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Conditions for Loss Averse and Gain Seeking Consumer

Price Behavior

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Abstract

It is commonly accepted that consumers use a reference price when evaluating prices in a category. Researchers have extensively studied if existing data reveals loss aversion, i.e. that consumers put more emphasis on prices above the reference price (perceived losses) than prices below it (gains). Reference price and loss aversion are corner stones in Kahneman and Tversky's prospect theory. In this article conditions for loss aversive and gain seeking behavior are developed when the consumers' preferences are given by a random additive utility model and the choice model is McFadden's conditional multinomial logit. In the results prospect theory plays only a minor part and, perhaps surprisingly, the market share of the product is a key player.

Keywords: reference price, loss aversion, conditional logit, brand choice

INTRODUCTION

The reference price concept is today well accepted in marketing theory. According to it consumers evaluate the prices of their choice alternatives not only in absolute values but against a reference price. Prices above the reference price are considered as perceived losses and below the reference price as perceived gains. Researchers have noted that consumers often are more sensitive to price increases than to decreases, which is called loss aversive behavior whereas the opposite is called gain seeking behavior. Loss aversive and gain seeking behavior represent asymmetric responses to price changes whereas a symmetric reaction is equal in size for both price rise and fall from the reference level. Similarly, Kahneman and Tversky's (1979 and 1991) prospect theory involves a reference level (for price, for instance) and a value function, which reflects higher sensitivity to losses than to gains.

In marketing literature, choice modelers have tested the reference effects, especially the existence of loss aversion typically using scanner panel data. Mixed evidence of loss aversion has been reported. The model of choice employed in the studies is commonly the multinomial (or conditional) logit (McFadden 1974) and the utility function estimated is additive which, in addition to price variables, can include e.g. brands, loyalty to the brands and promotional variables as explanatory variables (Kalwani et al 1990, Kalyanaram and Little 1994, Krishnamurti, Mazumdar and Raj 1992, Lattin and Bucklin 1989, Hardie, Johnson and Fader 1993, Rajendran and Tellis 1994). Aggregate models were often estimated but in some of the studies the results are considered by segments or in different groups (Erdem, Mayhew and Sun 2001, Mazumdar and Papatla, 1995 and 2000, Bell and Lattin 2000). Thanks to new efficient estimation methods, recently research including individual models estimated has come out (Klapper, Ebling and Temme 2005, Terui and Dahana 2006).

As stated, the consumer behavior around the reference price is the focus of a number of studies that use the multinomial logit model and an additive value function. Our analysis is based on McFadden's conditional logit model. When viewing consumers' response to price changes of a product the most striking result is the significant role played by the product's market share prevailing at its reference price. Perhaps contrary to intuition, prospect theory only plays a minor role in understanding loss aversion.

We proceed by reviewing the conditional logit model in Section 2; Section 3 develops conditions for loss averse and gain seeking consumer behavior, and Section 4 concludes.

CONDITIONAL LOGIT MODEL

Employing the conditional logit model by McFadden (1974), we aim to analyze consumer behavior under price variations of a given product.

Consider customers in a given population facing a finite set of alternative choices $i = 0, 1, 2, \ldots$. For $i > 0$, the alternatives refer to products which may be substitutes to each other. Alternative $i = 0$ refers to not choosing any of the products.

Customers are denoted by $\omega \in \Omega$, where Ω is the entire population under consideration. We interpret population Ω as a market segment. Each customer makes a choice either to buy one of the products ($i > 0$) or not to buy any ($i = 0$).

Customer preferences are assumed to be specified by an *additive random utility* model as follows. For each customer $\omega \in \Omega$, the utility $u_i(\omega)$ from choosing alternative i is given by

$$u_i(\omega) = v_i + e_i(\omega), \tag{1}$$

where v_i is common to all customers in Ω and $e_i(\omega)$ accounts for individual preferences.

We refer to component v_i as the *value function* of the random utility, and interpret the components $e_i(\omega)$ as realizations of a random variable ϵ_i in Ω. As in McFadden (1974), assume that the random variables ϵ_i are independent and identically Gumbel distributed[1] with mean zero, for all i. Furthermore, assume that the value components v_i and $e_i(\omega)$ account for product price but the distributions of random terms ϵ_i are independent of prices.

Given utility functions in Equation (1), alternative i is preferred by the customer ω to other alternatives $j \neq i$ if

$$u_i(\omega) \geq u_j(\omega) \quad \text{for all } j \neq i.$$

Assume that the utility function (1) is scaled such that the standard deviation of ϵ_i is $\pi/\sqrt{6} \approx 1.28$. With this scaling the probability of a randomly chosen customer $\omega \in \Omega$ choosing product i is

$$p_i = \frac{\exp(v_i)}{\sum_j \exp(v_j)}. \tag{2}$$

Hence, for product $i > 0$, p_i is interpreted as expected *relative demand*, while $p_i/(1-p_0)$ is the market share.

PRICING IMPACTS

Consider one particular product $i > 0$. Let prices h_K, for $K = N, H, L$ denote three alternative price levels for product i. Here N stands for normal price, which may be the current market price. Price h_N is considered as the reference price. Index H stands for high (an increased price) and L for low (a decreased price).

While keeping the prices constant for other products $j \neq i$, we now aim to investigate the sensitivity of demand of product i with respect to its price increase and decrease. For notational convenience, suppose the price increase $h_H - h_N$ is equal to the price decrease $h_N - h_L$. For the price alternatives N, H and L, denote the common value component v_i of product i by v_N, v_H and v_L, respectively. Denote

$$\delta_L = v_L - v_N \quad \text{and} \quad \delta_H = v_N - v_H, \tag{3}$$

the gain in value due to price decrease and the loss due to price increase, respectively. We assume $\delta_L \geq 0$ and $\delta_H \geq 0$.

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[1] One might assume normal distribution instead of Gumbel distribution. In this case only numerical analysis is possible instead of the main result in (2).

Given price levels N, H and L for product i, the respective expected relative demand of product i obtained from (2) is denoted by p_N, p_H and p_L. Price sensitivity of demand for i is measured by changes in expected relative demand, given a price increase or decrease while maintaining prices of other products unchanged.

Let $\Delta_H = p_N - p_H$ denote the decrease in demand and $\Delta_L = p_L - p_N$ the increase due to price increase and decrease, respectively. Denote

$$\Delta = \Delta_H - \Delta_L = 2p_N - p_H - p_L. \tag{4}$$

Definition. Given Δ in (4), the market segment Ω with respect to price changes of product i is *loss averse* if $\Delta > 0$, *gain seeking* if $\Delta < 0$, and *symmetric* if $\Delta = 0$.

Given the normal price level N for product i, (2) yields expected demand p_N for product i, and

$$\frac{1 - p_N}{p_N} = \frac{\sum_{j \neq i} \exp(v_j)}{\exp(v_N)}. \tag{5}$$

Then for any price level K ($K = N, H, L$) of product i, (2) and (5) yield expected relative demand

$$p_K = \frac{1}{1 + \exp(-v_K) \sum_{j \neq i} \exp(v_j)} = \frac{p_N}{p_N + (1 - p_N) \exp(v_N - v_K)}. \tag{6}$$

Hence, from (3), (4) and (6) we get

$$\Delta = p_N \left[2 - \frac{1}{p_N + (1 - p_N) \exp(\delta_H)} - \frac{1}{p_N + (1 - p_N) \exp(-\delta_L)} \right]. \tag{7}$$

Afrer straightforward algebra[2], the loss aversion condition $\Delta > 0$ becomes

$$p_N > p^* \equiv \frac{\exp(\delta_H) + \exp(-\delta_L) - 2 \exp(\delta_H - \delta_L)}{2[\exp(\delta_H) - 1][1 - \exp(-\delta_L)]}. \tag{8}$$

The denominator in (8) is positive. Hence, a non-positive nominator implies loss aversion. However, the nominator can be strictly positive. Hence, (8) implies loss aversion if $p_N > p^*$ while $p_N < p^*$ refers to gain seeking behavior. Consequently, we obtain the following result:

Proposition 1. For market segment Ω, given p^* in (8), $p_N > p^*$ implies loss averse, $p_N < p^*$ gain seeking, and $p_N = p^*$ symmetric behavior.

The market share of the product under consideration is $p_N/(1 - p_0)$, where p_0 is the expected share of population which chooses not to buy any of the products. Hence, by Proposition 1, the segment is loss averse with respect to the product under consideration if its market share is larger than $p^*/(1 - p_0)$. For example, if $p_0 = .80$ and $p^* = .1$, then a market share larger than $.1/(1 - .8) = 50\%$ implies loss aversion. Note that for

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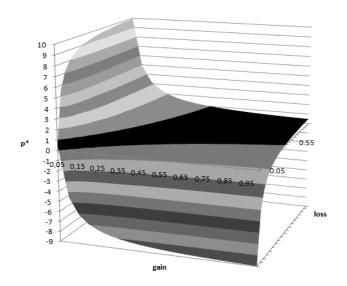
[2]To see the result, denote $p = p_N > 0$, $q = 1 - p > 0$, $x = \exp(\delta_H) > 1$ and $y = \exp(-\delta_L) < 1$. Then in (7), $\Delta > 0 \Leftrightarrow [2 - 1/(p + qx) - 1/(p + qy)] > 0 \Leftrightarrow [2(p + qx)(p + qy) - (p + qx) - (p + qy)] = [(p + qx)(p + qy - 1) + (p + qy)(p + qx - 1)] = [(p + qx)q(y - 1) + (p + qy)q(x - 1)] > 0 \Leftrightarrow [p(1 - x) + x](y - 1) + [p(1 - y) + y](x - 1)] = p[2(x - 1)(1 - y)] - x - y + 2xy > 0$, which implies (8).

suitable values of δ_H and δ_L, p^* is negative. In this case the market segment is loss averse for any level of p_N. On the other hand, p^* can be larger than one so that the segment is gain seeking.

Figure 1 presents p^* as a function of δ_H and δ_L. When δ_H is large compared with δ_L, p^* is negative which means loss averse price behavior whereas in the opposite case p^* exceeds 1 indicating gain seeking behavior.

FIGURE 1.
LIMIT p^* UNDER ALTERNATIVE LEVELS OF VALUE LOSS δ_H AND GAIN δ_L.
THE BLACK AREA REFERS TO THE REGION WHERE $0 \leq p^* \leq 1$

In the region of interest in Figure 1 we have $0 < p^* < 1$. We illustrate it in more detail in Table 1 presenting the values of p^* when $\delta_L = .35$.[3] In this demonstration, we set $p_0 = 0$ referring to a case where choice alternative $j = 0$ is non-existent. If $\delta_H = \delta_L = .35$, loss aversion appears if the market share with the prevailing price exceeds .5, a requirement hard to meet in almost any product category. Otherwise price behavior is gain seeking. Note that even with $\delta_H = .3 < \delta_L = .35$ price behavior is loss averse if $p_N > p^* = .74$ - in very favorable market conditions the market is more sensitive to an increase in the price than to a decrease that would further increase the already high demand. Similarly in case $\delta_H = .5 > \delta_L = .35$, price behavior is gain seeking if $p_N < p^* = .08$. Hence, in a situation where the market share is below .5 a price fall may raise the demand more than an equal price increase decreases it even if the price increase causes a value loss greater than the value gain in the price fall.

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[3]The interpretation of the levels of value gain δ_L and loss δ_H relates to the standard deviation of the random variable ϵ_i of the random utility model. To obtain (2) from the utility function (1), the standard deviation of ϵ_i is $\pi/\sqrt{6} \approx 1.28$. Hence, $\delta_L = .35$ refers to a value loss, which is about 27 percent of the standard deviation 1.28.
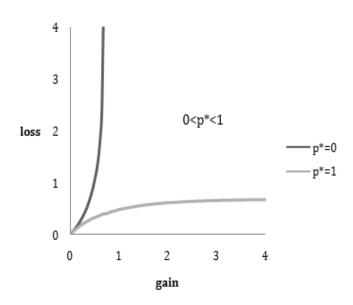
Given that the condition for loss averse behavior under equal value loss δ_H and gain δ_L is $p_N > .5$, perhaps growing attention should be paid to empirical studies concerning gain seeking price behavior. See also the more general results in Section 3.2 below.

TABLE 1.
LIMITS p^* UNDER ALTERNATIVE LEVELS OF VALUE LOSS δ_H
GIVEN THE LEVEL OF VALUE GAIN $\delta_L = 0.35$

δ_H	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65
p^*	1.57	1.07	.74	.50	.32	.19	.08	-.01	-.08	-.15

Figure 2 illustrates the values of δ_L and δ_H for p^* is between zero and one. For $p^* = 0$, (8) yields $\delta_L = \log[2 - \exp(-\delta_H)]$. Hence, δ_L increases with δ_H and approaches $\log 2$ for large δ_H. Symmetrically for $p^* = 1$, (8) yields $\delta_H = \log[2 - \exp(-\delta_L)]$, so that also δ_H approaches $\log 2$ for large δ_L.

FIGURE 2.
LEVELS OF VALUE LOSS δ_H AND GAIN δ_L WITH $0 \leq p^* \leq 1$.

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PROSPECT THEORY

Employing the normal price h_N as the reference price for product i, prospect theory suggests that the marginal value of the component v_i jumps down at the normal price. Hence, given small values of $\delta_H = v_N - v_H$ and $\delta_L = v_L - v_N$, prospect theory suggests

$$\delta_H > \delta_L. \tag{9}$$

Of course, Proposition 1 applies in this case as well. Because (8) does not imply that $p^* \leq 0$, it is possible to observe gain seeking behavior even if preferences conform to prospect theory. For δ_H and δ_L small, we employ first order Taylor approximation for the exponent functions in (8) to obtain

$$p_N > p^* \approx \frac{[\delta_L - \delta_H]}{2\delta_H \delta_L}. \tag{10}$$

Because $\delta_L - \delta_H < 0$ by (9), inequality (10) always holds. Consequently, we have the result:

Proposition 2. If δ_H and δ_L are small (i.e., the price changes are small), then prospect theory implies loss aversion for the market segment Ω.

AFFINE OR SMOOTH VALUE FUNCTION

Next, suppose v_i is an affine function of the price of product i. Then the marginal value with respect to price is constant, and consequently, $\delta_H = \delta_L$. In this case, $p^* = .5$ and (8) reduces to condition

$$p_N > .5. \tag{11}$$

Finally, consider the case where v_i is differentiable with respect to price at the normal price. Then for small price variations $\delta_H \approx \delta_L$, and again, condition (8) reduces to (11). Hence, we conclude

Proposition 3. For the market segment Ω, if the value function is smooth and the price changes are small or if the value function is affine, then $p_N > .5$ implies loss averse, $p_N < .5$ gain seeking, and $p_N = .5$ symmetric behavior.

By Proposition 3, the segment is loss averse if market share of the product under consideration is larger than $.5/(1-p_0)$. Hence, for $p_0 = .20$, a market share larger than $.5/(1-.2) = 62.5\%$ implies loss aversion.

CONCLUSIONS

Numerous studies consider empirically the presence of loss aversive or gain seeking behavior around the reference price. Here, the random additive utility model and the multinomial logit choice model are employed and general conditions developed for a market segment to be loss aversive or gain seeking. No assumptions from prospect theory are essential.

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