Preference for Variety: A Representation Theorem and Implications for Industrial Organization

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April 10, 2009

Abstract

This paper considers an agent who enjoys choosing from a large and diverse menu. We distinguish this preference for variety from preference for flexibility Kreps (1979), which also leads decision makers to prefer large menus, and discuss evidence for the enjoyment of menu options which are never consumed. Implications for the behavior of retailers and for the choice of product-line length are derived.

1. Introduction

Suppose a decision maker (DM) lives in a town with two movie theaters where three different movies (a, b, c) are showing. Movies a and b are blockbusters while c is a documentary so that most moviegoers prefer a or b to c: $\{a\} \succ \{c\}, \{b\} \succ \{c\}$. Theater 1 offers only one movie (a or b), while Theater 2 offers two movies at a time. Standard economic theory predicts that demand for each of the three movies offered in town does not depend on which theater it is shown at. However, if movie goers enjoy choosing from a varied billboard then it may be that the most popular movie in town is that which is shown in Theater 2. A good like c, which is never chosen but attracts consumers to a venue, is called a *lure* in the psychology literature (e.g. Brown, Read, and Summers 2003).

In this paper we derive a utility representation for a decision maker (henceforth referred to as DM) who enjoys choosing from a diverse menu of alternatives. DM must choose a menu of alternatives from which, at a later time, he will choose the alternative he will consume. If DM enjoys contemplating options in the menu from which he will choose, he will naturally prefer menus with more options. Note, however, that DM does not prefer larger menus because he is uncertain about his future tastes, as would an individual with preference for flexibility (Kreps 1979). Rather, he *savors* the options he will not choose. In our opening example, offering movie c had an effect on people's choices even though it was never chosen. This type of behavior, and its economic consequences, has been little studied by economists. Yet there is plentiful evidence, which we discuss in section 2, which suggests that humans enjoy the presence of alternatives in their choice set even if they are not chosen.

In Section 4 we analyze the consequences for market structure of having consumers with *savoring* preferences. First, we analyze competition when costs of transportation for consumers are zero, and find that price will reflect how strong consumer's preferences for variety are. In the second part we analyze symmetric equilibria of a spatial model of competition with positive transportation costs. The degree of preference for variety has no effect on price, but the number of retailers in the market has a negative relation with variety provided.

2. Evidence

In an article aptly named "The Lure of Choice," Brown, Read, and Summers (2003) conduct a series of experiments which study the effect of the presence of alternatives which are clearly inferior on choice behavior. In their most intriguing set-up, participants were asked to choose a table at a (imaginary) casino at which to gamble their last token. Each table offered a lottery with expected value of \$22.50, although these differed in their chance of winning and prize money. Only one table, however, also had a 'lure' which was a lottery with expected value of only \$18.75. The lure was moved from one table to the other so half of the participants faced choice conditions in which the lure was on table A, and for the other half the lure was on table B. After participants had chosen a table, they were asked to select the lottery they would like to play. The presence of the lure significantly increased the number of people who chose the table on which it was placed, while the lure itself was almost never the final choice.

Additionally, there is evidence that placing a *decoy* product, which is not meant to be sold, alongside a featured product can lead to increased demand (Huber, Payne and Puto 1982). While the mainstream explanation for this in the Psychology literature is that the decoy highlights the virtues of the featured product for the consumer, the evidence itself is also consistent with a savoring preferences interpretation.

According to Shiv and Huber (2000), when anticipating satisfaction "the consumer vicariously experiences the satisfaction of consuming a product prior to actual consumption" (p.203). It has been shown that consumers use imagery and representation when they choose among products. In this paper we assume that also holds when consumers are choosing among stores, so before going to a store the DM anticipates that he will have a good time imagining himself using each of the products available.

In the consumer behavior literature, Oppewal and Koelemeijer (2005) found that, even when the favorite product is always available, evaluations of assortment increase with its size. This suggests that the utility of the set is not the utility of its best element, as standard Economic Theory would predict. Furthermore, they found that increased variety of more important attributes increases assortment evaluation more than on less important attributes. This suggests that variety is valued in a way consistent with the way products are valued for consumption.

Boatwright and Nunes (2001) find that cutting items in stores has no negative consequences on profits if and only if the items that are eliminated from it are "repeated" or very similar to others in their characteristics. This suggests that variety is valuable to consumers, while sheer quantity is not.

Richards and Hamilton (2006) find that increasing variety is a strategy used by supermarket retailers to attract consumers and gain market share. They found that variety is positively related to price, a result consistent with our results on market structure in section 3.

In the literature on product line length, where they interpret brands as consideration sets, a series of papers (Draganska and Jain (2003), for yogurt, Kekfre and Srinivasan (1990) for a wide range of industries, and Bayus and Putsis (1999) for computers) find a positive correlation between product line length and market share and argue for causality. Our model can explain the correlation between market share and product line length through market structure parameters rather than causality.

Additionally, there is evidence that suggests that preference for large menus may have an evolutionary rationale. It has been shown that pigeons (Catania and Sagvolden (1998), Ono (2000)) and rats (Voss and Homzie (1970)) choose to put themselves in a situation in which they must make further choices even if a direct path to the desirable prize is available. In these studies subjects could choose among a single option path or a path that lead to a choice condition. Rewards in all paths were the same, yet subjects preferred the choice path.

2.1. PREVIEW OF RESULTS

In our representation the utility of a menu A is the sum of the utility derived from savoring and the utility of final consumption.

$$V(A) = \sum_{Z} \max_{\ell \in A} \ell_z v\,(z) + \beta \max_{\ell \in A} v(\ell)$$

Where Z is the set of goods in our universe, ℓ is a lottery, and ℓ_z is the probability with which lottery ℓ will award good z.

Note that our representation is a special case of subjective state dependent preferences. That is, DM can be interpreted as being uncertain about whether he will evaluate future choices as he does now ($\max_{\ell \in A} v(\ell)$) or he will only enjoy one particular good ($\max_{\ell \in A} \ell_z v\,(z)$). However, the subjective state space needed to interpret DM's preferences over sets as a preference for flexibility seems improbable, especially given the more natural interpretation we provide. To rule out the preference for flexibility interpretation we need to observe the effects of goods that are never chosen. While conclusive evidence is hard to come by, the research cited above point in the direction of a savoring interpretation.

The variety of a set A, in the model, is defined as $B(A) = \max_{\ell \in A} \{\ell_i\}_{i \in Z}$, where ℓ_i is the probability that lottery ℓ gives to prize $i \in Z$. For any lottery ℓ and set A, we define as the diversity that ℓ adds to set A as the difference of the variety with and without lottery ℓ : $B(A \cup \ell) - B(A)$.

Axiom 4 states that DM values variety, and that the savoring utility added by lottery ℓ is measured according to the utility over singletons. With this assumption we are implying that adding the same amount of diversity in two different dimensions adds different savoring utility to the set, so that adding one of the lotteries is better than the other.

Due to the fact that the consumer is behaving as if he derived utility from experiencing the satisfaction for each of the goods that belong to the set, then if the expected experiences were negative the DM would be better off if he could avoid variety. Botti and Iyengar (2004) in an experiment, found that when subjects faced less preferred choices (subjects had to choose between: fried scorpion, stewed snake meat, fried ants, and boiled spider egg as an entree) choosers anticipated enjoying the dish less than nonchoosers. In our representation this would lead to smaller sets being chosen when the options available are not attractive.

Axiom 5 states that DM values options which enhance his consumption value, even if they do not enhance variety. This means that once DM is choosing from the set he will choose the product that maximizes his consumption utility.

3. Representation

Let Z be a finite set of prizes and $\Delta(Z)$ be the set of all probability distributions on Z. $\mathcal{A}$ denotes the collection of all closed subsets of $\Delta(Z)$ and its elements, $A \in \mathcal{A}$, are referred as menus. $\succcurlyeq$ is a preference relation on $\mathcal{A}$. Endow $\mathcal{A}$ with the topology generated by the

Hausdorff metric[1]. For a given lottery $x \in \Delta(Z)$, let x_z denote the probability which x assigns to good z.

The following definition clarifies our notion of variety by providing an intuitive measure of the variety of a given menu of options.

Definition 1. *The variety of a set* $B(A) : \mathcal{A} \to \mathbb{R}^Z$ *:*

$$B(A) = \max_{x \in A} \{x_i\}_{i \in Z}$$

where $x \in \Delta(Z)$

When we add a lottery x to a menu A, the resulting menu $A \cup x$ may or may not have higher variety than A. We denote the increase in variety which x brings to A by $D(x, A)$ and refer to it as the Diversity added by x to A.

Definition 2. *The Diversity added by lottery* x *to menu* A *is a function* $D(x, A) : \Delta(Z) \times \mathcal{A} \to \mathbb{R}^Z$*:*

$$D(x, A) = \max\{x_i - B(A), 0\}_{i \in Z}$$

[1] Defined for any pair of non-empty sets, $A, B \in \mathcal{A}$, by:

$$dh(A; B) := max \left[\max_{a \in A} \min_{b \in B} d(a, b), \max_{b \in B} \min_{a \in A} d(a, b) \right]$$

where $d : \mathbb{R}^2 \to \mathbb{R}$ is the standard Euclidean distance.

Intuitively, DM will prefer $A \cup x$ to $A \cup y$ if $D(x, A)$ is more valuable to him than $D(y, A)$. However, $D(x, A)$ need not be an element of $\Delta(Z)$ so that comparisons may not immediately be made the preference relation $\succcurlyeq$ is defined over $\Delta(Z)$. In order to facilitate these comparisons we construct a Diversity Lottery by augmenting $D(x, A)$ with outcomes in the least preferred element of Z.

Definition 3. *For a given preference relation $\succeq$, let w be the least preferred element of Z. The Diversity Lottery of adding element x to set A is:*

$$\bar{D}_i(x, A) = \begin{cases} D_i(x, A) & \text{for } i \neq w \\ 1 - \sum_{i \neq w} D_i(x, A) & \text{for } i = w \end{cases}$$

Note that the preceding definitions are independent of any utility representation and serve only to clarify concepts and notation.

The first 3 Axioms are:

Axiom 1 (preference relation). *$\succeq$ is a complete and transitive binary relation.*

Axiom 2 (Strong Continuity). *The sets $\{B : B \succeq A\}$ and $\{B : A \succeq B\}$ are closed.*

Axiom 3 (Independence). *$A \succ B$ and $\alpha \in (0, 1)$ implies $\alpha A + (1 - \alpha) C \succ \alpha B + (1 - \alpha) C$.*

Together, these Axioms lead to the following result:

Theorem 1 (Dekel, Lipman, and Rustichini (2001)). *The preference $\succsim$ has an additive EU representation if and only if it satisfies weak order, strong continuity, and independence.*

The previous result guarantees that preferences can be represented by a utility function of the form:

$$V(A) = \sum_{s \in supp(\mu)} \mu(s) \max_{\ell \in A} u_s(\ell)$$

Where μ is a subjective probability measure over states of the world (s), each associated with a utility function for the decision maker (u_s). Our savoring representation adds structure by adding two axioms which serve to pin down the 'state-dependent utility functions' in a way which is consistent with the evidence on savoring and preference for variety. Our representation is the following:

Definition 4. *A savoring representation is a measurable utility function $v : \Delta(Z) \rightarrow \mathbb{R}$, and a constant β such that:*

$$V(A) = \sum_{Z} \max_{\ell \in A} \ell_z v(z) + \beta \max_{\ell \in A} v(\ell)$$

represents $\succcurlyeq$.

The following axiom plays a dual role. First, it says that variety is utility-enhancing.

That is, adding a lottery x which is not in the convex hull of menu A will make DM prefer $A \cup x$ to A. Second, it says that the value of additional variety is independent of the elements of the menu A, and preserves the order which $\succcurlyeq$ imposes on single lotteries.

Axiom 4 (Preference for Variety). *$x, y \prec z$ for some $z \in A$, then $A \cup x \succ A \cup y \iff \bar{D}(x, A) \succ \bar{D}(y, A)$.*

The next axiom states that adding an option x to a menu A, which is preferred to all options already in A, enhances the value of A to DM. This will clearly be the case if DM enjoys both savoring and consumption.

Axiom 5 (Preference for Quality). *If $D(x, A) = D(y, A) = 0$ and $x \succ y, z$ for all $z \in A$, then $A \cup x \succ A \cup y$.*

Theorem 2. *The preference $\succcurlyeq$ has a savoring representation if and only if it satisfies axioms 1-5.*

Proof. A full proof is provided in the Appendix A. ■

4. Market Structure

In this section we analyze the consequences that *savoring* preferences may have on market structure. A store is a profit maximizing agent that chooses an assortment A and a vector of prices p, and who incurs costs of providing assortment A, $c(A)$. We assume that costs are linear in the size of the assortment $c(A) = \kappa\,|A|$; we add this assumption because if we think of these costs as the costs of shelving, they may reasonably be thought to be linearly increasing in the number of products offered. For simplicity, we assume that consumers' preferences are quasilinear in money and that the cost to the store of all goods is the same. We also assume Z is large enough for stores never to be constrained in ther ability to offer variety.

The profits of the store are:

$$\Pi\,(A,p) = \sum_{\ell\in A} p_\ell Q\,(\ell|A) - c(A)$$

$Q\,(\ell|A)$ is the demand for product ℓ given that set A is offered. The demand for each object can only take two values: 1 or 0. Demand will be one if the expected utility of consuming the good minus its price p_ℓ is greater than this difference for any other product in the store. If some good is dominated, the demand for that product will be zero.

The utility of going to a store that offers set A to the consumer is:

$$V_s\,(A) = \sum_Z \max_{\ell\in A}\,[\ell_z v(z) - p_\ell] + \beta \max_{\ell\in A}\,[v(\ell) - p_\ell]$$

If all consumers are identical and there is a monopoly, variety will not be provided and all consumer surplus will be extracted by the store. Price will be equal to the expected utility of the good. Only the most preferred object will be offered.

When a retailer adds a product to its lineup in order to increase its variety it does not intend to sell it. Therefore, because consumers' enjoyment is proportional to the consumption value of the lure net of its purchase price, the retailer will price the lure as low as possible. Prices for lures will be lower than the price of the best good (ℓ^*), and will be determined according to how much anticipated utility that good ℓ provides to the consumer: $p_\ell = \ell_z v(z) - \frac{v(\ell^*)+\beta\kappa}{2}$. Given these prices, each new good added to a retailer's stock has the same effect upon consumer utility $(v(\ell^*) - p_{\ell^*})$ and the same carrying cost (k). This allows us to summarize variety as a single decision variabe x.

Proposition 1. *When there are two stores variety will be provided. Optimal variety* $x^* = \frac{v(\ell^*)-\beta\kappa}{2\kappa}$ *is decreasing in* κ *and* β, *and increasing in* $v(\ell)$. *Price is increasing in* $v(\ell)$ *and decreasing in* β, *but unrelated to* κ.

Proof. Zero profits for the firm imply: $p_\ell = \kappa\,|A|$, and $v(\ell) - p_\ell \geq v(r) - p_r$ for every $r \in A$.

The firm will maximize the utility of the consumer:

$$
\begin{aligned}
\max_{\substack{A \\ s.t.}} V_s(A) &= \max_{\substack{A \\ s.t.}} \sum_{Z} \max_{\ell \in A} \left[\ell_z v(z) - p_\ell\right] + \beta \max_{\ell \in A} \left[v(\ell) - p_\ell\right] \\
p_{\ell^*} &= \kappa\,|A| \\
\ell_z v(z) - p_\ell &\leq v(\ell^*) - \kappa\,|A|
\end{aligned}
$$

This is equivalent to:

$$\max_{\substack{x \\ s.t}} (x+\beta)\, CS$$
$$p_{\ell^*} = \kappa\,|A|$$

where CS denotes consumer surplus and x the cardinality of set A.

Optimal variety $x^* = \frac{v(\ell^*)-\beta\kappa}{2\kappa}$ is decreasing in κ and β, and increasing in $v(\ell)$ ■

When the utility of the best element offered increases, the store can lower the price of all the goods that consumers will not buy. An extra unit of variety will increase consumers' anticipatory utility more than before, so increasing variety has a greater marginal benefit for the consumer when the value of best element increases.

Corollary 1. *Variety is increasing in the number of competitors for $N \leq 2$ and decreasing for $N \geq 2$*

Proof. No profit condition:

$\frac{1}{N}p = \kappa x$

$\max_{\substack{x \\ s.t}} (x+\beta)(v(\ell) - N\kappa x)$

$x^* = \frac{v(\ell^*)-\beta\kappa}{2\kappa N}$ ■

Watson (2004) finds a similar non-monotonic pattern in the market for eyeglass retailers. He finds variety is decreasing for $N \geq 4$, and increasing for lower N.

4.1. Heterogeneous Consumers:

Consumers can be of two types, β_H and β_L, with equal probability. High type consumers don't care as much as low type consumers about variety, but they care more about the best element of the set.

The existence of two types of consumers who differ in their savoring parameter (β), and therefore their preference for variety, is consistent with the findings of Draganska and Jain 2003 in the market for yogurt.

In order for a high type consumer not to prefer to go to the low type store we require that:

$$(x_H + \beta_H) CS_H \geq (x_L + \beta_H) CS_L \tag{4.1}$$

Stores will maximize profits subject to constraint 4.1.

$$\begin{aligned} \max_{A} \Pi_s(A) &= p_H - x_H \kappa \\ s.t. & \\ (x_H + \beta_H) CS_H &\geq (x_L + \beta_H) CS_L \approxeq \gamma_H \end{aligned}$$

Low types value more variety so they pay a higher price for the same good than higher types that value variety less. Even though firms still make positive profits, consumer surplus for high types is always positive while for low types it is at least zero. As expected, price is increasing in costs of providing variety κ.

Proposition 2. *If there are two stores, each store will provide for a segment of the market and consumer surplus will be positive at least for high types.*

Proof. $\max_x \left(v - \frac{\gamma}{x_H+\beta_H}\right) - x_H\kappa$

F.O.C

$\gamma - \kappa (x_H + \beta_H)^2 = 0$

Solution is: $\left\{-\frac{1}{\kappa}\left(\kappa\beta_H + \sqrt{\kappa\gamma}\right), -\frac{1}{\kappa}\left(\kappa\beta_H - \sqrt{\kappa\gamma}\right)\right\}$ if $\kappa \neq 0$

$x_H^* = -\frac{1}{\kappa}\left(\kappa\beta_H - \sqrt{\kappa\gamma}\right)$

if $\kappa \geq 1$

$x_H^* = -\frac{1}{\kappa}\left(\kappa\beta_H - \sqrt{\kappa\gamma}\right)$

$x_H^* = -\frac{1}{\kappa}\left(\kappa\beta_H - \sqrt{\kappa\gamma}\right) \geq 0$

$\kappa \geq \frac{\gamma}{\beta_H^2}$

$p_H^* = v - \frac{\gamma}{\kappa\sqrt{\kappa\gamma}}$

$\frac{\partial\left(\frac{\gamma}{\kappa\sqrt{\kappa\gamma}}\right)}{\partial\gamma} = \frac{1}{2\kappa^2\gamma}\sqrt{\kappa\gamma}$

in equilibrium: For every $\gamma_H, \gamma_L > 0$

$(x_H + \beta_H)\, CS_H = (x_L + \beta_H)\, CS_L$

$\gamma_L^* = \gamma_H - (\beta_H - \beta_L)\frac{\gamma_H}{\sqrt{\kappa\gamma_H}}\kappa$

If $\gamma_L^* = 0$; $\gamma_H = 0$ is not an equilibrium.

$\Pi_j(A^*) = \frac{1}{\kappa^2}\left(\kappa^3\beta_j + \sqrt{\kappa\gamma_j} - \kappa^2\sqrt{\kappa\gamma_j}\right)$

$\Pi_L(A) > \Pi_H(A)$ ■

4.2. A Spatial Model of Retailing

In this section we study a spatial model of retailers in which a unit mass of consumers with savoring preferences are uniformly distributed over a circle of circumference one. We refer to this circle as *the economy*. Consumers' preferences are quasilinear in money and face transportation costs t per unit of distance (d) traveled, so that their utility is:

$$u = (x + \beta)(v - p) - td$$

where, as in the previous subsection, x denotes the diversity offered by the retailer, β is a preference parameter measuring how much consumers enjoy consumption as opposed to savoring, v is the utility of the best good in the store, and p is the price at which this good is sold. Retailers have a fixed cost f of entry.

For analytical simplicity, we focus only on symmetric equilibria in which retailers are evenly spaced on the economy and all offer the same variety - price combination. We also assume that $v^2 > 4kt$ and $f > \beta k$.

Let us focus on the determination of (x, p) by a retailer R in an economy in which there are $N - 1$ other retailers who offer consumers a shopping experience worth $\bar{u}$ net of transportation costs.

If R offers consumers utility $\bar{u}$ net of transportation costs, the number of consumer who shop at R is:

$$d(u) = \frac{u - \bar{u}}{t} + \frac{1}{N}$$

In order to provide utility level u, R solves:

$$\max_{p,x} dp - kx - f \tag{4.2}$$

$$\text{such that } (x + \beta)(v - p) = u$$

Using the constraint, we solve for x, $x = \frac{u}{v-p} - \beta$. And substituting into 4.2 and maximizing with respect to p we get:

$$p = v - \frac{\sqrt{uk}}{\sqrt{d}} \tag{4.3}$$

$$x = \frac{\sqrt{ud}}{\sqrt{k}} - \beta. \tag{4.4}$$

Substituting 4.3 and 4.4 in 4.2, maximizing with respect to u, using the zero profit condition for retailers, and the equilibrium condition $u = \overline{u}$ we derive the equilibrium values of:

$$u = \frac{1}{2Nk}\left(v\sqrt{-4kt + v^2} - 2kt + v^2\right) \tag{4.5}$$

$$p = v - \frac{1}{2}\sqrt{2}\sqrt{v\sqrt{v^2 - 4kt} - 2kt + v^2} \tag{4.6}$$

$$x = \frac{1}{2\sqrt{k}}\left(\sqrt{2}\sqrt{\frac{1}{N^2 k}\left(v\sqrt{v^2 - 4kt} - 2kt + v^2\right)} - 2\sqrt{k}\beta\right) \tag{4.7}$$

Note that the expression for x is decreasing in N. Therefore, parameters which lead to retailers having large market share (low N) also lead to retailers offering high variety (high x). This provides a structure-based explanation of the positive correlation between product line length and market share as noted in Draganska and Jain 2003, Kekre and Srinivasan 1990, and Bayus and Putsis 1999.

The zero-profit condition gives:

$$N = \frac{1}{-k\beta + f}\left(v - \frac{2}{\sqrt{2}}\sqrt{v\sqrt{-4kt + v^2} - 2kt + v^2}\right) \tag{4.8}$$

We define consumer welfare to be the average of the net benefit of shopping for our consumers:

$$W = u - \frac{t}{4N} \tag{4.9}$$

We summarize the comparative statics of the model in the following Proposition:

Proposition 3. *In the symmetric equilibrium of the spatial retailing model:*

1. *Greater preference for variety (smaller β) implies fewer retailers (N) who charge the same price (p) and offer more variety (x) so that consumer welfare (W) increases.*

2. *Lower fixed costs (f) lead to a greater number of retailers (N) and lower consumer welfare (W). There exists an $\bar{f} > 0$ such that for all $f < \bar{f}$ no variety is provided ($x = 0$).*

3. *An increase in transportation costs (t) leads to fewer retailers (N), higher price (p) and higher variety provided (x).*

Proof. Proof is in Appendix B. ■

The first result is intuitive: if consumers have stronger preferences for variety, the variety provided by retailers will be greater. Providing more variety increases costs for retailers, and therefore there will be fewer retailers in the market. In order to analyze the welfare effects of a decrease in β, we first note that transportation costs will increase. However, the presence of fewer retailers in the market means that increases in variety will attract more customers than they would have at a higher β and thus retailers will provide more of it. The net effect is that consumer welfare increases. This suggests that stronger preferences for variety give the consumer more market power.

Small fixed costs facilitate the entry of retailers leading to an increase in the number of retailers and a decrease in transportation costs. However, when N is large, the competition generated by more retailers harms consumers by decreasing the variety provided. The net effect is decrease in consumer welfare.

When transportation costs are high there will be fewer retailers because, even though they can charge a higher price, they also have to offer more variety in order to compensate consumers. In equilibrium the increase in costs due to more variety is greater than the increase in revenue due to the price increase.

The effects of an increase in transportation costs can be understood in light of recent parallel trends in retailing and suburbanization. If we think of people's move to the suburbs as an exogenous positive shock to transportation costs, our model correctly predicts that fewer retailers, each offering a wider selection of products, will serve the market.

5. Conclusions

In this paper we provide a representation utility for a consumer that derives utility from savoring all the alternatives provided and also derives utility from consumption. Our representation is an extension to preferences over sets of the observed phenomena in psychology that consumers experience satisfaction of consuming a product prior to consumption.

We analyze the consequences that this type of preferences have on market structure. First we study the case where cost of transportation to a retailer is zero. Consumers can go to the store that, according to his preferences, offers the highest utility.

As one might expect, if all consumers are identical and there is a monopoly retailer, variety will not be provided and all consumer surplus will be extracted by the store. When there is competition among stores, variety will be provided and price has a positive relation with preferences for variety. Consumers who have less of a preference for variety will pay a lower price.

When there are two types of consumers, one group with strong preferences for variety and the other with weaker preferences for variety, and two retailers, the market will be segmented. Each retailer will specialize in only one group. Consumer surplus of consumers with weak preferences for variety will be greater than for the other group.

In a spatial model of competition among retailers in which a unit mass of consumers with savoring preferences are uniformly distributed over a circle of circumference one, and costs of transportation are positive, we find that preferences for variety have no effect on the price. Greater preferences for variety will imply fewer retailers, and the stronger the preferences for variety of consumers the more market power they have, so that their welfare increases.

The more retailers there are (due to lower fixed costs) the lower welfare consumer gets. In this case, retailers still make zero profits, but will provide very little variety, making consumers worse off.

High transportation costs imply fewer retailers and more variety offered but also higher price. There will be fewer retailers because, even though they can charge a higher price they also have to offer more variety in order to compensate consumers.

A. Appendix

Proof of Theorem 1. It is straight-forward to verify that a utility function with a savoring representation satisfies Axioms 1-5. In what follows, we verify that any preference relation satisfying Axioms 1-5 has a savoring representation.

Step 1:

By theorem 1 there exists an additive EU representation

$$V(A) = \sum_{S} \mu_s \max_{\ell \in A} u(\ell, s)$$

Step 2:

Axiom 4 implies: $|S| \geq |Z|$

Suppose not i.e. $|S| < |Z|$ then there is at least one $z \in Z$, $x, y \in \Delta Z$ and $x, y \notin A$, such that $D_z(x, A) \neq 0$ and $\overline{D}(x, A) \succ \overline{D}(y, A)$ but $U(A \cup x) < U(A \cup y)$ which contradicts axiom 4.

$S = \{z \in Z\} \cup X$

Step 3:

To prove $u_z(\ell) = \ell_z g(z)$ for some $g > 0$.

Note that linearity of u_z can be derived from Axioms 1-3 over singletons (Kreps p. 47).

Suppose not:

Let $a \in Z$ be such that $a \succ b$ for every $b \in Z$.

denote $w(z) = V(\{z\}) = \sum_s \mu_s u_s(z) + \mu_{s'} v(z)$ the utility over singletons.

Define $v(z) = \gamma w(z) + b$.

i) If there is a $z \neq a$ such that $u_z(\ell) = \sum_z \gamma_z f(z)$, with $\gamma_z, \gamma_{z'} \neq 0$

Let $b = \arg\max_{x \in A} v(x)$

Then there exists a lottery y and a menu A with $|A| \geq 2$ such that $b \succ y$, $y \notin A$, $D(y, A) = 0$, and $A \cup y \succ A$ contradicting axiom 4.

ii) If $u_a(\ell) = \sum_z \gamma_z f(z)$

ii.a) if $u_a(\ell) = \sum_z \ell_z v(z)$

Let $b = \arg\max_{z \in A} v(z)$

w such that $w = \arg\max_{x \in A \cup \{w\}} \{x_a\}$ and $v(w) < v(b)$

then $A \cup \{w\} \sim A$ contradicting axiom 4.

ii.b) if $u_a(\ell) \neq \sum_z \ell_z v(z)$

Let $b = \arg\max_{z \in A} v(z)$, $y = \arg\max_{z \in A} u_a(z)$

w such that $w = \arg\max_{x \in A \cup w} \{x_a\}$ and $v(w) < v(b)$ and $u_a(w) > u_a(y)$

then $A \cup \{w\} \sim A$ contradicting axiom 4.

Step 4:

It is sufficient that $|S| = |Z| + 1$

denote $w(z) = V(\{z\}) = \mu_z u_z(z) + \mu_{s'} v(z)$ the utility over singletons.

Define $\gamma w(z) + b = v(z)$

If $|S| = |Z|$ only, then:

If $x \succ y$ and $D(x, A) = D(y, A) = 0$ then $U(A \cup x) = U(A \cup y)$ contradicting axiom 5.

Then, there most be another state s' such that:

$$x \succ y \Longleftrightarrow u_{s'}(x) > u_{s'}(y)$$

Define $S = \{z \in Z\} \cup s'$

let $u_z(\ell) = \begin{cases} \ell_z v(z) & \text{if } z \in s \\ 0 & \text{if } z \notin s \end{cases}$, $u_{s'}(\ell) = v(\ell)$, and $\mu_{s'} = 1 - \sum_{S \setminus s'} \mu_s$

$$V(A) = \sum_Z \mu_z \max_{\ell \in A} \ell_z v(z) + \mu_{s'} \max_{\ell \in A} v(\ell)$$

Step 5:

To prove there is no other relevant state:

Another relevant state m would imply a state-dependent utility function $u_m(\ell) = \sum_z \ell_z \gamma_z f(z)$.

Then, there exists a lottery x and a menu A such that $D(x, A) = 0$, $x \notin \arg\max_{z \in A \cup x}\{v(z)\}$, and $x = \arg\max_{z \in A \cup x}\{u_m(z)\}$.

Then $A \cup x \succ A$, contradicting A4.

Step 6:

To prove weights are the same for all $s \in S \setminus s'$:

Suppose $\mu_a \neq \mu_b$ for some $a, b \in Z$.

Then, $\exists\ \ell_a, \ell_b$ such that $\mu_a \ell_a v(a) > \mu_b \ell_b v(b)$ but $\ell_a v(a) < \ell_b v(b)$.

Therefore, there is a set A and lotteries x, y such that

$$D_i(x,A) = \begin{cases} 0 & \text{for } i \neq a \\ \ell_a & \text{for } i = a \end{cases} \text{ and } D_i(y,A) = \begin{cases} 0 & \text{for } i \neq b \\ \ell_b & \text{for } i = b \end{cases}$$

and $x, y \notin \arg\max_{z \in A \cup x \cup y}\{v(z)\}$

Then, $A \cup x \succ A \cup y$ but $\bar{D}_i(y,A) \succ \bar{D}_i(x,A)$ contradicting A5.

Lets define $\beta = \frac{\mu_{s'}}{\mu_z} = \frac{1-|Z|\mu_z}{\mu_z}$then we can rewrite

$$V(A) = \sum_Z \max_{\ell \in A} \ell_z v(z) + \beta \max_{\ell \in A} v(\ell)$$

■

B. Appendix

Retailers' maximization problem:

$$\max_u \Pi = \max_u \left(\frac{u-\bar{u}}{t} + \frac{1}{N}\right)\left(v - \frac{\sqrt{uk}}{\sqrt{d}}\right) - k\left(\frac{\sqrt{ud}}{\sqrt{k}} - \beta\right) - f$$

subject to $d = \frac{u-\bar{u}}{t} + \frac{1}{N}$

substitute d

$$\max_u \frac{1}{Nt}\left(\begin{array}{c} tv - Nv\bar{u} + Nuv + Nkt\beta \\ -Nt\sqrt{ku}\sqrt{\frac{1}{Nt}\left(t - N\bar{u} + Nu\right)} - N\sqrt{k}t\sqrt{\frac{1}{Nt}u\left(t - N\bar{u} + Nu\right)} \end{array}\right)$$

Foc:

$$\frac{\partial\left(\frac{1}{Nt}\left(tv - Nv\bar{u} + Nuv + Nkt\beta - Nt\sqrt{ku}\sqrt{\frac{1}{Nt}(t - N\bar{u} + Nu)} - N\sqrt{k}t\sqrt{\frac{1}{Nt}u(t - N\bar{u} + Nu)}\right)\right)}{\partial u} = 0$$

substitute equilibrium condition $\bar{u} = u$

$$-\frac{1}{Nt\sqrt{ku}\sqrt{\frac{1}{N}}}\left(kt + Nku - Nv\sqrt{ku}\sqrt{\frac{1}{N}}\right) = 0$$

solve for u

$$-\frac{1}{Nt\sqrt{ku}\sqrt{\frac{1}{N}}}\left(kt + Nku - Nv\sqrt{ku}\sqrt{\frac{1}{N}}\right) = 0$$

Solution is:

$u = \frac{1}{2Nk}\left(v\sqrt{-4kt + v^2} - 2kt + v^2\right)$ and

$u = -\frac{1}{2Nk}\left(v\sqrt{-4kt + v^2} + 2kt - v^2\right)$

$u = \frac{1}{2Nk}\left(v\sqrt{-4kt + v^2} - 2kt + v^2\right) > -\frac{1}{2Nk}\left(v\sqrt{-4kt + v^2} + 2kt - v^2\right)$ always.

Substituting u in the price and variety, we get:

$$p = v - \frac{1}{2}\sqrt{2}\sqrt{v\sqrt{v^2 - 4kt} - 2kt + v^2}$$

$$x = \frac{1}{2\sqrt{k}}\left(\sqrt{2}\sqrt{\frac{1}{N^2k}\left(v\sqrt{v^2 - 4kt} - 2kt + v^2\right)} - 2\sqrt{k}\beta\right)$$

The condition of zero profits gives:

$$\Pi\left(u^*, d^*\right) = 0$$

$$\left(\frac{1}{N}\right)\left(v - \frac{\sqrt{uk}}{\sqrt{d}}\right) - k\left(\frac{\sqrt{ud}}{\sqrt{k}} - \beta\right)$$

$$k\beta + \frac{1}{N}v - \sqrt{2}\sqrt{\frac{1}{N}\left(v\sqrt{v^2 - 4kt} - 2kt + v^2\right)}\sqrt{\frac{1}{N}} - f = 0$$

$$N^* = \frac{1}{-k\beta + f}\left(v - \frac{2}{\sqrt{2}}\sqrt{v\sqrt{-4kt + v^2} - 2kt + v^2}\right)$$

Proof of Proposition 3. PART 1

Greater preference for variety (smaller β) implies less retailers (N)

$$N^* = \frac{2}{-2k\beta + f}\left(-v + \sqrt{2}\sqrt{v\sqrt{-4kt + v^2} - 2kt + v^2}\right)$$

Variety is decreasing in β :

$x^* = \frac{1}{2\sqrt{k}}\left(\sqrt{2}\sqrt{\frac{1}{N^2k}\left(v\sqrt{v^2-4kt}-2kt+v^2\right)}-2\sqrt{k}\beta\right)$

Price is independent of β and N :

$p^* = v - \frac{1}{2}\sqrt{2}\sqrt{v\sqrt{v^2-4kt}-2kt+v^2}$

Welfare increases when β increases:

$W = u - \frac{t}{4N}$

we know $u \geq \frac{t}{N}$ (this happens due to the fact that $v^2 \geq 4kt$ and u is increasing in v^2)

therefore $\frac{\partial W}{\partial N} > 0$

PART 2

$A = v\sqrt{v^2-4kt}-2kt+v^2$

$W = \frac{1}{N}(\frac{1}{2k}A - \frac{1}{4}) \geq \frac{t}{N}\frac{3}{4}$

There is an $\bar{f} > 0$ such that for all $f < \overline{f}$ no variety is provided ($x = 0$).

not that

$x^* = \max\{\frac{1}{2\sqrt{k}}\left(\sqrt{2}\sqrt{\frac{1}{N^2k}\left(v\sqrt{v^2-4kt}-2kt+v^2\right)}-2\sqrt{k}\beta\right), 0\}$

N grows unboundedly as f decreases to $2k\beta$ and therefore the positive term goes to zero.

PART 3

Price and number of firms are decreasing in costs of transportation.

Variety is increasing in transportation costs

$\frac{\partial x}{\partial t} > 0$ ■

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