pi_{A2}}{\partial p_{A2}} = \frac{1}{2}\{(\sigma_{B1} - \sigma_{A1})[(1 - \nu - \mu)L + \mu s] + L + (\nu + \mu)(p_{B2} - 2p_{A2} + c)\}. \quad (24)$$

In equilibrium, $\partial \pi_{A2}/\partial p_{A2} = 0$, which yields (as long as $\mu + \nu \ne 0$):

$$p_{A2} = c + \frac{1}{\nu + \mu}\left\{L + \frac{1}{3}(2\sigma_{B1} - 1)[(1 - \nu - \mu)L + \mu s]\right\}, \quad (25)$$

$$q_{A2} = \frac{1}{2}\left\{L + \frac{1}{3}(2\sigma_{B1} - 1)[(1 - \nu - \mu)L + \mu s]\right\}, \quad (26)$$

$$\pi_{A2} = \frac{1}{2(\nu + \mu)}\left\{L + \frac{1}{3}(2\sigma_{B1} - 1)[(1 - \nu - \mu)L + \mu s]\right\}^2. \quad (27)$$

The equilibrium for B is symmetric provided that the conditions for Equation (22) are satisfied and provided that the first-order conditions specify firms' global best responses. Equations (25)–(27) define the unique symmetric pure strategy equilibrium provided that $|\sigma_{A1} - \sigma_{B1}| < s/L$.

Note that the firm with the *lower* market share charges the *higher* price. The reason is that on account of exploiting the larger number of variety-seeking brand switchers from its higher-share rival, it is less interested in attracting new customers than its rival,

[12] The following presentation is closely adapted from Klemperer (1987b) because of its expositional clarity.

[13] The fact that consumers do not know before their first-period purchase whether their tastes for the underlying product characteristics will change or whether they will leave the market guarantees that in the first period all consumers to the left of $\sigma_{A1}L$ buy from A, while all those to the right buy from B, for some $\sigma_{A1} \in [0, 1]$.

Table 1 Equilibrium Solutions Under the Differentiated Products Model

	First-period equilibrium prices	Second-period equilibrium prices	Total profits
No variety seeking	$c+L$	$c+L$	$\frac{L^2}{2}(1+\lambda)$
Naïve expectation	$c+L+\frac{2\lambda}{3(\nu+\mu)}\{(1-\nu-\mu)L+\mu s\}$	$c+\frac{L}{\nu+\mu}$	$\frac{L^2}{2}\left\{1+\frac{\lambda}{\nu+\mu}+\frac{2\lambda}{3(\nu+\mu)}\left[(1-\nu-\mu)+\frac{\mu s}{L}\right]\right\}$
Rational expectation	$c+Ly+\frac{2\lambda}{3(\nu+\mu)}\{(1-\nu-\mu)L+\mu s\}$	$c+\frac{L}{\nu+\mu}$	$\frac{L^2}{2}\left\{y+\frac{\lambda}{\nu+\mu}+\frac{2\lambda}{3(\nu+\mu)}\left[(1-\nu-\mu)+\frac{\mu s}{L}\right]\right\}$

Note. $y=1+\lambda\{(1-\nu-\mu)+(2/3(\nu+\mu))[(1-\nu-\mu)+\mu s/L]^2\}\geq 1$.

which has to charge a lower price to regain the market share that it is losing on account of variety-seeking effects.

In a symmetric equilibrium, $\sigma_{A1}=\sigma_{B1}=\frac{1}{2}$, so that we can rewrite Equations (25)–(27) as follows:

$$p_{A2}=c+\frac{L}{\nu+\mu}, \tag{28}$$

$$q_{A2}=\frac{L}{2}, \tag{29}$$

$$\pi_{A2}=\frac{L^2}{2(\nu+\mu)}. \tag{30}$$

It is easy to ascertain that total industry profits and the average price paid by consumers are higher in the second period of a market with variety seeking than in a market without variety seeking. In a symmetric equilibrium, the profits and prices of both firms are higher than in a market without variety seeking (by setting $\nu=1,\mu=0$). In general, it can be shown that the pricing outcomes lie between the collusive (joint profit-maximizing) and the competitive (no variety-seeking) outcomes. The higher the degree of variety seeking in the market, the more sensitive each firm's profit is to the market share of the other firm.

4.2. Period One

Firm A chooses its first-period price p_{A1} to maximize its total discounted future profits, as shown in Equation (16), while taking B's first-period price as given. Under Bertrand pricing equilibrium, firm A's first-order condition is given by Equation (18). Because $\partial\sigma_{B1}/\partial p_{A1}>0$ and we know from §4.1 that $\partial\pi_{A2}/\partial\sigma_{B1}>0$, it follows that $\partial\pi_{A1}/\partial p_{A1}<0$. Therefore, both A and B choose higher first-period prices than those that would maximize first-period profits given the opponent's behavior. Because the opponent's market share is valuable in the future period, each firm prices higher than it would otherwise to increase its competitor's market share.

Using Equations (16) and (27), we may write

$$\pi_A(p_{A1},p_{B1})=(p_{A1}-c)L\sigma_{A1}(p_{A1},p_{B1})+\frac{\lambda}{2(\nu+\mu)}\cdot\left\{L+\frac{[2\sigma_{B1}(p_{A1},p_{B1})-1][(1-\nu-\mu)L+\mu s]}{3}\right\}^2.$$

The form of consumer expectations determines how market shares depend on first-period prices. We make two alternative assumptions about consumer expectations: (1) "naïve expectations," in which consumers do not take expected second-period prices into account when making their first-period choices, and (2) "rational expectations," in which consumers take expected second-period prices into account when making their first-period choices. The results of these analyses are summarized in Table 1 (and the details are provided in the Technical Appendix, which can be found at http://mktsci.pubs.informs.org).

We find that under both assumptions, the first period of a market with variety seeking is more collusive than that of a market without variety seeking. More interestingly, we find that the first period is even more collusive in the rational expectations case than in the naïve expectations case (since $y\geq 1$; see Table 1).[14] Our interpretation of this finding is that rational (foresighted) consumers recognize that they will be partially locked in to their untried supplier in the second period, and they therefore must predict second-period prices when making their first-period purchase decisions. From Equation (25), they know that $\partial p_{A2}/\partial\sigma_{B1}>0$ and $\partial p_{B2}/\partial\sigma_{A1}>0$, so that a price cut that increases a firm's first-period market share also foretells a second-period price increase by the competing brand (to which a variety-seeking consumer is likely to switch in a search for variety).

[14] Under some circumstances, first-period prices may be even higher than second-period prices (for example, consider the special case when $\nu+\mu=1$)!

In this manner, because consumers' rational expectations make them realize that they may be "captive" to the untried product in the second period, they end up being less attracted by a price cut in the first period. This increases the firms' ability to collude in the first period. Naïve consumers, on the other hand, do not think about the future consequences of their current actions and, therefore, are more price elastic than rational consumers.

Interestingly, our result that the first period is even more collusive in the rational expectations case is consistent with the result in Klemperer (1987b). In other words, regardless of whether the market is inertial or variety seeking, the first period is found to be more collusive under rational expectations than under naïve expectations.

5. Conclusions

We investigate price competition between firms in markets characterized by consumer variety seeking. Whereas previous research has addressed the effect of consumer inertia on prices, there exists no research on the effects of variety seeking on price competition. Our study fills this gap in the literature. In this paper, we study the pricing implications of consumer variety seeking in a duopoly using a two-period model. We find that prices in both periods are higher than those in an otherwise identical market without variety seeking. Because firms' second-period profits depend on their competitors' first-period sales, firms price higher in the first period than if they were simply maximizing first-period profits. This provides an explanation for the high prices observed in some markets where consumers seek variety, such as for admission prices for tourist attractions within a tourist city such as Orlando. Our study also informs firms that understanding the extent of variety-seeking behavior in markets is important from the standpoint of better price setting for their products. A naïve managerial takeaway from observing a lot of consumer switching behavior within a product category may be to *lower* prices on one's brand to influence consumer switching behavior toward one's brand. However, our analysis suggests that the recognition that consumer switching behavior arises on account of variety-seeking tendencies of consumers will lead a brand manager in a duopoly to realize that a competitor's temporary price promotion (i.e., price cut), while attracting large market share for their brand during the promotion period, will favor one's brand in the following period (on account of consumers' search for variety within the product category) even if one's brand is higher priced. This will tacitly sustain high prices for both firms in the long run and will lead to a "win-win" profit situation.

Our pricing implications are similar to those obtained under the inertia model of Klemperer (1987a, b) in that both models predict tacit collusion in the second period. At the same time, our pricing implications differ importantly from those obtained under the inertia model of Klemperer (1987a, b) in that our model predicts collusion also in the first period, while the inertia model predicts fierce price competition in the first period (which may even undo the benefits of collusion in the second period). This result is obtained regardless of whether consumers are allowed to have naïve or rational expectations about the future. Interestingly, we find that under the rational expectations case, consumers' realization that firms have an incentive to tacitly collude in the second period makes demand less elastic in the first period and ends up sustaining greater collusion in the first period. This effect of rational expectations increasing first-period prices is consistent with those documented by Klemperer (1987b) for inertial markets (however, our explanation for obtaining this result in the variety-seeking case is subtly different from that provided in the inertia case). To summarize, therefore, whereas our variety-seeking analyses support two key results (pertaining to second-period prices and rational expectations) derived for inertial markets by Klemperer (1987a, b), they depart from one key result (pertaining to first-period prices).

There are some interesting directions for future research. First, we assume that variety-seeking behavior is exogenous in our model. However, there is some experimental evidence indicating that consumer variety-seeking behavior can be influenced by marketing variables such as in-store displays (Simonson and Winer 1992). It will be interesting to investigate optimal pricing strategies of firms if firms' prices influence the consumers' staying costs or preferences (for a treatment of endogenous switching costs in the inertia case, see Caminal and Matutes 1990). Second, it is possible that the rampant extending of product lines undertaken by manufacturers in various consumer packaged goods categories—such as cereals and cookies—over the past couple of decades may have artificially increased variety-seeking tendencies of consumers in the marketplace. Therefore, it will be useful to jointly endogenize consumers' variety-seeking behavior as well as firms' product line decisions within a theoretical framework to investigate normative prescriptions for firms' product line decisions. Third, it will be interesting to study the incentives for competing firms in variety-seeking markets to behaviorally price discriminate between segments of existing and new customers (as in Acquisiti and Varian 2005) or among individual consumers based on their underlying brand preferences (as in Chen and

Iyer 2002). Fourth, understanding the effects of consumers' contemporaneous (as opposed to intertemporal) variety seeking among multiple brands, as in Guo (2006), on firm pricing would be a challenging area for future research. Fifth, it would be useful to extend our analyses to a multiperiod framework, as in Klemperer (1995), and to an infinite-period framework, as in Beggs and Klemperer (1992), while also allowing for the arrival of new consumers into the market and the departure of old consumers from the market.

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Appendix

The demand functions of firms A and B under the undifferentiated products model can be derived as follows (assuming the utility primitives given in Equations (1)–(6)):

$$\begin{aligned} q_{A2} &= \sigma_{B1} \cdot \Pr(\text{Buy A in Period 2} \mid \text{Buy B in Period 1}) \\ &\quad + \sigma_{A1} \cdot \Pr(\text{Buy A in Period 2} \mid \text{Buy A in Period 1}) \\ &= \sigma_{B1} \cdot \mathrm{I} + \sigma_{A1} \cdot \mathrm{II}, \end{aligned}$$

where

$$\begin{aligned} \mathrm{I} &= \int_0^\infty \int_0^\infty \Pr(-p_{A2} > -p_{B2} - s_i, -p_{A2} > -r_i)\, ds_i\, dr_i \\ &= \int_0^\infty \int_0^\infty \Pr(p_{A2} < p_{B2}, p_{A2} < r_i)\, ds_i\, dr_i \\ &= \int_0^\infty \Pr(p_{A2} < r_i)\, dr_i \quad \text{because } p_{A2} < p_{B2} \text{ by definition} \\ &= h(p_{A2}) \end{aligned}$$

and

$$\begin{aligned} \mathrm{II} &= \int_{p_{B2}}^\infty \int_0^\infty \Pr(-p_{A2} - s_i > -p_{B2}, -p_{A2} - s_i > -r_i)\, ds_i\, dr_i \\ &\quad + \int_{p_{A2}}^{p_{B2}} \int_0^\infty \Pr(-p_{A2} - s_i > -p_{B2}, -p_{A2} - s_i > -r_i)\, ds_i\, dr_i \\ &= \int_{p_{B2}}^\infty \int_0^\infty \Pr(s_i < p_{B2} - p_{A2}, s_i < r_i - p_{A2})\, ds_i\, dr_i \\ &\quad + \int_{p_{A2}}^{p_{B2}} \int_0^\infty \Pr(s_i < p_{B2} - p_{A2}, s_i < r_i - p_{A2})\, ds_i\, dr_i \\ &= \int_{p_{B2}}^\infty \int_0^\infty \Pr(s_i < p_{B2} - p_{A2})\, ds_i\, dr_i \\ &\quad + \int_{p_{A2}}^{p_{B2}} \int_0^\infty \Pr(s_i < r_i - p_{A2})\, ds_i\, dr_i \\ &= h(p_{B2})\Gamma(p_{B2} - p_{A2}) + \int_{r=p_{A2}}^{p_{B2}} \Gamma(r - p_{A2})\,[-dh(r)]; \end{aligned}$$

therefore, the demand functions are

$$\begin{aligned} q_{A2} &= \sigma_{B1} h(p_{A2}) + \sigma_{A1} h(p_{B2})\Gamma(p_{B2} - p_{A2}) \\ &\quad + \sigma_{A1} \int_{r=p_{A2}}^{p_{B2}} \Gamma(r - p_{A2})\,[-dh(r)], \\ q_{B2} &= \sigma_{A1}[1 - \Gamma(p_{B2} - p_{A2})]h(p_{B2}). \end{aligned}$$

References

Acquisiti, A., H. R. Varian. 2005. Conditioning prices on purchase history. *Marketing Sci.* **24**(3) 367–381.

Bawa, K. 1990. Modeling inertia and variety seeking tendencies in brand choice behavior. *Marketing Sci.* **9**(3) 263–278.

Beggs, A., P. Klemperer. 1992. Multi-period competition with switching costs. *Econometrica* **60**(3) 651–666.

Brickman, P., B. D'Amato. 1975. Exposure effects in a free-choice situation. *J. Personality Soc. Psych.* **32**(3) 415–420.

Caminal, R., C. Matutes. 1990. Endogenous switching costs in a duopoly model. *Internat. J. Indust. Organ.* **8** 353–373.

Che, H., K. Sudhir, P. B. Seetharaman. 2007. Bounded rationality in pricing under state dependent demand: Do firms look ahead? How far ahead? *J. Marketing Res.* **44**(3) 434–449.

Chen, Y., G. Iyer. 2002. Consumer addressability and customized pricing. *Marketing Sci.* **21**(2) 197–208.

Chintagunta, P. K., V. R. Rao. 1996. Pricing strategies in a dynamic duopoly: A differential game model. *Management Sci.* **42**(11) 1501–1514.

Coombs, C. H., G. S. Avrunin. 1977. Single-peaked functions and theory of preference. *Psych. Rev.* **84** 216–230.

Erdem, T. 1996. A dynamic analysis of market structure based on panel data. *Marketing Sci.* **15**(4) 359–378.

Farquhar, P. H., V. R. Rao. 1976. A balance model for evaluating subsets of multi-attributed items. *Management Sci.* **5**(5) 528–539.

Feinberg, F. M., B. E. Kahn, L. McAlister. 1992. Market share response when consumers seek variety. *J. Marketing Res.* **29**(2) 227–237.

Givon, M. 1984. Variety seeking through brand switching. *Marketing Sci.* **3**(1) 1–21.

Guo, L. 2006. Consumption flexibility, product configuration, and market competition. *Marketing Sci.* **25**(2) 116–130.

Jeuland, A. P. 1978. Brand preference over time: A partially deterministic operationalization of the notion of variety seeking. S. Jain, ed. *Research Frontiers in Marketing: Dialogues and Directions, 43, AMA 1978 Educators' Proceedings*. American Marketing Association, Chicago.

Kahn, B. E. 1995. Consumer variety-seeking among goods and services. *J. Retailing Consumer Services* **2**(3) 139–148.

Kahn, B. E., M. U. Kalwani, D. G. Morrison. 1986. Measuring variety-seeking and reinforcement behaviors using panel data. *J. Marketing Res.* **23**(2) 89–100.

Kim, J., G. M. Allenby, P. E. Rossi. 2002. Modeling consumer demand for variety. *Marketing Sci.* **21**(3) 229–250.

Klemperer, P. 1987a. Markets with consumer switching costs. *Quart. J. Econom.* **102**(1) 375–394.

Klemperer, P. 1987b. The competitiveness of markets with switching costs. *RAND J. Econom.* **18**(1) 138–150.

Klemperer, P. 1995. Competition when consumers have switching costs: An overview with applications to industrial organization, macroeconomics, and international trade. *Rev. Econom. Stud.* **62**(213) 515–539.

Lattin, J. M. 1987. A model of balanced choice behavior. *Marketing Sci.* **6**(1) 48–65.

Lattin, J. M., L. McAlister. 1985. Using a variety-seeking model to identify substitute and complementary relationships among competing products. *J. Marketing Res.* **22**(4) 330–339.

McAlister, L. 1979. Choosing multiple items from a product class. *J. Consumer Res.* **9**(3) 141–150.

McAlister, L. 1982. A dynamic attribute satiation model of variety-seeking behavior. *J. Consumer Res.* **6**(4) 213–224.

McAlister, L., E. Pessemier. 1982. Variety-seeking behavior: An interdisciplinary review. *J. Consumer Res.* **9**(3) 311–322.

Raju, P. S. 1980. Optimal stimulation level: Its relationship to personality, demographics and exploratory behavior. *J. Consumer Res.* **7**(4) 272–282.

Ratner, R. K., B. E. Kahn, D. Kahneman. 1999. Choosing less-preferred experiences for the sake of variety. *J. Consumer Res.* **26**(1) 1–15.

Roy, R., P. K. Chintagunta, S. Haldar. 1996. A framework for investigating habits, the hand of the past and heterogeneity in dynamic brand choice. *Marketing Sci.* **15**(3) 280–299.

Seetharaman, P. B. 2003. Probabilistic versus random utility models of state dependence: An empirical comparison. *Internat. J. Res. Marketing* **20**(1) 87–96.

Seetharaman, P. B. 2004. Modeling multiple sources of state dependence in random utility models: A distributed lag approach. *Marketing Sci.* **23**(2) 263–271.

Seetharaman, P. B., P. K. Chintagunta. 1998. A model of inertia and variety seeking with marketing variables. *Internat. J. Res. Marketing* **15**(1) 1–17.

Seetharaman, P. B., A. Ainslie, P. K. Chintagunta. 1999. Investigating household state dependence effects across categories. *J. Marketing Res.* **36**(4) 488–500.

Simonson, I., R. S. Winer. 1992. The influence of purchase quantity and display format on consumer preference for variety. *J. Consumer Res.* **19**(2) 133–138.

Trivedi, M., F. M. Bass, R. C. Rao. 1994. A model of stochastic variety-seeking. *Marketing Sci.* **13**(3) 274–297.

Villas-Boas, J. M. 2004. Consumer learning, brand loyalty and competition. *Marketing Sci.* **23**(1) 134–145.

Walsh, J. W. 1995. Flexibility in consumer purchasing for uncertain future tastes. *Marketing Sci.* **14**(2) 148–165.

Wernerfelt, B. 1991. Brand loyalty and market equilibrium. *Marketing Sci.* **10**(3) 229–245.

Zhang, Z. J., A. Krishna, S. K. Dhar. 2000. The optimal choice of promotion vehicles: Front-loaded or rear-loaded incentives? *Management Sci.* **46**(3) 348–362.

Zuckerman, M. 1979. *Sensation Seeking: Beyond the Optimal Level of Arousal*. Lawrence Erlbaum, Hillsdale, NJ.