Quantity Surcharges on Groceries

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Abstract

A quantity surcharge exists when the unit cost of a given brand is higher for a large-size package than for a smaller one. This paper examines some product and household characteristics that influence observed quantity surcharging practices. Results indicate that the propensity to buy a large-size package of a product is positively influenced by the extent of a household's usage of that product, procurement cost, and carrying capacity, and is negatively influenced by the propensity to price search. A retailer's decision to levy a quantity surcharge is, in turn, influenced by the demand for the product, the propensity to buy large-size packages, and to some extent the product's carrying cost.

Quantity Surcharges on Groceries

1. Introduction

A quantity surcharge exists when the unit cost of a given brand is higher for a large package than for a small one.[1] Quantity surcharges are an important topic for research because average annual grocery expenditures in the United States constitute about ten percent of a household's income (*U.S. Statistical Abstracts 1991*).[2] Consequently, any cumulative loss to the consumer due to this practice may represent a substantial dollar value. It may be possible to reduce the extent to which consumers pay quantity surcharges through public policy changes or consumer education.

Although there is ample evidence of the prevalence of quantity surcharges on grocery products, past literature provides limited theoretical rationale for the existence of this phenomenon. The objective of this paper is to examine some product and household characteristics which are hypothesized to influence the quantity surcharge phenomenon.

In the following section, the evidence supporting the existence of quantity surcharges is discussed, together with a brief review of past theoretical research. Next, several hypotheses associating product and household characteristics with the likelihood of a quantity surcharge on a product are proposed. This section is followed by a description of the data and the estimation method used to empirically test the hypotheses. The results are subsequently presented and discussed.

2. Literature Review

Two streams of research have examined quantity surcharges. The first and earlier stream documents the existence of quantity surcharges on groceries. The second stream of research provides some rationale for the existence of quantity surcharges from two distinct approaches: the supply side and the demand side.

Widrick (1979a, 1979b), followed by Nason and Della Bitta (1983) and Cude and Walker (1984) have empirically demonstrated how extensive this pricing practice is in several different markets. The results from these studies are presented in Table 1.

Table 1 Percentage of Sampled Brands Exhibiting Quantity Surcharges Across Studies

Products	Markets Surveyed				
	Oswego, New York (1977)[a]	Monroe, New York (1977)[a]	Rhode Island (1980)[b]	Rhode Island (1981)[b]	Jackson, Illinois (1981)[c]
1. Tuna fish	85%	77%	36%	48%	47%
2. Ketchup	45	—	42	44	—
3. Cooking oil	37	—	41	59	10
4. Dishwashing liquid	34	—	50	52	10
5. Laundry detergent	33	31	36	48	33
6. Peanut butter	—	24	31	27	—
7. Instant tea	—	16	32	36	—
8. Frozen orange juice	—	20	13	11	27
9. Jams and jellies	12	20	24	5	—
10. Dry breakfast cereal	—	4	22	7	0
11. Beans in sauce	41	38	—	—	—
12. Tomato sauce	—	—	53	46	—
13. All-purpose flour	—	—	35	65	2
14. Liquid bleach	—	—	31	54	5
15. Toothpaste	—	—	23	37	—
16. Soft drinks	—	—	12	17	—
17. Canned coffee	—	—	10	20	—
18. Powdered bleach	—	—	37	3	—
19. Gelatin	—	—	22	3	—
20. Snack crackers	—	—	13	7	4
21. Mayonnaise	—	—	11	2	2
22. Shampoo	—	—	8	5	—
23. Aspirin	—	—	7	14	—
24. Mustard	—	—	1	10	—
25. Table syrup	5	5	—	—	—
26. Rice	—	7	—	—	3
27. Salad dressing	—	6	—	—	—
28. Juices	—	6	—	—	—
29. Vegetables	13	—	—	—	12
30. Cheese	32	—	—	—	16
31. Pork & beans	—	—	—	—	14
32. Fabric softener	—	—	—	—	16
33. Shortening	—	—	—	—	—
34. Mouthwash	—	—	—	—	4
Average Percentage of Quantity Surcharged Brands	34%	18%	25%	29%	19%
Number of Stores Audited	50	70	32	22	15
Number of Products	10	12	26	26	23
Number of Brands	970	2177	2069	1461	NA

Note: "—" indicates product not examined, NA = not available.

a. Widrick (1979a; 1979b)
b. Nason & Della Bitta (1983)
c. Cude & Walker (1984)

Table 1 shows the average percentage of quantity surcharged brands across sampled stores for each product and market. Average quantity surcharges range from a minimum of 18 percent in Monroe County (New York) to a maximum of 34 percent in Oswego, New York with a grand average of 25 percent for all brands examined across the four studies. The Table clearly indicates a pattern of quantity surcharging with certain products exhibiting consistently high or low levels of quantity surcharges across different markets surveyed at different times.

Several researchers have contributed to the second stream of literature on quantity surcharges. On the demand side, Gerstner and Hess (1987) examine the relationship between demand characteristics and quantity surcharges, assuming that consumers are fully informed. Their model states that, in general, consumers with low storage costs will prefer large packages and will be willing to pay a higher unit price. Further, Gerstner and Hess argue that manufacturers design package sizes in such a way that the combination of two smaller packages yields a quantity significantly greater than a single large "ideal package." As a result, the consumer is discouraged from purchasing multiple small packages as a strategy for avoiding surcharges.

Salop (1977) did not find it necessary to assume that consumers are fully informed. He argued that quantity surcharges are a price discrimination device directed toward shoppers with high search costs. The underlying premise that high search costs prohibit price comparisons across package sizes, fosters a certain level of ignorance in the marketplace. This leads to payment of higher price by those consumers who search less. Past empirical studies on price search for groceries show that those who search more tend to pay lower prices than those who search less (Carlson and Gieseke 1983; Frank, Green and Sieber 1967; Isakson and Maurizi 1973). Paying lower prices could be due to not only buying large packages on discounts, but sometimes smaller packages to avoid quantity surcharges, because of price search within stores (Walker and Cude 1983).

While providing important insights into quantity surcharges, the theories of Gerstner and Hess (1987) and Salop (1977) cannot explain the *systematic* variations in quantity surcharging across product categories. In addition, the notion of an "ideal" package size would seem most applicable to perishable grocery items consumed in discrete amounts. If an item is non-perishable, the marginal carrying cost would be quite low, and the purchase of a quantity in excess of the "ideal" may not prevent a consumer from purchasing two smaller packages to avoid a quantity surcharge. In addition, if an item is not

consumed in discrete units, it would be difficult for a consumer to conceptualize an "ideal" package size.

Walden (1988) attempts to explain *systematic* variations in quantity surcharges across products by examining supply characteristics. His model describes the decision to impose a premium price as a function of package costs, retailer storage costs and product turnover rates. Walden's model states that higher costs and lower turnover rates will result in a higher likelihood of increasing per unit costs. With respect to differences in packaging costs, he argued that all forms of packaging exhibit marginal savings for large packages although the level of savings may vary across different package forms. If such is the case, the impact would be on the degree of discounting, rather than on premium pricing. However, for large packages of frozen and refrigerated goods, which require increased carrying costs for the retailers, it is expected that retailers pass along the higher cost of storage to consumers.

The major difference between existing theories and the arguments presented in this paper is that the effects of both supply and demand characteristics on quantity surcharges are considered. This aspect contributes to the literature. Unlike Gerstner and Hess (1987) and Walden (1988), an assumption that consumers are fully informed about the distribution of prices in the market is not made. Though prices may be available, it is not necessary that consumers pay attention to it; in one study about half the respondents appeared to be ignorant of prices for grocery items (Dickson and Sawyer 1990). The unique treatment of the impact of information search is another highlight of this paper. Respondents can make their product choices based on price search during that particular trip; besides, the unit prices posted for the products also provide useful information at the point of purchase. In the following section, some specific hypotheses relating seller's storage cost, as well as product and household characteristics, to quantity surcharges are presented.

3. Hypotheses

3.1 Who Buys Large-Size Packages?

The total cost to a household for a given basket of grocery products includes various indirect costs, such as carrying costs (whether a good needs refrigeration or not), search costs (to make price comparisons within the store) and procurement costs (cost of traveling time), in addition to cash paid at the checkout counter (Blattberg,

Eppen and Lieberman 1981; Kunreuther 1973; Stigler 1961). Since most grocery products are available in different package sizes, one way a household can minimize its grocery costs is by selecting the optimal quantity to buy for each product; i.e., choosing the right package size of each product given its demand, carrying cost, procurement cost and product price. For example, since dry cereal has a reasonably long shelf life, a large family can buy a large package of dry cereal and keep it in storage, thus avoiding frequent trips to convenience stores and typically higher prices they charge. Such decisions regarding package size across all products in a grocery basket could significantly reduce the number of shopping trips or in-store shopping time. Thus, it is proposed that

> $H1_{(a-c)}$: The propensity to buy a large package of a product by a household (a) is positively influenced by the household's demand for the product; (b) is positively influenced by the household's procurement cost (i.e., travel time); and (c) is negatively influenced by the household's carrying cost of products.

Conceptually, the above relationship is similar to an inventory model, where the decision is to buy either one large package of a product on a single trip or to buy two small packages on two different trips given a household's demand, carrying cost, procurement cost and product price.[3] Such an inventory model, or variant form, has been used in the past in marketing to explain other aspects of consumer behavior (Blattberg *et al.* 1978; Granger and Billson 1972; Kunreuther 1973).

3.2 Why Buy on Quantity Surcharge?

The obvious question is why should a household buy one large package instead of buying two small packages, thus easily avoiding quantity surcharges, even if that household satisfies the conditions necessary for a higher likelihood of buying a large package size? As argued by Salop (1977), the consumer's knowledge of quantity surcharges is not free of cost. The theory of the economics of information postulates that dispersion in market price may be an outcome of ignorance on the part of consumers but also depends on the cost-benefit ratio for information gathering (Alcaly 1976; Stigler 1961; Urbany 1986). The same premise can be used to explain the existence of quantity surcharges.

The practice of quantity discounting is very common for groceries (Cude and Walker 1984; Gestner and Hess 1987).[4] Consequently, it has

created a strong belief among consumers that "bigger is cheaper" (Granger and Billson 1972; Nason and Della Bitta 1983). Perhaps as a result of this belief, most consumers do not seem to make within-brand price comparisons (Dickson and Sawyer 1990; Hoyer 1984). A high incidence of discounts on large packages not only perpetuates this belief, but also acts as a disincentive to unit price searching. It also creates a situation in which the cost of search (in terms of time and effort required for information gathering and processing) is likely to exceed the expected benefits of search (through a reduction in price) for a bundle of grocery products.

What happens when the consumer engages in price search? The direction of the impact of search on the propensity to buy large packages depends on the pervasiveness of quantity surcharges or discounts on a product. When the incidence of quantity surcharge on a product is small, the product category may contain many discounted brands. In such a case, although increased search provides greater exposure to discounts, the decision to buy a large- or small package depends on the household's demand for that product. Therefore, when the likelihood of quantity surcharge on a product is low, the direction of the relationship between the likelihood of buying a large package and search cannot be specified *a priori*. However, if quantity surcharge on a product is large, increased search is likely to lead to a greater awareness of quantity surcharges and, consequently, a reduction in the propensity to buy a large package. Determination of the "threshold level" or "switch-point" is, therefore, an empirical question. Hence, the following hypothesis is proposed:

> $H1_d$: Price search will have a negative effect on the propensity to buy a large size package if the quantity surcharge on a given product is beyond a threshold level.

3.3 Which Products are Quantity Surcharged?

Walden (1988) argues that for those products where carrying costs are higher for retailers (e.g., refrigerated items compared to shelf items), retailers should have less incentive to provide discounts. Hence retailers impose quantity surcharges on these products in order to recover the higher carrying costs.

Other factors which are likely to affect products exhibiting quantity surcharge are overall demand for the product, propensity for consumers to buy a large package of that product, and number of close substitutes available for a given product. The greater the overall

demand for a product, the greater will be the likelihood that a sufficiently large segment of the population will purchase large packages, thus making quantity surcharging economically attractive for the retailer. However, it is possible that, while aggregate demand for a product is large, purchases may be made in small quantities; e.g., bread and milk. Therefore, it is also suggested that quantity surcharging is more likely when the propensity to purchase a large package is relatively high.

The degree of substitutability is also proposed as an explanatory variable influencing the likelihood of observing a quantity surcharge. The reasoning is as follows: the fewer the number of close substitutes for a good, the greater the likelihood of observing a quantity surcharge. The importance of the degree of substitutability may be illustrated in the following example: if the consumer is out of macaroni and cheese, s/he may substitute rice, potatoes, bread, or any number of edible products. However, some items are less likely to have close substitutes. For example, there is no close substitute for dishwashing liquid or toilet tissue.

Based on the arguments presented above, the following hypotheses are proposed:

$H2_{(a-d)}$: The likelihood of quantity surcharge on a product is positively influenced by (a) the demand for the product, (b) the carrying cost of a product, (c) the propensity to buy large-size packages of the product, and (d) the degree of substitutability with other products.

The above hypotheses suggest that the decision to impose a quantity surcharge is based on certain demand and supply characteristics. Retailers impose quantity surcharges on those products which have relatively high demand, high carrying costs for the retailer and for which the market's propensity to buy a large package is high. The propensity to buy a large package, in turn, depends on procurement costs, demand, carrying costs for the consumer and the propensity to price search. Thus, quantity surcharging is a form of price discrimination operating through self-selection, affecting those consumers who have relatively high time costs and high demand for the product but low carrying costs. Those products with wide usage throughout the marketplace and which exhibit high carrying costs for the retailer are most likely to exhibit quantity surcharges.

4. Method

In this section, the data and the estimation procedures used to empirically test the hypotheses are described.

4.1 Data

Data for this study were collected from three different sources:

4.1.1 Store Audits

Store audits were conducted in Fall 1988 to provide primary data on quantity surcharging practices. Stores were selected from a large metropolitan area in Western New York. The area sampled has four major supermarket chains. Sixteen stores from the four chains were selected in order to incorporate the pricing policies of the different chains. In addition to representation of the four major chains, stores were selected in such a way as to incorporate high, medium and low income markets.

As groceries represent a large number of goods, it was necessary to develop some criteria for the selection of a manageable number of products. *Progressive Grocer's 1987 Supermarket Sales Manual* for grocery products (*Progressive Grocer*, July 1987) identified 35 basic product categories. Either one or two products, characterized by relatively high sales volume, were selected from each of the 35 different categories. High sales volume was used as a criterion in order to increase the likelihood that stores of all sizes carried the audited products. A total of 600 brands, representing 62 products, was included in the study. Those brands which were under special promotions are excluded from the study.

4.1.2 Survey

A survey of households was conducted in Fall 1988 to obtain information on household demand for products, carrying capacity, procurement costs, propensity to price search and likelihood of buying large packages of the 62 products which were audited. Respondents were individuals responsible for the majority of their household's shopping. Using this screening, 400 questionnaires were distributed at several stores to consumers who were willing to participate. They were each given (i) a self-addressed stamped envelope with a University return address for returning the completed questionnaire, (ii) a cover letter describing the study and announcing a lottery (cash prizes), designed to act as an incentive to stimulate returns, and (iii) a post card

to be mailed separately (to preserve confidentiality of responses) for some participation incentives through a lottery drawing. Of 286 returned questionnaires, only 255 were usable due to missing values in excess of a pre-specified limit of five percent, resulting in a usable response rate of 64 percent. The demographic profile of the sample indicated a median education level of "some college;" a median after-tax household income of $25,000 - $29,999;" and a median household size of two. Excepting education, this is comparable to the characteristics of the population in the metropolitan area studied (Buffalo, New York).[5]

4.1.3 Secondary Sources

Two sources were used to extract market demand data. First, *Progressive Grocer's Guide to Usage of Supermarket Products*, as reported in *Progressive Grocer* (September 1986), was used to assess the appropriate percentage of users for each of the 62 products sampled. If information on a particular product was unavailable from this source, the Simmons Market Research Bureau's *Simmons' 1985 Study of Media & Market* report was used.

4.2 Estimation Procedure

The hypothesized relationships in **H1** and **H2** are tested using the following two linear regression equations respectively.

$$L_{ij} = \alpha + \beta_1 DMND_{ij} + \beta_2 PCOST_i + \beta_3 CCAP_{ij}$$
$$+ \beta_4 SEARCH_i + \beta_5 \left[d(SEARCH_i) \right] + e_{ij} \quad (1)$$

where

L_{ij} = propensity of the ith household to buy a large-size package of the jth product

$DMND_{ij}$ = demand of the ith household for the jth product

$PCOST_i$ = procurement cost for the ith household

$CCAP_{ij}$ = carrying capacity of the ith household for the jth product

$SEARCH_i$ = propensity to price search by i^{th} household

and

$d = 1$ if $SEARCH_i >$ threshold value of quantity surcharge on a product; 0 otherwise.

$$Log \left(\frac{QS_j}{1 - QS_j} \right) = \alpha + \beta_6 ULEVEL_j + \beta_7 CCOST_j \quad (2)$$
$$+ \beta_8 L_{j*} + \beta_9 PTYPE_j + e_j$$

where

QS_j = likelihood of a quantity surcharge on the jth product

$ULEVEL_j$ = market demand for the jth product

$CCOST_j$ = carrying cost for the jth product

L_{j*} = propensity to buy a large-size package of jth product averaged across the sample of households surveyed.

$PTYPE_j$ = a dummy variable indicating paper and soap products ($= 1$; 0 otherwise), to capture product substitutability effects.

Table 2 provides a detailed description of the operationalization of the variables presented in the above two equations. One might argue that income could be a proxy for demand, procurement and carrying cost, but the explanatory richness would be lost.

Before presenting results, some of the variables used in estimation are discussed. First, a positive relationship is expected between procurement costs $\left(PCOST_i \right)$ and the likelihood of buying a large package. Procurement costs are measured as the dollar cost of travel time based on the wage rate of the respondent and travel time, both of which are obtained from the shopper survey. The household's carrying capacity for a given good $\left(CCAP_{ij} \right)$ is used as a surrogate for the household's carrying cost of a product and is captured as the product of X_j and Y_i, where X_j is a dummy indicating that refrigerator storage is required for the product and Y_i is a measure of the refrigerator storage space available to the household. From the consumer's point of view, because kitchen shelf storage capacity is likely to be greater than the capacity of the refrigerator, for most products, only a small package can be conveniently stored in the refrigerator, while relatively large items can be stored on kitchen shelves. Hence, space limitations discourage the consumer from

Table 2 Measurement of Variables

L_{ij} = Likelihood of buying large-size package of jth product by i^{th} household is measured by asking respondents to rate each product on "I usually buy this product in the....."

Don't buy	Smallest size		Medium size		Largest size
(0)	(1)	(2)	(3)	(4)	(5)

$DMND_{ij}$ = Demand for j^{th} product by i^{th} household is measured as the mean response to two following items measured on a 5-point strongly disagree and strongly agree scale for each of the 62 products:
1. My household uses a lot of this product.
2. My household cannot do without this product.

$PCOST_i$ = Procurement cost of ith shopper is measured as the dollar cost of traveling time to and from the most patronized store as follows: Wage rate per hour/60 x Traveling time in minutes; Both of these measures are obtained from the shopper survey.

$CCAP_{ij}$ = Carrying capacity of ith household for j^{th} product is measured as the product of X_j and Y_i, where
X_j = 1 if j^{th} product requires storage in the refrigerator after opening the product, otherwise 0.
Y_i = Self-reported refrigerator storage space of ith household (coded as small = 1; medium = 2; and large = 3).

$SEARCH_i$ = Propensity to price search by i^{th} shopper is measured as the mean response to the two items: (both items are reverse coded)
1. I usually check prices of products I buy when I do grocery shopping, measured on a 5-point scale, labeled "strongly disagree" to "strongly agree".
2. In general, once you've decided on a brand, do you check unit prices to see which size is the least expensive? That would be the price per unit (ex., the price per pound or ounce) that is listed on the tag attached to the shelf below the product. Measured on a 5-point scale, labeled "never" to "always".

QS_j = Likelihood of quantity surcharge on the jth product is measured as the number of package sizes with a quantity surcharge, relative to any smaller size package, divided by the total number of packages available within a given brand. This preliminary measure is then averaged across brands and stores for a given product.

$ULEVEL_j$ = Market demand for j^{th} product is defined in terms of the percentage of users of jth product reported in *Progressive Grocer* and *Simmons*.

$CCOST_j$ = Carrying cost for j^{th} product is defined in terms of the natural location of product before opening, where shelves = 0, refrigerator or freezer section = 1.

L_{j^*} = Propensity to buy a large-size package of the jth product is averaged across the sample of households surveyed.

$PTYPE_j$ = 1 if paper or soap products, 0 otherwise.

purchasing large packages of items which require refrigeration. Therefore, a positive relationship is expected between carrying capacity and propensity to buy a large-size product.

Price search is assumed to affect the likelihood of buying a large size package rather than affecting quantity surcharge directly. As the extent of price search is affected by the volume of purchases, in addition to search costs, a self reported direct measure of the general propensity to price search is used in this study.

It was argued earlier that the direction of the impact of price search on the likelihood of buying a large package depends on the pervasiveness of discounts or quantity surcharge on a given product. Therefore, in order to measure the impact of search on the propensity to purchase quantity surcharged products, the variable $SEARCH_i$ appears twice in equation (1) — with and without a dummy variable. In Equation (1), $(\beta_4 + \beta_5)$ indicates the impact of search $(SEARCH_i)$ on the propensity to buy a large size package of the jth product (L_{ij}) when quantity surcharge on that product (QS_j) is equal to or greater than an empirically derived threshold value of QS_j. β_4 alone indicates the impact of $SEARCH_i$ on L_{ij} when QS_j is less than the empirically derived threshold value of QS_j. β_5 represents the change in the slope of the equation when the quantity surcharge is above a certain threshold (Maddala 1977).

In equation (2), QS_j is a positive fraction with a lower bound of zero. Therefore, the logistic model is applied to limit the expected value of QS_j to this range. $ULEVEL_j$ and $PTYPE_j$ are surrogates for product demand and degree of substitutability, respectively. $ULEVEL_j$ represents the percentage of users of a given product reported in either *Progressive Grocer's* or *Simmons Market Research Bureau*. The dummy variable $PTYPE_j$ is set equal to unity for household goods, such as soaps and paper products and zero otherwise. As a class of products, this group is presumed to have fewer close substitutes than foodstuffs. Hence, a positive relationship is expected between these two variables and the incidence of quantity surcharges.

5. Results

5.1 Level of Quantity Surcharge

Table 3 presents the average percentage of quantity surcharge for each of the 62 products across the sampled brands and stores. Differences in quantity surcharge across stores in the high, medium and low income neighborhoods were tested and found not to be statistically significant. Overall, the incidence of quantity surcharge across all brands included in the study is sixteen percent. Out of 62 products, 57 have quantity surcharges, ranging in degree from a minimum of one percent for raisins to a maximum of 62 percent for tuna.

A comparison of the percentages of quantity surcharge for the first ten products on Table 1 with the results of this study (Table 3) clearly suggests that there are certain products for which the incidence of quantity surcharges is relatively high, indicating some pattern in quantity surcharges across different markets. This pattern rests on audits of 155 stores in five different markets where chains are owned and operated by different organizations.

5.2 Hypotheses Tests

In this section, results from the empirical test of the hypotheses are presented and discussed. Table 4 presents the estimates of parameters of the two regression equations. Both the equations are significant (F significant at $p < 0.01$). In general, the signs of the coefficients are as expected.

5.2.1 H1: Propensity to Buy a Large-Size Package

Equation (1) is designed to explain the consumer's propensity to buy a large-size package of product j which, in turn, is assumed to affect a retailer's motivation to impose a quantity surcharge on that product. This equation explains a significant portion of variance in the household's likelihood of buying a large package $(R^2 = 46.22\%)$. All five variables included in equation (1) are significant at $p \le 0.05$. Of the variables included in equation (1), household demand for product j dominates all the other explanatory variables. As hypothesized, the higher a household's demand for a product, the greater the likelihood of purchasing a large package.

Procurement cost $(PCOST_i)$ is expected to have a positive effect on L_{ij}, as those who have higher procurement costs are expected to buy large packages to avoid frequent trips to the store. The results support this expectation. However, the effect size is small. Procurement cost is a joint cost assignable across all the products purchased during any trip to the grocery. Thus it is understandable that the impact is not high.

The next variable which significantly affects L_{ij} is refrigerator and freezer capacity, given that the storage location of an item after opening is the refrigerator or freezer $(CCAP_{ij})$. This variable is included as a surrogate measure of carrying cost. The positive coefficient and significance of $CCAP_{ij}$ means that the households having greater refrigeration capacity tend to buy larger package sizes of refrigerated goods.

Table 3 Observed Quantity Surcharges

Products[a]	Percent Quantity Surcharge[b]	Number of Observations[c]	Number of Stores[d]	Number of Brands[e]
1. Tuna Chunk Light Oil	61.97	27	14	7
2. Green Olives	45.07	21	16	3
3. Paper Towels	41.49	39	16	5
4. Barbecue Sauce	38.89	18	11	5
5. Tuna Solid White Water	37.66	31	15	5
6. Apple Juice (frozen)	35.71	7	7	2
7. Peanut Butter	35.90	54	16	9
8. Toilet Paper	34.19	52	15	9
9. Tissues	33.72	34	14	4
10. Pork & Beans	32.26	33	15	7
11. Ketchup	29.93	49	15	11
12. Coffee (can)	29.13	38	15	4
13. Detergent (liquid)	28.98	82	16	12
14. Orange Juice (frozen)	26.14	33	16	7
15. Napkins	25.00	36	14	10
16. Fabric Softener (solid)	24.47	74	16	10
17. Cooking Oil	23.81	77	16	9
18. Coffee Creamer	21.62	48	16	7
19. Yogurt	19.57	18	14	3
20. Fabric Softener (liquid)	18.63	65	16	8
21. Tomato Sauce	17.83	45	14	9
22. Dishwashing (liquid)	17.35	81	16	7
23. Cereal	16.67	89	16	23
24. Tomato Juice	16.67	18	14	4
25. Bar Soap	16.18	73	16	13
26. Detergent (powder)	15.31	76	16	8
27. Spaghetti	14.44	38	13	8
28. Macaroni elbow	14.29	42	14	9
29. Milk	14.06	27	14	8
30. Bleach (liquid)	12.71	42	16	7
31. Mayonnaise	12.62	32	14	5
32. Beer	12.39	85	16	21
33. Plastic Wrap	12.28	46	15	5
34. Orange Juice (dairy)	11.34	43	16	10
35. Spaghetti Sauce	10.58	37	14	8
36. Potato Chips (regular)	10.38	77	16	11
37. Trash Bags	10.16	45	16	8
38. Baked Beans	9.82	38	15	4
39. Soft Drinks (regular)	9.14	72	16	14
40. Apple Sauce	8.84	49	16	9
41. American Cheese	8.65	40	15	7
42. Cleaner Disinfectant	6.48	54	16	8
43. Diapers	6.36	41	14	7
44. Grape Jelly	5.98	44	16	6
45. Grape Juice (shelf)	5.56	15	13	2
46. Pretzels	4.92	27	14	5

(Continues)

Table ? Continued

Products[a]	Percent Quantity Surcharge[b]	Number of Observations[c]	Number of Stores[d]	Number of Brands[e]
47. Cookies	4.86	72	16	14
48. Crackers	4.71	42	15	9
49. Charcoal	4.65	18	13	5
50. Sour Cream	4.55	22	15	3
51. Rice	4.41	49	15	7
52. Cat Food (can)	3.85	13	12	2
53. Tea Bags	2.94	53	15	8
54. Corn Tortilla Chips	2.94	27	15	4
55. Aspirin	2.47	54	16	8
56. Dog Food (dry)	2.28	91	16	16
57. Mustard	2.10	60	16	8
58. Raisins	1.19	29	15	5
59. Baby Formula	0.00	49	14	5
60. Pickles (Dill)	0.00	47	15	6
61. Syrup (Maple)	0.00	40	15	6
62. Grapefruit Juice	0.00	18	14	4

a. $PTYPE_j$ = 1 for paper and soap products; i.e., item # 3, 8, 9, 13, 15, 16, 20, 22, 26, 30, 33, 37, and 43; $PTYPE_j$ = 0 for all other items.
b. The percentage of package sizes exhibiting quantity surcharges across brands and stores. Conceptually, this percentage may be viewed as the likelihood of exposure to a quantity surcharge across brands and stores if a large-size package of a product is picked randomly.
c. Number of brands across stores.
d. Number of stores carrying a product.
e. Number of brands audited.

Table 4 Regression Estimates of Equations 1 and 2

Independent Variables	Coefficients	Expected Sign	L_{ij}	$Log[QS_j/(1-QS_j)]$
$DMND_{ij}$	β_1	+	0.683** (116.14)	
$PCOST_i$	β_2	+	0.031** (5.12)	
$CCAP_{ij}$	β_3	+	0.012** (2.03)	
$SEARCH_i$	β_4	?	-0.015** (-2.46)	
$SEARCH_i(d)$	β_5	-	-0.029** (-4.97)	
$ULEVEL_j$	β_6	+		0.262** (2.03)
$CCOST_j$	β_7	+		0.189* (1.58)
$L_{j.}$	β_8	+		0.226** (1.72)
$PTYPE_j$	β_9	+		0.131 (0.95)
F Value			2716.92	4.23
(df)			(5, 15804)	(4, 57)
R^2			46.22%	22.90%
Observations			15810	62

Note: Betas are standardized; their t-values appear in paaarentheses.
** denotes significance at $p < 0.05$.
* denotes significance at $p < 0.10$.

The next significant variable is the propensity to price search, particularly when quantity surcharge is beyond a threshold level for any particular good j. Since the threshold of QS_j is unknown *a priori*, multiple analyses had to be performed, starting from a minimum value of QS_j starting at five percent and increasing in increments of one percent (Maddala 1977; p 136), until the coefficient β_5 just reached statistical significance ($p < 0.05$). For each analysis, d in equation (1) is set equal to unity if the quantity surcharge on the jth product is greater than or equal to the threshold value being tested.   At a value of $QS_j \geq 30$ *percent*, the coefficient of β_5 achieves statistical significance and the coefficient is negative $(\beta_5 = -0.029; t = -4.97)$.

The result suggests that when QS_j is low, high search decreases the propensity to buy large packages, although the impact is small ($\beta_4 = -0.015$) relative to the situation when the prevalence of quantity surcharge is higher; i.e., when $QS_j \geq 30\%$, $(\beta_4 + \beta_5 = -0.044)$. In other words, when the probability of finding a quantity surcharge on a product is equal to or greater than 0.30, the negative effect of the propensity to price search on the propensity to buy large packages accelerates.

Overall, equation (1) shows that the propensity to buy a large package of a product by a household is influenced by demand for that product, procurement cost, carrying capacity and propensity to price search as hypothesized in **H1a** through **H1d**. The impact of demand for the product is the strongest. The other variables — procurement cost, carrying capacity and propensity to price search — although significant, make a negligible impact on the decision to buy large or small size package. It would be reasonable to conclude that package size appears to be a useful segmentation variable.

5.2.2 H2: Likelihood of Imposing Quantity Surcharges

In equation (2), quantity surcharge is modeled as a function of usage level in the market $(ULEVEL_j)$, carrying cost $(CCOST_j)$, the propensity of households to buy a large package (L_{j*}), and type of product $(PTYPE_j)$. The parameter estimates of this equation indicate that quantity surcharge on a product is primarily affected by the usage level and the demand for the large package. The extent of product usage in the marketplace $(ULEVEL_j)$ makes the most significant impact on the percentage of quantity surcharge ($\beta_6 = 0.262$; $p < 0.05$). The positive coefficient of this variable suggests that the higher the percentage of users for a product, the greater the incidence of quantity surcharge on that product, thus supporting **H2a**.

Recalling that individual demand for the jth product is the dominant variable in explaining the propensity to buy a large package, it can be observed that consumers with high demand, low carrying cost and high procurement cost are expected to be more prone to buying quantity surcharged items. Even if the fraction of consumers with these characteristics is low, in the case of a widely used product, their absolute number should provide sufficient economic incentive to the retailer to quantity surcharge.

The next variable hypothesized to affect the likelihood of quantity surcharge is carrying cost $(CCOST_j)$, as measured by the location in which an item is stored (refrigerator or shelf). The sign of the coefficient is in the expected direction indicating a greater likelihood of quantity surcharge on refrigerated and frozen goods. However, the

coefficient is only significant at $p < 0.10$ $(\beta_7 = 0.189; t = 1.58)$, providing partial support for hypothesis **H2b**.

The propensity to buy a large package is hypothesized as positively affecting quantity surcharges. Its coefficient, $\beta_8 = 0.226$, is significant at $p < 0.05$. This result, supporting **H2c**, implies that the retailer is encouraged to impose quantity surcharges on those products which are most often bought in large packages.

Product type $(PTYPE_j)$ is included to capture a product's degree of substitutability. This dummy variable is set equal to unity for household goods, such as soaps and paper products and zero otherwise. The likelihood of encountering a quantity surcharge is expected to be greater for household "necessity" items than for food products. However, this expectation is not supported $(\beta_9 = 0.13; t = 0.95)$. One possible reason for its insignificance may be because of the availability of these products in a large number of drug stores and discount stores, and perhaps, even at a cheaper price than in supermarkets. For this reason, sellers may hesitate to impose a quantity surcharge on these products.[6]

In sum, the results indicate that the likelihood of buying a large package of a product is positively influenced by the extent of a household's usage of that product, procurement cost, carrying capacity, and is negatively influenced by propensity to price search. A retailer's decision to levy a quantity surcharge is, in turn, dependent on demand for the product, the likelihood of households buying large packages, and to some extent by the carrying cost of products.

6. Summary and Conclusions

In this paper, several product, household and market characteristics influencing quantity surcharges are presented and empirically tested. A number of hypotheses are tested using data from store audits, a survey of a sample of households and secondary data. Results suggest that the likelihood of buying a large size package of a product is primarily influenced by the demand for that product. The likelihood of quantity surcharge on a given product, in turn, is influenced by the demand for large packages and the overall demand for that product.

The empirical evidence appears to suggest that a retailer considers the nature of the demand for a product and the likelihood of large packages being purchased when deciding whether or not to impose a quantity surcharge. The results also provide partial support for the hypothesis that refrigerated and frozen items are more prone to quantity surcharge than the items stored on shelves. The results imply that quantity surcharging is a price discrimination practice directed towards

households with large families and correspondingly high demand, whose carrying capacity is high, as is their procurement cost. Such households are less likely to price search, and will buy large packages in order to avoid frequent trips to the store and stock-outs.

These results provide some support for the hypotheses proposed in previous theories of quantity surcharge. For example, the results show that the decision to impose a quantity surcharge is affected by the propensity to buy a large package which, in turn, is affected by propensity to price search (Salop 1977), and by the household's storage capacity which acts as a surrogate for carrying cost (Gerstner and Hess 1987). Walden's (1988) hypothesis about the relationship between retailers' storage cost and quantity surcharge is also partially supported. Besides considering both the supply and demand sides, establishing the substantial impact of demand for a product and the role played by a household's propensity to price search are unique contributions of this study.

Grocery expenditures account for a substantial portion of disposable income. Because of the size of grocery expenditures, quantity surcharges may, over a period of time, represent a sizable loss to consumers due to ignorance. One approach to reducing quantity surcharge would involve labeling changes, because propensity to price search is the most controllable element in the two equations. Awareness and ease of information processing would help a great deal to minimize the problem (cf. Devine and Marion 1979; McCracken, Boynton and Blake 1982). Rather than the current practice of placing individual tags under each size of a brand, a single label which lists the unit and total cost of each size of each brand in a product category, could be centrally located. While the consumer would still be able to make inter-brand price comparisons, the effort required to make intra-brand comparisons would be substantially reduced. This suggestion is a modification of unit price information displays suggested by Russo, Krieser and Miyashita (1975).

Endnotes

1. Quantity surcharges which arise from short-term promotions are excluded in this study. Only price differentials in favor of smaller size packages which are part of regular pricing decisions are considered.

2. The New York Times (2/26/92) reports that the nation's annual market for groceries has reached $362.7 billion.

3. Theoretically, an inventory model should include the price of the good. However, it has been excluded in this case because the consumption unit per serving differs across products and also perhaps households, making

price estimates per unit of consumption impossible to measure.

A consumer is likely to buy two small size packages on two trips if the demand for the product is low, carrying cost is high, and procurement cost is low. However, the decision to buy two small packages in the same trip instead of buying one equivalent large package depends on the existence and knowledge of quantity surcharges on large packages of that product.

4. In this study, about eighty percent of all packages are found to be discounted; about two and a half percent are linearly priced and about eighteen percent are quantity surcharged. In comparison, Cude and Walker (1984) found 90 percent incidences of discounts and ten percent incidences of quantity surcharge. Gerstner and Hess (1987) found discounts on over ninety percent of all packages; linear pricing on about one percent and quantity surcharges on about seven percent.

5. The preliminary 1990 Census of Population and Housing (sample data) for Buffalo PMSA shows a median education level of "high school or equivalency;" a median household income category of "$27,500 - $29,999;" and a median household size of two.

    In general, survey research tends to use better educated and higher income people primarily because they reveal higher response rates. A possible impact of this slightly upscale sample is on the propensity to search. Past studies on price search for frequently bought goods show that income, a proxy for search costs, tends to reduce search, whereas education, a proxy for search efficiency, tends to increase search (Alcaly 1976; Bucklin 1969; Carlson and Gieseke 1983; Goldman and Johansson 1978; Kunreuther 1973; Marvel 1976; Maurizi and Kelly 1978). Even ignoring collinearity, the net effect of these two variables is not clear, and might well be an empirical question (Zimmermann and Geistfeld 1984).

6. A reviewer's suggestion of this plausible explanation is gratefully acknowledged.

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