The Paradox of Choice:

Why More is Good & Too Much is Terrible

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Poster prepared for presentation at the Agricultural & Applied Economics Association's 2012 AAEA Annual Meeting, Seattle, Washington, August 12-14, 2012

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Introduction

The standard economic model of perfect competition leads to the law of one price. The law of one price suggests that if homogenous goods are sold and everyone (sellers and buyers) have perfect information about the cost of producing the product and the market prices, then the only possible market outcome is that the product is sold by all sellers at the same price. The problem of course is that a uniform price for a homogenous product is rarely observed. Recognizing that price dispersion is more the 'rule' than an 'anomaly' Stigler (1961) relaxed the assumption of perfect price information on the part of the buyer and developed a model that explained why price dispersion exists. Despite John Nash's extension of Game Theory to mixed strategy solutions in 1951, this explanation for price dispersion was not extended to an equilibrium setting until Salop and Stiglitz (1977). Since that time consumer search has been used as the foundation for explaining a number of economic and marketing phenomenon including temporary price promotions (Banks and Moorthy 1999), wholesale price pass through (Tappata 2009), price dispersion (Van Hoomissen 1988; Sorensen 2000; Chandra and Tappata 2010), and variety seeking behavior (McAlister and Pessemeier 1982).

The focus of the current research is on variety seeking behavior. There is much experimental evidence to suggest consumers (and their decision making ability) are hindered when presented with a large number of alternatives to choose from (Jacoby et. al. 1974; and Iyengar and Lepper 2000). However, it is also well known that consumers' preference for variety is quite heterogeneous leading many to purchase multiple items in a single shopping trip (Richards, Gomez, and Pofahl 2012). Theoretical models of consumer search have largely ignored this later observation and focused on demand models that assume consumers only make a single purchase (often in unit increments). Therefore, the objective of this research is to extend the consumer search literature by allowing for the observation that consumers purchase multiple products. In so doing we are able to account for consumer satiation and their preference for variety in determining the optimal number of products the consumer wants.

The Model

Consumers shop at a firm and search for a set of products that match their tastes at a reasonable price. Consumers are assumed to be able to purchase multiple products in varying quantities. The total consumption of the population is normalized to 1 (without loss of generality). Consumers follow a parallel search pattern in which they randomly sample a fixed number of products, say *K*, and then purchase their most preferred set of products among those sampled. Consumers choose a search strategy to maximize their utility given the price and assortment decisions of the firm.

In many product choice situations consumers often purchase multiple products in a single trip such as ice cream (Richards, Pofahl, and Gomez 2012). Therefore the utility from purchasing several products at the same time is given by:

$$u = \sum_i u_i$$

The reason consumers make multiple product purchases in a single shopping occasion can be explained by a number of observations, such as product satiation, and/or preference for variety (Dubé 2004). Moreover, consumers often purchase products in varying quantities. Allowing for this observation we follow Kim, Allenby, and Rossi (2002) and Bhat (2005) to extend utility by writing the total utility from making a purchase in a product category as:

$$U = \sum_i u_i \left(q_i + \gamma_i\right)^{\alpha}$$

where q_i is the quantity purchased of good *i* which is assumed to be greater than or equal to zero, $\gamma_i \geq 0$ is a satiation parameter that determines corner solutions, or whether the consumer makes a single, or multiple purchases. The parameter α represents a general measure of the consumer's preference for variety and is assumed to be bound by 0 and 1. As α moves from 1 to 0 the consumer's preference for variety increases.

An important aspect of search is the number of products offered and/or considered. As the selection of products increases it provides the consumer with more opportunities to find a product that closely matches their preferences, however it also decreases the income the consumer has to spend on the products searched. To account for these two separate effects we explicitly model the increase in utility the consumer gains from potentially finding a product that better meets their needs, while introducing the added cost of search to the budget constraint below. So, the total utility is written as:

$$U = \sum_i \exp\left[\ln\left[\frac{K}{(\rho_i - \hat{\rho})^2}\right] + \phi_i\right]\left(q_i + \gamma_i\right)^{\alpha}.$$

where ρ_i represents the set of attributes of product *i*, and $\hat{\rho}$ is the ideal set of attributes the consumer is looking for. φ_i represents other choice specific characteristics the consumer may take into account such as brand loyalty. In this way the utility function directly accounts for the increase in utility the consumer gets by having a wider selection of products to chose from, and thereby being able to potentially find a product that better meets their needs.

We assume that the cost of searching through *K* products is spread over all of the products purchased, say *I*, through the budget constraint. So, the consumer's budget constraint is:

$$y = \sum_{i=1}^{I} p_i q_i + c(K)$$

where *y* is the consumer's income, and $c(K) > 0$ is the search cost the consumer incurs, which is an increasing function of the number of products *K*. We assume $c'(K) > 0$, and $c''(K) \leq 0$.

The Consumer's Problem

The consumer maximizes the Lagrangian: $\mathrm{L} = U + \lambda\left(y - \sum_i p_i q_i - c(K)\right)$

whose first order Kahn-Tucker conditions with respect to q_i are given by:

$$\frac{K}{(\rho_i - \hat{\rho})^2}\exp\left[\phi_i\right]\alpha\left(q_i^* + \gamma_i\right)^{\alpha-1} - \lambda p_i = 0 \qquad \text{if } q_i^* > 0 \;\; \forall i$$

$$\frac{K}{(\rho_i - \hat{\rho})^2}\exp\left[\phi_i\right]\alpha\left(q_i^* + \gamma_i\right)^{\alpha-1} - \lambda p_i < 0 \qquad \text{if } q_i^* = 0 \;\; \forall i$$

Solving the above FOCs with respect to the budget constraint yields the optimal demand q^*_i as:

$$q_i^* = \frac{y - c(K) + \sum_{k=1}^{I} p_k \gamma_k}{\sum_{k=1}^{I} p_k \left(\frac{p_k \exp[v_i]}{p_i \exp[v_k]}\right)^{(\alpha-1)^{-1}}} - \gamma_i$$

which is the chosen level of consuming product *i* for any given set of prices, search costs, and income. The indirect utility becomes:

$$U^* = \sum_{i=1}^{I} \exp[v_i]\left(\frac{y - c(K) + \sum_{k=1}^{I} p_k \gamma_k}{\sum_{k=1}^{I} p_k \left(\frac{p_k \exp[v_i]}{p_i \exp[v_k]}\right)^{(\alpha-1)^{-1}}}\right)^{\alpha}.$$

Comparative Statics:

The more interesting implications of the model come from the observation of how the consumer's utility changes, taking into account that they may or may not allocate their income across several products on a single shopping occasion. We find the consumer's indirect utility function changes in the following way with respect to their search costs and the number of products searched:

$$\frac{\partial U^*}{\partial c(K)} = -\frac{\alpha U^*}{y - c(K) + \sum_{k=1}^{I} p_k \gamma_k} < 0. \qquad \text{and} \qquad \frac{\partial U^*}{\partial K} = (\rho_i - \hat{\rho})^{-2}\left(1 - \frac{\alpha K c'(K)}{2\sum_{k=1}^{I} p_k \gamma_k}\right)\sum_i \mathrm{e}^{\phi_i}\left(q_i + \gamma_i\right)^{\alpha}$$

Search Costs:

Therefore, the consumer's indirect utility always decreases when search costs increase, no matter the number of products purchased in a single shopping occasion. This is an important result because prior search models that assumed only one product purchase would have to absorb the entire cost of search. However, we find here that even when the consumer can spread their search cost over a large number of products their marginal utility still decreases as the search cost increases. Moreover, this suggests that a consumer would want to get their search costs as low as possible.

Number of Products:

We find the optimal number of products that maximize utility, $\frac{\partial^2 U^*}{\partial K^2} < 0$ is given by: $K^* = \frac{2\sum_{k=1}^{I} p_k \gamma_k}{\alpha c'(K)}$ which is critically dependent upon the consumer's satiation and preference for variety parameters γ and α, and how search costs change as more products are searched. As expected smaller values of α and/or larger values of γ lead the consumer to prefer more products to choose from. What's more, if prices across products all increase, the consumer also prefers to have a larger selection of products, presumably because the quality of the products will become more important. This is an important result that is in contrast to Cachon, Terwiesch, and Xu (2008) who find that consumers are always worse off as more products are added to their choice set.

Empirical Estimation:

The value of this utility specification comes not only from its analytical tractability, but also by the fact that the satiation and preference for variety parameters γ and α can be directly estimated empirically. Specifically, by adding a multiplicative error term which is assumed to be independently and identically distributed following an extreme value distribution to u_i we arrive at the following closed form analytical probability expression that can be consistently estimated via maximum likelihood.

$$\Pr\left(q_2^*, q_3^*, \ldots, q_I^*, 0, \ldots, 0\right) = (1-\alpha)^{(I-1)}\left(\frac{y - c(K) + \gamma_1 + \sum_{i=2}^{I} p_i \gamma_i}{\left(c(K) + \sum_{j=2}^{I} p_j q_j - \gamma_1 - y\right)\prod_{i=2}^{I} q_i + \gamma_i}\right)\frac{\prod_{i=1}^{I} e^{W_i}}{\left(\sum_{j=1}^{K} \mathrm{e}^{W_j}\right)^{I}}(I-1)! \quad \text{where} \quad W_i = \frac{K}{(\rho_i - \hat{\rho})^2} + \phi_i + \ln\alpha + (\alpha - 1)\ln\left(q_i^* + \gamma_i\right) - \ln p_i.$$