CONSUMER PRICE AWARENESS IN FOOD SHOPPING:

THE CASE OF QUANTITY SURCHARGES

by

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Introduction

A not uncommon price phenomenon in retail food markets is the presence of quantity surcharges: higher unit prices for larger than smaller sizes of the same product. Store surveys have found that approximately 25% of brands exhibit some surcharge pricing (e.g., Widrick, 1979a, 1979b; Nason and Della Bitta, 1983; Agrawal, et al.,1993). While in part surcharges arise due to temporary price promotions or from pricing errors, Widrick found they do not occur randomly but reflect conscious pricing policy. Indeed, for some commodities surcharging is more the rule than the exception.

Since consumers can avoid surcharges by buying smaller sizes, why don't they do so? One possibility is simply a preference for larger sizes. Undoubtedly there are consumers with this preference. However, it seems more reasonable to suppose that the majority of surcharge purchasers are simply unaware that the surcharge exists. Consumers vary considerably in their knowledge of prices and thus their sensitivity to them. One study found that little more than 50 percent of buyers are aware of prices paid, even immediately after selection (Dickson and Sawyer, 1990). While this is a departure from standard economic assumptions, it is the grist of the mill of information economics (Stigler). Obtaining accurate price information is costly, depending on the value of time, and optimum behavior requires a comparison of benefits to costs. Benefits are small when purchasing low-valued goods, as in retail grocery markets, and so

complete information in support of all decisions is beyond the constraints of many time-pressed shoppers. Then they are likely to ignore all but broad price differences across products, or they may use shopping rules. One such rule---the "volume discount heuristic" (Nelson and Della Bitta, 1983)---is the source of the present problem. Generally the rule works, since discounting is the norm---larger sizes are often labeled as "economy size." [1] However, complete reliance on this rule opens the way to paying quantity surcharges.

This study is an empirical analysis of consumer response to quantity surcharges. We analyze the role of prices and consumer characteristics in determining sensitivity to a surcharge. We are guided by the economics of information, and our study can be regarded as a test of its implications. Actual behavior under surcharges has not previously been examined, owing to the difficulty of obtaining appropriate data. Our study came about through access to a large sample from a grocery product tracking firm. The data consists of measures from large grocery marketing

districts rather than data on individual consumers. We find a surprising amount of variability in prices and consumer characteristics over these markets. We examine a single commodity, canned tuna, which surveys and current data indicate is universally surcharge Our results are generally supportive of the economics of information explanation of surcharges.

[1]Cude and Walker (1984) show that blind adherence to this rule is on balance a money-saving strategy.

Background

Quantity surcharges have been documented in trade, government, and academic literatures for more than 40 years.[2] Canned tuna is surcharged with the greatest frequency. Widrick (1979a) found 85% of tuna brands had surcharges, the most in his survey. In Nason and Della Bitta's survey of two years' prices, tuna was consistently among the most surcharged items in both years. Cude and Walker found tuna to be the commodity most likely to thwart a strategy of buying large sizes. In Agrawal et al.'s 1993 price audit, tuna was the most surcharged item.
Data compiled by USDA from the 1988-1995 A.C.Nielsen Scantrack Database — a compilation of annual scanner data from 3000 supermarkets nationwide — shows a stunning surcharge for tuna. Across the U.S. the largest (12.5 oz.) size is on average 40% more costly per ounce than the popular 6.5 oz. size Below we provide additional evidence that tuna surcharges are substantial and universal across U.S. markets.

There is considerable literature of relevance to surcharges, especially studies of price search and unit pricing (Boynton et al. (1983); Kujala and Johnson (1993)) Much of this is based on Stigler's information theory. Goldman and Johansson (1978) directly tested this theory using a survey of gasoline purchasers and found weak support. Urbany, Dickson, and Kalapuraki (1996) examined determinants of grocery price search and found a negative association with income, hours worked, and the presence of young children, and a positive effect of education, results which are all expected implications of information economics. In an early study of unit prices, Granger and Billson (1975) showed that in the absence of unit prices consumers had difficulty choosing best values; in a later study Capon and Kuhn (1982) found 40% of buyers questioned could not do so. Although this would seem to increase the use of unit prices,

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[2]Widrick (1979a) cites an article in a 1957 issue of the *Consumer Bulletin*.

Dickson and Sawyer (1990) found that only 8% of buyers did so. This will obviously contribute to falling victim to surcharges.

Data

All data on product sales came from Sales Area Marketing, Inc (SAMI), a product tracking firm which discontinued operation in 1991. SAMI monitored grocers' warehouse shipments of 484 categories in 54 market areas, which were aggregations of counties and which accounted for 85 per cent of US grocery sales. The warehouses provided SAMI with data on case movements to supermarkets, along with corresponding retail sales and price data.

We had paper reports showing, for each market, price, cases, sales, and share figures for every variation of every brand (e.g. Starkist chunk light in 6.5 oz. cans packed in water in 24-can cases), for the previous four weeks and year. Annual 1990 data (the last year available) was compiled from these, but not all brands, types, and sizes were included. We confined attention to the main type of tuna sold, chunk light. The majority of this is sold in a 6.5 oz. can, with much also sold in a larger 12.5 oz. size. These were the study focus. We used data for the three leading brands (Starkist, Chicken-of-the-Sea, and Bumblebee), which account for 77% of US sales, and the fourth largest other brand for each individual market.[3] No distinction between oil pack and water pack was made (i.e. they were aggregated), for these generally sell for the same price.

Demographic data for the study came from the US Bureau of the Census "USA Counties" CD-rom, containing county data from numerous federal agencies. An algorithm was developed to aggregate this county data into the 54 SAMI regions.

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[3]Detailed data was not available for private label, but only total cases and sales of all types. With no information on sizes, we could not use it. It accounts for 12% of tuna sales.

. Model Formula

The model used for the analysis was of the following general form:

SMALLCAN=*f* (PRICES, DEMOGRAPHICS).

SMALLCAN is the ratio of tuna sold in the 6.5 ounce size to the total sold in 6.5 and 12.5 ounces combined, PRICES are the unit prices for each, and DEMOGRAPHICS are relevant characteristics of the market, as discussed below.

An important question is how prices should be included, in particular, whether as the individual variables P_{12} and P_6 or as the direct surcharge measure $S=(P_{12}-P_6)$, with model components $\beta_{12}P_{12}+\beta_6 P_6$ and $\beta_S(P_{12} - P_6)$, respectively.[4] The second is the first with the restriction that $\beta_{12}=-\beta_6$. The restriction holds if consumers are choosing large sizes by preference, for they would tradeoff sizes on the basis of this difference. Because we wanted to test this, not impose it, we included the prices as separate variables.

The demographic variables were chosen based on two considerations: (1) factors which affect consumer proneness to buy large sizes for reasons other than a belief in quantity discounts[5], and (2) factors which affect price search behavior. Note these are independent. Although we would expect a consumer who does not make careful price comparisons to be prey to surcharges, we first need to determine whether the consumer would ever buy a large quantity. A giant-sized box of corn flakes is likely to languish to unpalatability in a single person's cupboard, but quickly disappear in a household full of children. In the former case, no matter how cheaply-bought, it

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[4]Of course there are other possibilities, one being the ratio P_{12}/P_6. However, there is no a priori reason for a measure differing from the two specified.

[5]By this we mean that the consumer would choose a large over a small size when unit prices were identical and known.

will in the end be quite expensive. Thus, we would expect a single-person household, no matter how price-insensitive, to be less subject to surcharges than a larger household.

In both cases (1) and (2), the variables used were based on the literature reviewed above and on our own judgement. We were somewhat restricted in this process, however, because we were dealing with market-level data, as opposed to survey measures for individual households. This is especially true in the case of (1). We could not use variables like "shopping trips per week," "distance to the nearest store," and "household storage space" (as discussed in Agrawal et al.). We used only two measures: HHSIZE, the average household size in the market, and HOMES, the percent of households in single-family detached dwellings. The reason for the first is obvious, and we expect its coefficient to be negative. HOMES is a proxy measure of storage space, and the ability to inventory goods in the household facilitates stocking up and purchasing large sizes. Thus its coefficient should be ≤ 0.

We included eight variables to capture various aspects of search costs. INCOME, per capita income, and FEMLAB, the female labor force participation rate, are factors higher values of which increase the value of time, thus making careful shopping less likely. We expect negative coefficients. The opposite applies to OLDER, the percentage of the population over 65, and UNEMP, the overall unemployment rate. Also, in the case of unemployment, the value of information--careful shopping--would be expected to rise, also contributing to a positive effect. Four of the variables capture ease of processing information. HIGH and COLLEGE are the per cents of market population with high school and college educations, respectively. We expect more education to increase the likelihood of surcharge awareness, implying positive coefficients.

For opposite reasons, we expect a non-positive coefficient for LANG, the percentage of households speaking other than English at home.

As a measure of shopping experience, we include TUNA, the per capita consumption of chunk light tuna in the market. The more often an item is purchased, the more likely that buyers acquire detailed knowledge of prices of its various forms. Also, the cost of information is spread over a greater number of purchases. So we expect a positive effect.

However, TUNA has a second dimension. Households consuming more tuna would be expected to have a greater tendency to purchase larger quantities and hence larger sizes.[6] To the extent this is important, TUNA would have a negative impact on small can purchases. If both dimensions are present, they may counterbalance each other, leaving no detectable effect. Our view is that the information effect is the more important.

The model also contained three regional dummies to control for possible regional differences of unknown nature or cause. Descriptive measure of all variables are presented in table 3.

[6]However, unlike many items, an opened can of tuna will not keep. Therefore, higher consumption due to greater consumption frequency would not create a tendency to large sizes. Only more "tuna intensive" dishes would do this.

Table 3. Descriptive Statistics of Model Variables.

Variables	Units	Mean	STV. Dev.	Minimum	Maximum
SMALL CANS	Proportion	.909	5.1	67.5	97.0
P6	Dollars/Ounce	.127	.014	.097	.154
P12	Dollars/Ounce	.163	.011	.132	.184
INCOME	Thousands $ Per Cap	13.65	2.11	9.97	18.9
HIGH	PCT	31.2	4.5	22.0	42.1
COLLEGE	PCT	19.4	4.0	10.9	28.8
TUNA	Ounces/Person	20.8	6.3	11.3	44.8
FEMLAB	PCT	56.5	4.6	40.4	65.4
OLDER	PCT	12.7	2.2	8.1	18.8
UNEMP	PCT	5.5	1.1	3.4	8.5
LANG	PCT	10.1	10.1	2.1	48.0
HHSIZE	Persons	2.7	.1	2.5	3.1
HOMES	PCT	62.3	8.0	37.4	73.1

The estimation method used exploited the fact that the dependent variable is a proportion. Although models of this kind are often estimated with either ordinary or generalized least squares, these impose a restrictive functional form and permit prediction outside the bounds in which a proportion can fall. To avoid this, we used a form of probit analysis that is possible when the dependent variable is proportional rather than binary. The method requires the calculation of the probit of each proportion p_i i.e. the standard normal value z_i such that $P(Z<z_i)=p_i$. The probit is then used as the dependent variable in a weighted least squares procedure (see Greene pp 894-96).

Results

In table 4 are presented the estimation results, the most important of which are those for the price variables. Importantly, we find no evidence that P_6 plays a role in the choice of can

Table 4. Estimation Results.

Variable	Parameter Estimate	t
INTERCEP	1.83	.597
P6	.52	.160
P12	7.30	2.040
INCOME	-.103	-2.574
HIGH	.008	.367
COLLEGE	.078	2.922
TUNA	.013	1.902
FEMLAB	-.016	-.863
OLDER	.007	.227
UNEMP	.038	.773
LANG	-.003	-.573
HHSIZE	-.413	-.660
HOMES	-.009	-1.162
WEST	-.363	-2.078
MIDWEST	-.141	- 1.170
SOUTH	-.004	-.021

size. Rather, the percent of small cans depends only on P_{12}, increasing when P_{12} does. A test that $\beta_{12} = -\beta_6$ is easily rejected at $\alpha = .05$, with a computed F^1_{38} of 5.62. We thus have evidence against a large size preference hypothesis, a condition for which is that the equality hold, at least approximately. The absence of responsiveness to P_6, coupled with a reasonably strong effect of P_{12}, is more consistent with the volume-discount heuristic. The reasoning is as follows. Unless

price is being ignored completely, it is likely to be employed in the decision as to whether to buy tuna. The price observed will be the form whose purchase is contemplated, the large size. If this price is judged excessive, the consumer will consider substituting other items--the more expensive but higher quality solid white variety of tuna, other protein products, etc. Certainly this process may involve switching to smaller cans of tuna, either as a means to reduce tuna consumption or because the high price for the large size has jarred the consumer into noticing that the smaller can is cheaper. All of these can only increase the share of sales of 6.5 ounce cans. We conclude that consumers are buying the large size of tuna not by preference but on the mistaken belief that it is cheaper. They are evidently not willing to take the time required for careful price comparison.

We need to point out that the coefficients in the table are not the marginal effects of the variables on the proportion of small cans, as they would be in a linear model. The marginal effects are found by multiplying the coefficients by $f(X\hat{\beta})$, where *f* is the standard normal density (Greene p. 976). Thus, the marginal effects are a function of *X*. Following the standard practice of evaluating $f(X\hat{\beta})$ at the sample means, we obtain a value of .16. The marginal effect of greatest interest, that for P_{12} , is thus 1.18 at the means. Since P_{12} is measured in dollars, this implies that a one cent increase in the unit price of the large can will increase the small can proportion by about .01.

A value of information interpretation of the price results is supported by results for many of the value of time and information variables. INCOME is highly significant, with the anticipated negative effect. Although HIGH, the per cent with a high school degree, is of no importance, COLLEGE has a strong positive effect. More highly educated markets are less subject to surcharges, presumably due to an enhanced ability to detect them.[7]

[7]The interpretation of HIGH is somewhat ambiguous because it measures the per cent of the population with *only* a high school education. Nevertheless, it might be viewed as a subtle indictment of the oft-bemoaned state of math education in the nation's public schools.

The result for TUNA, our measure of shopping experience, is perhaps most interesting. As previously discussed, TUNA can also be taken as a measure of size preference, and the two interpretations generate different signs. The strong positive effect, the effect we expected, supports the information hypothesis: in markets where tuna purchase is more frequent, consumers are less likely to be victims of surcharges. The TUNA result is thus completely consistent with the price estimates, discriminating between the two hypotheses in the same manner.

Although none of the remaining information variables is estimated to have a strong impact, signs agree with the information framework. The same applies to the variables meant to measure large-size proneness. In the case of HOMES, the absence of a perceptible impact may not be surprising, for it is at best an inadequate proxy for storage space.[8] The absence of a measurable effect for HHSIZE, on the other hand, is somewhat unexpected, for it can hardly be questioned that larger households are more likely to buy larger sizes.[9]

The dummy variables results indicate there are geographic differences unexplained by the model. (A joint test that they are zero is easily rejected at a 5% level of significance.) The coefficients suggest that the East, the reference region, is the least prone to large cans and the West the most. This is also the relationship among the sample means.

Concluding Remarks

The results of this study form a coherent pattern of a cost of information of consumer behavior under surcharges and provide evidence that the economics of information exercises an

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[8]Furthermore, for tuna, availability of storage is unlikely to play a role in the choice of size. The binding constraint in most home pantries is shelf space, not volume, and two stacked small cans require less shelf space than a single large can.

[9] An inspection of influence diagnostics (Belsley, Kuh, and Welsch 19__) revealed this coefficient to be the most sample-sensitive in the equation, one reason for which being that the market with the largest HHSIZE, Salt Lake City, was among those with the largest proportion of sales in small cans.

active role in retail food markets. They thus support what we regard as the most likely explanation for consumers to buy surcharged goods: time-short consumers are using low-cost information, in this case the general tendency for larger sizes of grocery items to be more economical--in place of careful price comparison and evaluation of a particular grocery item. If the time-costs of expanded information exceed the benefits--benefits unlikely to be large in retail food purchasing--this is the rational thing to do. However, it opens the way to falling victim to surcharges.

The question remains as to why the pricing structure we examined exists. Some have argued that quantity surcharges are a form of price discrimination which exploits the inelasticity arising from a failure to respond to price differences (Salop 1977). If this is the case for tuna pricing, it is evidently not imposed at the retail level, for the surcharges appear to be universal. Widrick (1979b) appears to arrive at a like conclusion. Commenting on his survey, he notes:

> Retailers were asked about the pricing of tunafish. Both respondents reported that they had been getting a trade promotional special on the 6.5 ounce for years. A tuna manufacturer spokesperson reported that 6.5- to 7- ounce sizes represent 73 percent of the total tuna volume....Have tunafish manufacturers been using a promotional special on 73 percent of their output for years? (p. 57)

The smaller size continues to be heavily promoted, or "footballed," through manufacturer deals. Under this condition, it may be proper to view the real (long term) price as the manufacturer price net of promotion. If large cans are unpromoted, this strategy would be a means of price discrimination.[10] In any case, the question of surcharges is worth studying, for there must be a

[10]It would also be a means of sidestepping antitrust strictures against manufacturers' setting retail price.

reason for their persistence. They are not all happenstance. Indeed, in the market we studied, quantity surcharges are long-standing and apparently cemented into the pricing structure.

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