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MARKET-STRUCTURE DETERMINANTS OF NATIONAL BRAND-PRIVATE LABEL PRICE DIFFERENCES OF MANUFACTURED FOOD PRODUCTS

John M. Connor,

Robert L. Wills

and

Everett Petersen

PRICES -- Analysis

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The authors are members of the departments of agricultural economics at Purdue University, West Lafayette, IND, the University of Wisconsin, and Purdue University, respectively.

ABSTRACT

This paper estimates the relationships between market structure and price margins between manufacturers' brands and private-label processed food products. These margins, which are related to the Lerner index of monopoly, are computed from two unusual retail price sources spanning 1975-1980. Market seller concentration and product differentiation are significant determinants of higher price margins.

A widely cited and frequently criticized journal article by Parker and Connor (1979) utilized three quite different methods to estimate the consumer loss due to the exercise of market power in the food-manufacturing industries. While the three estimation methods yielded unexpectedly consistent results, the third approach was in several respects the most innovative. This last approach employed a simple linear OLS equation to explain variation across 41 product classes of the price differences between "national brand" and "private label" food products. The authors argued that this price difference, which was converted to a percentage margin, measure by dividing by the national brands' price, was essentially equivalent to the Lerner index of monopoly, $\frac{Pm-Pc}{Pm}$, where Pm is the observed price set by the monopolist (or a collusive group of oligopolists) and Pc is the competitive market price.

The principal practical difficulty faced by empirical researchers in applying the Lerner index is that the competitive price Pc is unobservable so long as the monopolist effectively exercises its market power. The special contribution of the national brand-private label model lies in its assumption (unchallenged by the critics) that the prices of private-label food products are a reasonable proxy for competitive price levels (that is, the price that would be observed if the manufacturing industries were perfectly competitively structured). Therefore, that <u>portion</u> of the margin that is determined by market structure and conduct may be interpreted as a monopoly index. It is noteworthy that this estimation procedure was developed independently by two British researchers and published practically simultaneously (Nickell and Metcalf).

Purpose

The principal purpose of this paper is to present preliminary estimates of the relationship of elements of market structure to national brand-private label price margins among a large sample of manufactured food product classes. In addition, some modest improvements in measuring market structure are attempted. The new estimates shed light on the sensitivity of the Parker-Connor model with respect to alleged problems in data construction and measurement. The present preliminary results appear to suggest that some of the five criticisms raised above are unsupported while others have some validity. However, a concluding discussion points out that limitations to this type of analysis remain that may be insoluble given current data availability.

Estimation Problems

Given that part of the national brand-private label price margin represents a reasonable proxy for the Lerner index, there nevertheless remain a number of limitations that were recognized by Parker and Connor and reinforced by their critics (O'Rourke and Greig, Marion and Grinnell). Many of the limitations concern measurement problems with respect to the data set employed. There are five criticisms that might be mentioned.

First, there is the "matching" problem. This problem arises because the dependent variable (DIFF) is drawn from a data set that uses different classification principles than the data sources used for the explanatory variables. DIFF was constructed from a special report of a commercial grocery-product information service, Selling Areas-Marketing, Inc. (SAMI). The SAMI data system has many admirable features for price analyses of many kinds, including broad coverage of transactions prices and shipments of an enormous number of warehoused grocery items. However, the SAMI report available to researchers aggregated retail product prices into one of 171 food and beverage categories (these 171 product categories each had private-label market shares of over 5% and comprised 42% of grocery sales of 320 edible-product SAMI categories). These 171 primary observations (less 5 unusable observations) have been placed into one of 49 (out of 102 possible consumer) five-digit SIC product classes by the present authors.

The "matching problem" occurs because SIC product classes are typically more broadly defined than SAMI product categories. The data available to construct the explanatory variables are based on 1977 SIC definitions. Therefore, some of the calculated price margins on the left-hand side of the equation are "unrepresentative" of the structural variables on the right side of the equation in the sense that SAMI product categories account for only a small percentage of sales of the SIC product class. In an appendix (available from the authors) we show that 7 of the 49 product classes are from SAMI product categories that account for approximately 20% or less of sales in that product class. A related matching difficulty, uncertainty about the proper SIC into which a few SAMI categories should be placed, was largely resolved with additional information and research over the past five years.

Second, the model estimated by Parker and Connor utilized 41 observations. Because there were ten independent variables used in the regression analysis, there remained only 30 degrees of freedom, a level that some researchers might judge too low.

Third, objections were raised about what might be termed the "quality factor." Is it reasonable to compare the prices of all manufacturers' products with the prices of all private-label products in the same SAMI product category? There are arguments on both sides of this issue. The specificity of most SAMI categories and private-label procurement practices ensures that quality differences are unimportant. On the other hand, there are some categories that do contain national brand items that are only partially matched by equivalent private label items; if the unique national brand items are newer, higher value added items, the calculated price difference will be exaggerated. This is especially problematic given evidence that new product introductions are systematically related to markets characterized by differentiated oligopoly (Connor 1981).

Fourth, the analysis purports to be a structural one and yet the price data were drawn from only one year (April 1976 to April 1977). Traditionally in market structure-performance studies, attempts were made to develop performance measures that represented a period that bridged a business cycle. Moreover, the period analyzed was one of very rapid food price inflation.

Fifth and finally, the price data were taken from a different time period than the structural data. Parker and Connor developed their data set during 1978, a year in which the latest Bureau of the Census data available were from the 1972 Census of Manufacturers. Thus, the results are valid only under the assumption that the structural changes between 1972 and 1976 were either slight or equiproportional across product classes.

The Model and Variables

The equation used for testing derives from the structure → conduct → performance paradigm of industrial organization economics. Performance is assumed to be a function of market structure and conduct, controlling for demand or supply factors that influence price margins. Conduct is not modeled directly, but rather is assumed to be a form of Cournot-Nash oligopolistic coordination consistent with joint-profit maximization across product classes. In essence, the model specifies performance directly as a function of structure.

There are three dependent variables used to represent national brand-private label price differences. The first, DIFF, was discussed above. DIFF is essentially the same as the Parker-Connor variable of the same name, but additional knowledge of Census Bureau classification standards permitted reclassification of 26 SAMI product categories into their appropriate SIC product classes (the retail sales weight of the affected categories is 1.92% of store sales). For example, barbeque sauce was formerly classified as a "prepared sauce" (SIC 20336).

Dependent Variables

The other two dependent variables (NEIS79 and NEIS80) were constructed from item-level observations of retail prices reported by the Nielsen Early Intelligence System for April and May of 1979 and 1980. These data address the question of whether the structure-price relationships are representative of just 1976-1980. Moreover, NEIS79 was constructed specifically to cope with the "matching problem." For NEIS79 product class price differences were painstakingly built up from 1,043 item prices taken from 153 NEIS product categories. Most importantly, only those SICs for which the NEIS categories accounted for at least 50% of product class sales were used. In addition, NEIS categories with less than 5% of sales in private label products were utilized where necessary (e.g., breakfast cereals). NEIS coverage of a few product classes extended the number of SICs in a few cases (e.g., refrigerated cheeses). In short, the NEIS79 data are highly representative of the SIC definitions used for the independent variables.

The third measure of product class price margins is NEIS80, which was carefully assembled from about 1,400 grocery-item prices spanning 145 NEIS categories. Unlike DIFF and NEIS79, NEIS80 was specifically constructed so as to filter those categories judged to contain private label products with significantly different physical quality characteristics compared to the manufacturers' brands in the same category. Selection criteria are more fully explained in Wills (1983, 1987). Examples of excluded NEIS categories are canned soups, canned pork and beans, refrigerated whipped toppings, frozen pot pies, and dry dog food.

Independent Variables

Four-firm 1977 seller concentration (CR477) is conventionally employed in structure-performance tests to represent the potential for collusion among the leading firms in pricing or output decisions. A second-degree term is often included to capture (imprecisely) the expected sigmoidal shape of the concentration-performance relationship that would result from a critical concentration level. The expected signs on CR477 and CR477SQ are positive and negative. Three variables are included primarily to correct for excessive breadth of Census product class definitions. PROC is the percentage of 1977 domestic shipments flowing to industrial uses, and PVTFDSTR is the percentage shipped for private-label sales in food stores. As both these distribution channels involve large scale purchases by professional buyers experienced in tough price negotiation, both variables should display negative coefficients. Geographic dispersion (GEOG) is also expected to be negative as it signals the presence of regional markets thereby correcting for underestimation in the national concentration figures.

The degree of product differentiation (and consequent high barriers to entry) is modeled by the usual advertising-expenditures-to-sales ratio. ADBFS uses 1977 seven-media advertising expenses for all brands in the product class divided by 1977 shipments of branded products sold in food stores. The variable TVAD, the ratio of television to total media advertising, is meant to capture the degree of "image" or "persuasive" (non-informational) content in advertising messages. Both advertising ratios should be positive. Finally, five-year growth rates are conventionally included to correct for transitory and unanticipated (nonstructural) demand shifts. Growth is the only nonstructural variable in the model.

Results

The theoretical model was estimated by OLS for each of the three dependent variables: DIFF, NEIS79, and NEIS80. These three variables incorporate observations from 16 of the 50 months of the period spanning April 1975 to May 1980.

Each equation had the same independent variables except for DIFF which has a variable for industry growth from 1972 through 1977 (GR277). This variable was chosen because the DIFF price data refer to 1975-1976. The other equations used industry growth from 1977 through 1982 (GR7782) because the other dependent variables incorporate 1979 and 1980 price data. The results are given in Table 1.

Almost all of the estimated coefficients had the expected signs. The four firm concentration ratio (CR477) was positive and significant at the 5% level or better in every equation. The square of concentration (CR477SQ) was negative in all equations and was also significant at the 10% level or better in every equation. From these estimated coefficients the maximum price differential occurs at the following concentration levels: DIFF -- 63%, NEIS79 -- 49%, and NEIS80 -- 54%. These critical points seem to be a little lower than previous empirical studies have found for the food manufacturing industries.

The three variables used to correct CR4, when significant, were negative as expected. However, PROC, PVTFDSTR, and GEOG are not consistently significant across the three models.

Both of the estimated coefficients of the two advertising variables had positive signs and were significant in every equation except for DIFF. Finally, the variables measuring industry growth had positive signs for all equations, and the estimated coefficients were significant in the DIFF and NEIS79 equations. Other variables, such as net imports, minimum efficient plant size, number of firms, size of the industry, and percent of domestic supply going to the food stores were included in earlier models, but were found to be nonsignificant or collinear with other independent variables included in the model.

Differences in the estimated coefficients between equations can be attributed to two factors: (1) differences in the samples and (2) differences in methods of computation of the dependent variables. Structural data were available on 102 SIC consumer product classes, but only 59 of these could be used due to the limited coverage of the price data. The inclusion or

Table 1. Regression Results Using Three Alternative Measures of National Brand-Private Label Price Differences of Manufactured Food Products, Selected Periods 1975-1980.

Independent Variables	Dependent Variable		
	DIFF	NEIS79	NEIS80
Intercept	-14.16	-0.34	-1.70
	(-1.12)	(-0.03)	(-0.19)
CR477	0.64^b	0.49^b	0.40^b
	(1.76)	(1.90)	(1.85)
CR477SQ	-0.0051^c	-0.005^b	-0.004^b
	(-1.53)	(-2.25)	(-2.06)
PROC	0.018	-0.18^a	-0.034
	(0.30)	(-3.56)	(-0.77)
PVTFDSTR	-0.048	-0.33^a	0.0055
	(-0.31)	(-2.68)	(0.04)
GEOG	0.017	-0.038	-0.032
	(0.38)	(-1.25)	(-1.23)
ADBFS	0.52	0.74^b	1.53^a
	(1.15)	(2.21)	(4.73)
TVAD	0.076	0.099^c	0.11^b
	(1.15)	(1.56)	(1.87)
GR7277	0.051^c	--	--
	(1.52)	--	--
GR7782	--	0.07^b	0.013
	--	(2.02)	(0.43)
General Statistics			
N	45	50	42
R^2	30.2	55.4	56.4
F	1.95^c	6.37^a	5.33^a
CR peak	63	49	52

Note: Student's t-values given in parentheses and statistical significance at the 1%, 5%, and 10% levels is indicated by superscripts a, b, and c, respectively. One-tailed tests are used for all variables except the growth variables.

exclusion of certain SIC categories could have had a large impact on the estimated coefficients for any one equation. Secondly, there was considerable variability in the methods used to develop the price differences reported by the DIFF, NEIS79, and NEIS80 variables. This variability certainly caused some of the differences in the estimated coefficients.

The two models that used the NEIS data had the best overall fit. Both had large F values that were significant at the 1% level and R^2s of at least 55%. The DIFF model has a distinctly poorer fit. The simple correlations among the three dependent variables ranged from 0.53 to 0.75.

Conclusions

Recalculation of DIFF and updating some of the market-structure data have virtually no effect on the estimated coefficients of concentration compared to the Parker-Connor results, but the results for the advertising variables are weakened considerably. Further investigation will be done to uncover the reasons for the relatively weak impact of product differentiation on price margins.

In the two NEIS equations, both concentration and product differentiation have strong, positive impacts on the national brand-private label price margins. The impact of advertising intensity is higher in 1980 than in 1979, but otherwise the two equations are very similar. This suggests (1) that the ability to work with individual item prices produces superior measures of product class price margins than when only product category prices are available, (2) that the "matching problem" is severe, or (3) that the 1976-1977 period was in a disequilibrium with respect to advertising and prices (perhaps inflation was still responsible for pricing distortions, but by 1979 such decisions were routinized). If the NEIS and SAMI data are from the same parent distribution, this can be confirmed by pooling the 1976-1980 observations and applying a Chow test. What is particularly interesting about the two NEIS results is that physical heterogenity makes little difference in structure-performance results, a conclusion supported at the brand level by Wills' (1983, 1987) work.

There are a number of limitations to structure-performance tests of the kind reported here using cross-sectional data on national brand-private label price margins. First, coverage is limited to warehoused grocery products that have comparable private label offerings (about 45% of food and beverage sales in grocery stores). For most fresh meat and produce items, there are no national brands (that is, the price difference is zero). Moreover, the SAMI and NEIS systems do not record shipments of grocery products that are delivered to stores by manufacturers or specialty wholesaler, though recently developed systems using electronic check-out data can provide such data. Second, the matching problem may be reduced through access to item prices, but it is possibly still significant. An interesting extension of this line of analysis would be to test whether the SAMI or NEIS categories (320 and 420 respectively) are superior market definitions to the 102 SIC product classes. This would require developing concentration, advertising, and barrier proxies at the product category level.

Third, and most serious, the price margins developed from SAMI-type sources are retail-level price differences. Therefore, the margins include the gross margins of national-brand manufacturers, wholesalers, and retailers. If distributors' margins are equiproportional across product classes, or if they are positively correlated with manufacturers' margins, the analysis is valid. (Connor and Weimer provide some evidence on this topic). If, on the other hand, distributors' margins are uncorrelated with the manufacturing-level structural variables, the analysis is also valid. However, a more direct test would involve calculations of price margins closer to the manufacturer level, a task in which the authors are presently engaged.

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