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WHAT UNIT PRICES REVEAL ABOUT MARKET POWER: EVIDENCE FROM THE SUPERMARKET

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WHAT UNIT PRICES REVEAL ABOUT MARKET POWER:

Evidence from the supermarket

ABSTRACT--Output of leading food manufacturers typically is priced higher than similar private label merchandise. Whether this reflects superior quality or imperfectly competitive markets is a recurring empirical question. An interbrand comparison of price schedules by package size permits testing these alternative hypotheses using only retail price data.

WHAT UNIT PRICES REVEAL ABOUT MARKET POWER: Evidence from the supermarket

Over the past half century an extensive literature has examined food manufacturing from an industrial organization (IO) persective. One goal of this research has been to establish whether industry prices and profits exceed a competitive level due to the exercise of market power by leading firms. Of these studies, many report a positive link between manufacturers' profitability and structural variables such as market concentration and market share (Connor and Rogers et.al). To some, these findings are proof that leading firms employ market power to overcharge consumers. Others offer alternative interpretations: for instance, a positive relationship between profits and market concentration could imply that large firms are more efficient and have lower costs, rather than higher prices (Demsetz); or could reflect biases inherent in accounting data (Schmalensee, pp. 961-66).

In light of these disparate views, recent empirical IO studies have increasingly focused on prices, not profits, as the relevant measure of industry performance (Bresnahan). Unlike previous works based on Bain's structure-conduct-performance (S-C-P) paradigm, this "new empirical industrial organization" (NEIO) literature seeks to discover information about industry or firm behavior without relying on direct observation of economic profits or costs. For example, when firms sell output in distinct geographic markets subject to unique demand or cost shocks, it may be possible to infer industry markups over marginal cost directly from intermarket price differences. Authors adopting this approach include Sumner and Sullivan, who estimate tobacco industry overcharges by comparing cigarette prices in states with differing cigarette excise taxes; and Knetter, who examines whether exporters price discriminate by destination in response to country-specific exchange rate shocks.

In food manufacturing, geographic market boundaries are often insufficiently distinct to permit sharp interregional price comparisons of the sort described above. Yet another source of comparative price data is readily available, consisting of matched prices of nationally advertised branded goods and similar private label products, or "store brands" sold through the same retail outlets. Most private label goods closely resemble their name brand counterparts in contents and packaging, in many cases being manufactured to identical specifications (Wills). Therefore authors including Nickell and Metcalf, Parker and Connor, and Connor and Peterson argue that the costs of producing branded and private label goods should be closely related, making national brand/private label price differentials a valuable source of information on industry performance.

Despite its apparent richness, data on national brand/private label price differences has received relatively little use in empirical IO studies to date. This may reflect the difficulty of controlling for possibly product heterogeneity within a S-C-P framework, where some aggregation across products is required in order to achieve conformity with available market structure data. A case in point is Parker and Connor, 1979. Regressing national brand/private label price ratios on several structural variables, PC estimated that about half of the premium paid for branded food products in 1975 reflected price enhancement by leading firms, resulting in a loss of over $10 billion in U.S. consumer surplus. Although PC confirmed these estimates using two more conventional methodologies, their results nonetheless generated considerable controversy (O'Rourke and Greig; Bullock; D. Marion and Grinnell; Parker and Connor 1981, 1984). Much of the debate concerned whether quality differences between branded and private label output had incorrectly been attributed to imperfect competition.

The purpose of this paper is to propose a new framework for analyzing national brand/private label price spreads, one designed to overcome some objections of previous critics. In contrast to the S-C-P models used previously, the NEIO approach used here relies solely on market price data, avoiding any need to aggregate across dissimilar products. Also unlike previous studies, which have focused solely on interbrand differences in average or representative prices, this analysis simultaneously considers both interbrand and within-brand price differences. For a typical packaged good, within-brand price is a function of package size, so that consumers face a price/quantity schedule rather than a single price. By comparing the price schedules of branded and private label manufacturers, several hypotheses about firms' relative costs and market competitiveness can be tested using only retail supermarket price data. The basis of these hypothesis tests is that a firm's degree of market power (as measured by its ability to raise price above marginal cost) affects both the level and the slope of its price schedule. In contrast, cost differentials arising from quality differences or scale efficiencies are expected to affect only the relative levels of firms' unit prices.

I. Model

A visit to a supermarket reveals that many food and household items are identified by product, brand or label, and package size (e.g., "Corn flakes, Post Toasties, 18 oz."; "Powdered sugar, C&H, 2 lbs."). Additionally, two stylized facts about prices are evident. First, within-brand prices differ considerably by package size, with smaller packages generally carrying a higher unit price. And second, price also depends on brand or label, with one or more leading brands commanding a premium over prices of other, apparantly similar goods.

A model of packaged goods pricing based on these characteristics can yield information about market competitiveness, as demonstrated below.

Manufacturers' pricing decision. Consider a firm that produces a differentiated good and markets it in several discrete package sizes. Letting j = (j,k,...,n) denote package size in units, the firm's profit function can be written as:

$$\Pi = \sum_j P_j(Q)Q_j - C(Q) \tag{1}$$

where P_j (**Q**) is inverse demand for the firm's output in packages of size j, **Q** is the firm's output vector, and Q_j is output of packages of size j. In the event that substitutes or complements exist for the good, $P_j(*)$ can be interpreted as residual demand for the firm's production.

For each package size k, the firm chooses output Q_k to satisfy:

$$\frac{\partial \Pi}{\partial Q_k} = P_k + \sum_j \frac{\partial P_j}{\partial Q_k} Q_j - \frac{\partial C}{\partial Q_k} = 0 \tag{2}$$

Rearranging this first-order condition, the firm's optimal price for a package of size k can be expressed as a markup over marginal cost:

$$P_k = \theta_k \, MC_k \tag{3}$$

where

$$\theta_k = \frac{1}{1 + \sum_j \eta_{j,k} \frac{w_j}{w_k}} , \tag{4}$$

$\eta_{j,k}$ is the price flexibility of P_j with respect to Q_k, and w_j and w_k are revenue shares from sales of packages of size j and k, respectively.

Next consider specification of the cost function. It is characteristic of packaged goods that certain costs of production vary according to the number and types of packages produced, while other costs depend on total output of the good, irrespective of packaging. That is, the production technology is Leontief, in the sense that a fixed amount of contents and one package are required as inputs for each item produced. Therefore variable costs are separable in packaging costs and in cost of contents:

(5) $$C(Q) = F + \sum_j g(j)\,Q_j + c(\sum_j Q_j \cdot j)$$

where g(j) indicates the packaging-related costs for a package of size j, and where c(*) is the total variable cost of the contents.

From **(5)**, the marginal cost of producing a package of size k is:

(6) $$MC_k = g(k) + c' \cdot k .$$

Combining **(6)** and **(3)**, dividing by k and letting $\frac{g(k)}{k} = h(k)$ yields the firm's optimal unit price:

(7) $$p_k = \theta_k \, (h(k) + c') .$$

Now consider the case of two or more firms each supplying a similar version of a product for resale through a common marketing channel. To facilitate discussion, let all output be classifiable as either a "leading brand" or a "store brand". Let $\mathbf{p}_b$ and $\mathbf{p}_s$ represent manufacturers' unit price schedules for leading brands and store brands, respectively. Under the assumption that producers of store brands have negligible ability to raise price above marginal cost, equation (7) implies that

(8) $$p_{sk} = (h_s(k) + c_s)$$

For leading brands,

(9) $$p_{bk} = (1 + m_{bk})\ (h_b(k) + c_s + c_b)$$

where c_b reflects possible differences in marginal cost per unit between branded and private label goods, and where $\theta_{bk} = (1 + m_{bk})$.

In the empirical analysis that follows, I assume that packaging-related costs are independent of brand; $h_i(j) = h(j)$ for $i=b,s$. This should not be unduly restrictive, given that uniformity of packaging across brands was a primary criterion in chosing products for inclusion in the study. Substantial and systematic cost differences between apparently identical packages would be surprising, since a firm with packaging costs in excess of the indusry average could presumably adopt the lower-cost technology of its rivals. In the event that economies of scale lead smaller producers to operate with higher packaging costs, the benefits would likely accrue to large branded manufacturers, causing the model to understate any price overcharges resulting from imperfect competition. Thus the effect of this assumption is-neutral or conservative with respect to estimating market power.

A key advantage of the above specification is its provision for a unit cost differential (c_b) between branded and private label goods. If branded products are of higher quality and therefore are more costly to produce at the margin, then $c_b > 0$. Conversely, if Demsetz is correct in contending that larger firms are more efficient and have lower costs, then $c_b < 0$.

The formulation used here admits either of these possibilities.

What do equations (8) and (9) tell us about relative prices of national and store brands at the manufacturing level? Trivially, if the marginal costs of each brand's outputs are equal ($c_b=0$) and firms price competitively ($m_{bk}=0$), then their price schedules will coincide. If firms are competitive with different unit costs, then we would expect a vertically parallel shift (either upward or downward) by the amount c_b, as shown in Figure 1a. If manufacturers of leading brands exercise market power but do not price discriminate ($m_{bk}=m_b > 0$), then p_{bk} will will include a premium that is proportional to p_{sk}, as illustrated in Figure 1-b. Or firms might price discriminate as suggested by Adams and Yellen, charging a markup over marginal cost that varies by package size. This could yield a number of other relative price configurations, as shown in Figures 1-c and 1-d.

Retailer's pricing decision. Often information on manufacturers' prices is unavailable, or fails to reflect promotional allowances and discounts and thus overstates actual prices paid by retailers. Retail prices are a readily available alternative, and have the desirable property of embodying all the costs paid by retailers for a manufacturer's goods. However, retail prices also incorporate retailers' markups over manufacturers' prices. An identity for retail price is:

$$r_{ik} = p_{ik} + s(i,k,p_{ik})$$

where r_{ik} is the retail price of brand i and size k, and where s( ) is the total selling cost above manufacturer's price. For purposes of hypothesis testing, a functional form for s( ) must be specified. Package size is expected to affect shelf space requirements and transactions costs per unit, while manufacturers' prices might affect retail margins through their influence on inventory and insurance costs. Brand could also have a direct positive or negative effect on retailers' margins, independent of price; however, empirical evidence is not conclusive on this point (Albion; Wills). Therefore let the retail unit price of goods in packages of size k be given by

(11) $$r_{ik} = s_k + (1+s_p)p_{sk}$$

where i = (b,s). Under this formulation, selling costs are a function of package size and manufacturers' price, with brand having a possible indirect effect through price.

II. Estimation and hypothesis testing.

To rewrite (11) in an estimable form, let δ_j be a dummy variable indicating package size, where j=(j,k,...,n); and let δ_b be a dummy variable equal to 1 for leading brands and 0 for store brands. Then

(12) $$p_{ij} = a_j \cdot \delta_j + b_j \cdot \delta_b$$

where

$$a_j = [s_j + (1+s_p)(h(j) + c_s)]$$

and

$$b_j = (1+s_p)[c_b + m_{bj}(h(j) + c_s + c_b)]$$

These general expressions incorporate various hypotheses about the relative prices of national brand and store brand goods. By imposing restrictions on estimates of a_j and b_j, the following hypotheses will be tested for consistency with retail data:

Hypothesis I. Competitive firms with unit cost differential. In this case, $m_{bj}=0$ for all j, implying that b_j is constant for all j.

Hypothesis II. Imperfectly competitive leading firms with no unit cost differential. Here $c_b=0$. Provided that $m_{bj} = m$ for all j (no price discrimination by package size) and $s_j=0$ (proportional retail markup), then b_j/a_j is constant for all j.

Hypothesis III. Imperfectly competitive leading firms with unit cost differential. Assuming $m_{bj} = m$ and $s_j = s$, then $(b_j-b_k)/(a_j-a_k)$ is constant for all j and k.

Data and results. Prices of branded and private label versions of several common food and household products were collected from every supermarket in Yolo County, California (excluding convenience stores, and several small grocery stores in outlying rural communities), for a total of 16 stores. Products chosen for the study are listed in Table 1. Each product satisfies two criteria: (i) at least one dominant brand exists that is stocked by every store; and (ii) similar private label goods are available in a range of package sizes that closely match the packaging of the branded product. Breakfast cereal data were collected during a five-day period in July; sugar, bleach and acepaminophen during a three-day period in August, and the remaining prices were observed over three days in December, all in 1993. In the case of acetaminophen, prices at a large chain drug store was also sampled to reflect a likely alternative source of the product for consumers.

Regression results are shown in table 1. Two patterns are apparent. First, average unit prices of store brands (measured by a_1--a_4) are generally decreasing with respect to package size, with minor exceptions. Second, price differentials associated with name brand goods (b_1--b_4) are uniformly positive and also tend to be negatively related to package size, though less consistently so.

Results of hypothesis tests I-III are shown in table 2. Hypothesis I, which states that firms are perfectly competitive but have different marginal costs per unit, is accepted for six of thirteen products. However, it provides the best fit only in the case of coffee. Hypothesis II, which states that price premia charged by national brand manufacturers are attributable entirely to imperfect competition, is accepted for seven commodities. It provides the best fit in three cases (vegetable oil, frozen concentrated orange juice, and acetaminophen), and is the only hypothesis that is accepted for acetaminophen. Hypothesis III, which allows for both imperfectly competitive pricing and interbrand cost differences, is accepted for eleven goods and is the only model accepted for non-dairy creamer prices. It is the best-fitting model in nine of the thirteen markets.

Taken together, the major results of this empirical analysis are twofold: (1) quality-related or other cost differences cannot account for observed price differentials in more than half of the cases considered, indicating the presence of imperfect competition; and (2) a combination of cost differences and market power is consistent with pricing of most goods in the sample. While based on an entirely different methodology and data set, this latter result is in accord with Parker and Connor's 1979 finding that about half of the price premium paid for national brands is attributable to imperfect competition among leading firms.

III. Summary

This paper has jointly considered two empirical regularities found in markets for packaged household goods. First, nationally branded products sell at a premium over similar private label output; and second, the unit price charged by each firm for its output is a function of package size. I have shown that in markets where such price/quantity relationships prevail, an interfirm comparison of unit pricing schedules can distinguish whether brand premia arise from (1) quality-related cost differences; (2) imperfectly competitive pricing by leading firms, or (3) a combination of both. An appealing feature of this empirical approach is that it relies solely on market price data.

Based on data from Yolo County, California, retail prices of thirteen food and household products were tested for consistency with the three hypotheses above. Taken alone, brand-specific cost differences failed to rationalize the observed national brand/private label price differentials for seven of thirteen products considered. A combination of cost differences and imperfectly competitive pricing was found to be consistent with prices of most goods in the sample.

TABLE 1. Regression results

(standard errors in parentheses)

	a1	a2	a3	a4	b1	b2	b3	b4	R^2
Corn flakes n=83	.108 (.018)	.093 (.004)	.083 (.007)	.083 (.010)	.052 (.018)	.029 (.006)	.024 (.009)	.028 (.013)	.66
Raisin bran n=82	.128 (.003)	.125 (.007)	.118 (.015)	--	.052 (.005)	.047 (.007)	.011 (.016)	--	.72
Flour n=89	.345 (.009)	.178 (.005)	.174 (.006)	.159 (.010)	.077 (.010)	.068 (.006)	.062 (.008)	.071 (.014)	.96
Sugar n=99	.576 (.012)	.557 (.013)	.336 (.012)	.315 (.012)	.018 (.017)	.014 (.018)	.022 (.016)	.047 (.017)	.89
Vegetable oil n=117	.059 (.001)	.044 (.001)	.046 (.001)	.041 (.001)	.011 (.002)	.007 (.001)	.008 (.002)	.011 (.002)	.78
Tomato sauce n=111	.025 (.001)	.029 (.001)	.030 (.001)	--	.014 (.001)	.012 (.001)	.012 (.001)	--	.73
Orange juice n=88	.108 (.004)	.073 (.004)	.088 (.004)	--	.061 (.006)	.038 (.005)	.038 (.005)	--	.82
American cheese slices n=79	.198 (.015)	.199 (.007)	.162 (.006)	.151 (.007)	.111 (.018)	.084 (.009)	.064 (.008)	.066 (.009)	.83
Non-dairy creamer n=72	.115 (.007)	.108 (.007)	.090 (.008)	.079 (.015)	.081 (.009)	.041 (.009)	.069 (.010)	.069 (.016)	.75
Regular coffee n=88	.151 (.007)	.116 (.006)	.098 (.005)	--	.023 (.007)	.026 (.006)	.037 (.004)	--	.73
Dishwashing detergent n=47	.045 (.003)	.043 (.001)	.041 (.002)	--	.027 (.004)	.011 (.001)	.013 (.002)	--	.91
Chlorine bleach n=78	.655 (.024)	.398 (.013)	.236 (.012)	--	.156 (.023)	.094 (.018)	.043 (.018)		.95
Acetaminophen n=76	.060 (.002)	.048 (.002)	.027 (.009)	--	.044 (.003)	.029 (.003)	.039 (.009)		.85

TABLE 2. Results of hypothesis tests

Model I: Perfectly competitive firms with marginal cost differential

Model II: Imperfectly competitve firms with no marginal cost differential

Model III: Imperfectly competitive firms with marginal cost differential

	Accepted at 90% (Asterisk indicates best fit)
Corn flakes	I, III*
Raisin Bran	II, III*
Flour	I, III*
Sugar	I, II, III*
Veg. oil	I, II*
Tomato sauce	I, II, III*
Orange juice	II*, III
Am. cheese	II, III*
Non-dairy creamer	III*
Coffee	I*, III
Dishwashing detergent	III*
Bleach	II, III*
Acetamino-phen	II*

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