

# An Empirical Study of Price Thresholds and Price Sensitivity

Dr. Mete B. Sirvanci, Marketing, University of Wisconsin-Whitewater

## Abstract

*Consumer price sensitivity is studied in the context of supermarket grocery shopping using a survey of supermarket shoppers. It is shown that price sensitivity depends both on product features and consumer characteristics. Price laws such as Weber's law and the Weber-Fechner law are empirically investigated. Shopper profiles are identified on the basis of price sensitivity by discriminant analysis of variables representing consumer demographics, shopping behavior, and price awareness.*

## Introduction

In this paper, consumers' price sensitivity is studied in the context of supermarket grocery shopping using a survey of supermarket shoppers. One of the objectives is to investigate empirically the various price laws, such as Weber's law and the Weber-Fechner law, (e.g. Monroe, 1979) where it is hypothesized that the price (stimulus) of a given product is the main factor which determines the magnitude of the response. However, it may also be argued that individuals perceive the same price differently and their responses to prices may depend on such factors as their demographic, shopping behavior, and price knowledge characteristics. In what follows, after a literature review on price sensitivity, the price laws are studied empirically and then various other factors are examined in order to identify specific shopper profiles on the basis of price sensitivity.

## Literature Review

One notes from the literature that there are at least four major price concepts; price awareness, price sensitivity, price thresholds, and the impact of contextual influences on price perceptions. While price sensitivity denotes the degree of reaction provoked in an individual by price differentials, price awareness refers to the ability of the buyer to remember prices. The first term can be more simply characterized as "concern" and the second as "recall". The relationship between these two price concepts is noted by Gabor and Granger (1961) that it cannot be assumed that "having some recollection of the price paid can be taken as evidence of being consciously concerned with it." However, they do assert that "the converse is certainly true: if a housewife cannot remember the price paid for a recent purchase, she could not have paid much attention to it at the time." Studies (e.g. Dickson and Sawyer, 1985 and Zeithaml, 1982) indicate that consumers do not always

know or recall actual prices of products. In fact, they encode and categorize prices according to their own internal reference systems, thus giving rise to perceived price of the product which is distinguished from the objective or the actual price of the product. In addition, Zeithaml and Berry (1987) show that price awareness differs among various demographic groups. On the other hand, while McGoldrick and Marks (1987) indicate that, in general, socioeconomic variables are not strong predictors of price awareness, they state that price is of the most importance to the larger households and less educated and older shoppers.

Monroe (1976), (1973), (1979) and Monroe and Petroschius (1981) have devoted much attention to the concept of price thresholds and the importance of the Weber-Fechner law to pricing. Weber's law states that small, equally perceptible changes in a response correspond to proportional changes in the stimulus (just noticeable difference):

$$\Delta S/S = K, \quad (1)$$

where S is the magnitude of the stimulus,  $\Delta S$  is the change in S corresponding to a defined change in response, and K is a constant. Subsequently, Fechner reformulated Weber's law to derive the Weber-Fechner law:

$$R = K \log S + a, \quad (2)$$

where R is the magnitude of response, S is the magnitude of the stimulus, and a and K are constants. This law implies that a buyer has lower and upper price thresholds, and that a buyer has a range of acceptable prices for a purchase (Monroe and Petroschius, 1981). Wheatley et al. (1981) used Weber's law to analyze the

ability to discriminate customers exposed to carpeting of different quality and price levels. In a series of papers, Kamen and Toman (1970), Monroe (1971a), Gabor et al (1971), argued for and against the application of Weber's law to pricing studies.

There are certain questions that can be formulated such as whether buyers have upper and lower price limits and how buyers discriminate among differentially priced choices. For example, Monroe and Petrosius (1981) state that it cannot be assumed that prices are perceived to be different even if they are numerically different. They conclude that buyers will be more sensitive to price changes for some products, that is, they have lower differential price thresholds. On the other hand, for some products, a price increase or decrease may not be perceived, suggesting that these products have a relatively high  $K$  value in Equation (1).

Although price influences buyers' perception of cost and value, previous research suggests that the specific way price affects buyers' decision-making processes depends also on the purchase context. Two schemes, adaptation-level theory and assimilation-contrast effects, provide support for understanding contextual influences on buyers' perception of price. For example, adaptation-level theory suggests that price perception depends on the actual price and individual's reference price, or adaptation level. In other words, an individual judges a given stimulus relative to what he or she has become accustomed. Emery (1970) identified some implications of adaptation-level theory on price perception. He suggested that price perceptions depend partially on other prices and on how the product is used and also that there exists a region of indifference about a reference price, i.e., changes in price within this region produce no change in perception.

From the review of the literature on price perception, it can be concluded that there are no simple explanations as to how price influences individual shopper's purchase decisions. Moreover, there is evidence of much variability in individual responses to price. Finally, there is conflicting evidence in the literature about the relationships existing between three major groups of variables, consumer demographics, shopping behavior, and price sensitivity. In this study, the themes of differential price thresholds and contextual influences are developed by investigating what magnitude of price increase would cause shoppers to change their shopping behavior, that is, to switch or stop buying certain grocery items. Insofar as most of the price perception research has concentrated on relatively lower-priced consumer goods (such as grocery products and gasoline), the present study continues this research direction and undertakes to expand our understanding of consumer price perceptions.

## Procedure

Data collection was accomplished by means of personal interviews with supermarket shoppers using a structured questionnaire. The sample was randomized by selecting every  $n$ th shopper exiting a particular store, with provisions for substitution of the next shopper in the case of a refusal to participate. Data collection took place over a two-week period across a Midwestern state and sampling included communities of varying sizes, from small cities to leading conurbations as shown in Table 1. Store sites were selected on a convenience basis to include major national or regional chains and independents.

The interview instrument was designed to provide data on four key groups of variables. These are a) demographic variables (age, sex, marital status, household size, income, community size), b) shopping behavior variables (shopping frequency, number of stores patronized, store loyalty, brand loyalty, price comparisons, coupon usage, attention to price changes and price 'specials'), c) price awareness (recall of prices for items purchased), and d) price sensitivity (high end values for items purchased). Price awareness was measured by asking respondents to cite prices paid for eight basic grocery items (hamburger, lettuce, milk, cream cheese, soda, coffee, laundry detergent, and paper plates). Actual prices were later verified for these items in the store and the difference (over or under) was calculated in relation to the cited price.

Price sensitivity was measured by asking shoppers how much of a price increase would be needed to prompt the shoppers either to switch to other product categories or completely stop buying the product if the price of the item under consideration is on the rise. Actual monetary response was noted for each of the eight grocery items although some shoppers responded that they would never stop buying the product. The objective was to identify the limit of the high end of an individual's price range for that item. This was considered to be the critical point where the perceived price would assume a contrast effect and be categorized in a different price range.

In data analysis, various factors which potentially influence buyers' price perception and buyers' response to price changes were taken into consideration. While, in Weber's law and the Weber-Fechner law, price (stimulus) is assumed to be the only factor which determines the response of the buyers, there are other factors such as consumer demographics and shopping behavior which also influence shoppers' price sensitivity. In the data studied here, the eight items, all belonging to the class of grocery products, form a relatively homogeneous group, but there are still some essential differences among them with respect to the frequency of

purchase, price, and consumption context. As a result, it can be argued that the price sensitivity has two main sources of variation, which are 1) products (with different features) and 2) shoppers (with different shopping characteristics and demographics, i.e., while different segments of shoppers have different thresholds for the same product, a given shopper segment has different thresholds for different products.) The first type of variation may be referred to as variation among products while the second kind as the variation among the shoppers or the subjects.

In the subsequent analysis, these two types of effects on the buyers' response to price change are distinguished. First, following Weber's law and the Weber-Fechner law, the effect of the base price of the product on shoppers' price sensitivity (stop/switch amount) is studied. The following model is hypothesized,

$$\Delta P = \beta_0 + \beta_1 P + \epsilon, \quad (3)$$

where  $\Delta P$  and  $P$  are the increase in the price of a product to cause the consumer to stop purchasing the product and the base price of the product, respectively.  $\beta_0$  and  $\beta_1$  are the constants of the model and  $\epsilon$  is the random error. In addition, one can argue that there must be factors other than the base price contributing to the levels of the price thresholds. Thus, another variable, which is derived from the data and may further explain the differences in price thresholds among products for a given shopper segment, is incorporated into the model in Equation (3). In the subsequent part of the analysis, the characteristics of individual shoppers in terms of consumer demographics and shopping behavior are taken into consideration and their effects on price sensitivity are studied. In this analysis, for each product, the consumer characteristics which may discriminate between price sensitive (early stoppers) and price insensitive (late stoppers) shopper groups are investigated. Although no formal hypotheses are made, store loyal, brand loyal, and higher income shoppers are expected to be less sensitive to price increases. On the other hand, price aware, generics buyer, coupon and specials prone shoppers are expected to be more price sensitive.

## Results

Table 1 presents a simple profile of the sample. Nonresponse by individual shoppers was mitigated by the substitution process. Nonresponse to specific questionnaire items occurred mostly in relation to the questions on price awareness and sensitivity. Nonresponse also occurred due to nonpurchase of some of grocery items studied, particularly, for those items which are purchased less frequently. Interviewers were adequately trained and briefed in advance and their load was limited to ten interviews per person. Control

**Table 1. Sample Description  
(number of respondents = 349)**

		N	%
<u>Sex</u>	Male	101	29
	Female	248	71
<u>Age</u>	Under 20	15	4
	21-35	14	42
	36-50	119	34
	Over 51	63	18
	No response	5	2
<u>Marital Status</u>	Single	101	29
	Married	230	66
	Other	12	3
	No response	28	8
<u>Number in Household</u>	One	64	18
	Two	87	25
	Three	61	17
	Four	64	18
	Five	34	10
	Six	28	8
	No response	11	4
<u>City</u>	Small (less than 10,000 pop.)	98	28
	Medium (10,000-50,000 pop.)	151	43
	Large (over 50,000 pop.)	100	29
<u>Frequency of Shopping</u>	Once a week or more often	236	68
	Once every two weeks	83	24
	Less often than once every two weeks	30	8
<u>Number of Supermarkets Regularly Shopped</u>	Just one store	111	32
	Two stores	166	48
	3 or more stores	72	20

procedures were set up to verify consistency by individual interviewers and by the group as a whole.

In an attempt to remove the variation due to differences in shoppers, mean values for stop/switch amounts were used for each of the eight grocery items. These values labeled as "mean price increase to stop" are given in Table 2 along with some other related results. The total number of respondents in the survey was 349. Since most shoppers did not purchase all of the eight grocery products, the number of valid cases was less than 349 for individual items. Some shoppers responded that they would never stop purchasing certain grocery items regardless of the amount of increase in their prices. Even if the price increase situation was a hypothetical one, it can be argued that this response represents a specific type of consumer behavior due partly to consumer price insensitivity and partly to the nonsubstitutibility and essentiality of the particular product. The last column of the table represents the percentage of these responses.

**Table 2. Price Sensitivity Data for Eight Grocery Items**

Product	P Mean Base Price (\$)	$\Delta P$	
		Mean Price Increase to Stop(\$)	E Percentage of Nonstoppers
Hamburger	1.55	.71	8.2
Lettuce	.59	.39	5.2
Milk	1.59	.79	19.4
Cream Cheese	.86	.41	3.9
Soda	1.69	.67	5.0
Coffee	4.88	1.30	7.9
Laundry Detergent	3.63	1.08	17.3
Paper Plates	1.35	.44	0.9

The "mean price increase to stop" column in Table 2 is obtained as the mean of all valid cases excluding the nonstopper group. Because the averages are calculated over the respondents, it is expected that the effects of various types of shoppers on price thresholds is removed. The remaining variation in column 2 of Table 2 is primarily due to the differences in the products, including their price differences and possibly other product features. Treating  $\Delta P$  and P of Table 2 as  $\Delta S$  and S in Weber's law, the following expression is derived by the least squares method:

$$\Delta P = 29.0 + .215 P, \tag{4}$$

(.003) (.000)

where  $R^2 = 92.2\%$  and the p-values for parameters are

given in parentheses. In the spirit of the Weber-Fechner law, equation (4) demonstrates that shoppers' response to price increases depends, for the most part, on the actual price of the product for this set of relatively low-priced grocery items. In particular, the threshold to stop purchasing is equal to 21.5% of the price of the product plus a constant of \$.29. Although it is not always possible to interpret the constant term in regression results, we may argue that \$.29 in equation (4) represents the grocery shoppers' mean insensitivity threshold to price increases; the shoppers, on the average, either do not notice price increases less than this amount or even if they notice the increases, they do not perceive them significant enough to change their purchasing behavior.

Even for a relatively homogeneous set of products such as the eight grocery items in Table 2, there are features other than price which may influence the shoppers' price sensitivity. One such property is the perceived importance or essentiality of the product which also depends on the availability of substitutes. The 'percentage of nonstoppers' in Table 2 may be considered as a measure representing this characteristic. The following model:

$$\Delta P = \beta_0 + \beta_1 P + \beta_2 \log E, \tag{5}$$

where E = % of nonstoppers, is suggested to study the effect of essentiality on the price thresholds. In equation (5), log E is used because E is expressed as a percentage while the other variables are actual amounts, and, in fact, log E provides a better fit in equation (6). Using the data in Table 2, one obtains:

$$\Delta P = 17.1 + .191 P + 9.21 \log E, \tag{6}$$

(.009) (.000) (.007)

where  $R^2 = 98.4\%$  and p-values are given in parentheses. Comparison of equation (6) with equation (4) indicates that the change in the coefficient of the base price P is not large. However, equation (6) confirms the existence of another factor which causes variability in price thresholds besides the actual price. While equation (4) implies a common region of indifference (\$.29, excluding the effect of the base prices) to price increases for all eight products, according to equation (6) there are differences among the products even when the base prices are similar. For example, comparing three similarly priced products, milk, soda, and paper plates, the thresholds of indifference (excluding the effect of price) are \$.44, \$.32, and \$.16, respectively, as calculated from  $17.1 + 9.21 \log E$ . These results agree with the argument of Monroe and Petroschius (1981) who state that the buyers will be more sensitive to price changes

for some products. Thus, the model above captures most of the variation in shoppers' price thresholds due to the differences in products. It employs a measure of essentiality in addition to the actual price to explain why grocery shoppers are more sensitive to price increases for some products than others.

The analysis above attempts to explain the differences in price sensitivity for various products using aggregate values for price thresholds. However, even when the product is kept constant, price thresholds vary considerably among the individual shoppers. This variation is due to the differences in shopping behavior and the differences in demographical characteristics of the consumers. To study the price sensitivity differences for individual shoppers, respondents were divided into two groups as price sensitive and price insensitive for each grocery item. For a particular product, respondents who have stated a low stop/ switch threshold, in most cases \$.50 or less depending on the product, were put into the price sensitive or early stopper group while those with larger thresholds, \$1.00 or more for most cases, were labeled as price insensitive or late stopper group. A separate stepwise discriminant analysis was run for each product where the set of discriminating variables included the shopping behavior variables, demographic variables and also the variable representing the actual price awareness for that particular product. The objective of this analysis was to derive profiles for price sensitive shoppers as opposed to those who are less sensitive to price increases.

The results of the discriminant analysis are presented in Table 3. The top entries in the cells are the standardized canonical coefficients of the discriminant function and those in parentheses are the F-statistic values to remove the particular variable from the discriminant function. Group 1 is the early stopper (sensitive) and Group 2 is the late stopper (insensitive) group. For each product, the signs of group centroids are also indicated so that it can be argued in which direction each variable affects price sensitive or the early stopping behavior.

Although there were differences among the products in terms of the variables selected by the stepwise discriminant procedure, certain variables appeared in most of the discriminant functions. In general, the price sensitive group consisted of shoppers who patronize more stores, consider themselves selective generics buyers and also consider themselves aware of price changes, who are in fact more aware of the prices they pay, and who have lower income but larger families. Although sex of the shopper was not significant in the univariate tests conducted initially, sex seemed to have

some discriminating power, particularly, for products such as laundry detergent, hamburger, milk, and soda, for which females were less sensitive to price increases. There were some exceptions to the general characteristics summarized above. Specifically, for laundry detergent neither income nor price awareness was significant, but instead, shoppers who regularly take advantage of price specials were more sensitive. This may be due to nonavailability of substitutes for this product. Store loyalty was an important discriminating variable for coffee and paper plates for which loyal behavior coincided with price insensitivity. Coupon using behavior favored price sensitivity mainly for soda and cream cheese. Among the demographic variables, other than income, family size, and sex, marital status did not indicate any direction for group membership except for cream cheese while age had different effects for different products; older shoppers were less sensitive to price increases for laundry detergent and paper plates, but more sensitive for coffee and soda although the average coffee shopper was older than the average soda shopper.

## Discussion

The objective of this article was to study the various factors influencing consumer price sensitivity. It is shown that price sensitivity depends both on the product and the purchaser. The same shopper may have different price thresholds for different products while different shoppers will generally have different price thresholds for the same product. The study attempted to identify the product characteristics and the specific shopper profiles which cause the variation in price sensitivity in the context of eight grocery items. When the analysis concentrated on product differences by using aggregate data of price thresholds, it was found that price thresholds depend primarily on actual prices of the products, where shoppers have larger stop/switch amounts for higher priced grocery items. This result supports the claims of earlier researchers (Monroe and Petroschius, 1981) who based their arguments on the Weber-Fechner law. It was also shown that perceived "essentiality" of a product has a secondary effect, next to the base price, on price sensitivity. In general, shoppers have relatively larger price thresholds for those products which they perceive as essential with few or no substitutes such as milk and laundry detergent. Essentiality was employed along with the base price to predict the price threshold as an extension of the Weber-Fechner law. This extension implies that the magnitude of the response depends both on the magnitude and the nature of the stimulus. Further research may be carried on along these lines to define better measures of "essentiality" and "importance" for various products as perceived by different consumer segments.

Table 3. Discriminant Analysis Results

Product group:	V5 Number of stores Patronized (larger (more stores))	V6 Regular shopper = 1 others = 0	V7 Perception of prices (larger prices are higher)	V8 Coupon Usage (smaller coupon usage)	V9 Specials Usage (smaller specials usage)	V10 Perception of price: (know = 1 don't know = 0)	V11 Generic Buyers (larger more generics)	Actual Price (smaller more aware)	V36 Family Size (larger more members)	V37 Marital Status (married = 1)	V38 Income (larger more income)	V39 Sex (Female = 1 Male = 0)	V40 Age (large older)
Milk 1(-),2(+)	-.59 (6.7)	—	—	—	—	—	—	.55 (5.7)	-.47 (2.9)	—	.61 (5.5)	.27 (1.2)	—
Detergent 1(+),2(-)	.67 (9.7)	—	—	—	-.36 (2.3)	—	.26 (1.3)	—	.43 (3.1)	—	—	-.31 (1.8)	-.43 (3.6)
Coffee 1(-),2(+)	-.35 (4.1)	.59 (11.1)	.45 (6.3)	—	—	-.42 (5.6)	—	.59 (12.8)	-.29 (2.4)	—	.47 (7.0)	—	—
Hamburger 1(+),2(-)	.42 (3.5)	—	—	—	—	.45 (3.7)	—	-.30 (1.8)	.61 (5.1)	—	-.65 (6.6)	-.26 (1.1)	—
Soda 1(+),2(-)	.54 (7.7)	—	—	-.40 (3.3)	—	—	.54 (7.3)	—	—	—	-.44 (4.5)	-.44 (4.2)	-.34 (2.6)
Lettuce 1(+),2(-)	.58 (9.3)	—	—	—	—	.41 (4.5)	—	-.26 (1.8)	.48 (4.5)	—	-.69 (10.9)	-.33 (2.8)	—
Cream Cheese 1(+),2(-)	.50 (4.8)	—	—	-.32 (1.6)	—	.56 (5.6)	—	—	.46 (3.1)	—	-.40 (2.7)	—	—
Paper Plates 1(+),2(-)	—	-.47 (3.9)	—	—	—	.79 (11.4)	.32 (1.7)	—	—	—	—	—	-.38 (2.4)

The objective in the next stage of the analysis was to identify shopper profiles on the basis of price sensitivity. Although there were some differences among the products, it was not surprising to find out that brand loyalty, store loyalty, and higher income were general characteristics of the price insensitive group while price knowledge, coupon usage, proneness to specials, larger families, lower income, and patronizing more stores regularly were prominent characteristics of the price sensitive shoppers. Price awareness, measured as the recall of actual store price of product, was also a good predictor of price sensitivity particularly for items which are purchased more frequently and have relatively more standard package sizes and fewer brands. This research, using a survey of supermarket grocery shoppers, brought into focus both shopper and product characteristics to predict consumer price sensitivity. The results, while confirming earlier claims and arguments in the price perception literature, also provide insights into the relationships which exist between consumer demographics, supermarket shopping behavior, and price awareness variables and price sensitivity.

#### Suggestions For Future Research

The research undertaken in this study can be extended in various directions. A natural generalization is to study the price laws with respect to other groups of products. In this article, the empirical study was confined to eight grocery items. The research can certainly be extended to more products in different categories. Another fruitful area for further research is to continue the study of the concept of essentiality of products as perceived by different consumer segments. In this study, the variable for essentiality was derived rather indirectly from the data. It is highly desirable to measure this variable separately in the study. Of course, research can be carried out on other aspects of the price concept besides price sensitivity and price thresholds. In the literature review section some of these areas are identified.

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