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RESEARCH REPORTS: FOOD PROCESSING

Advertising, Concentration and Efficiency In the Processed Potato Subsectors

by

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Introduction

Three theories of market behavior have gained credibility among agricultural economists as offering testable hypotheses of the structure-performance relationship in food industries (Marion, 1986). These theories are those of market power-profitability, (2) efficiency-profitability, and (3) strategic groups-market power-profitability (Bain, 1956; Demsetz, 1974; Caves and Porter, 1977). Several studies have applied the theoretical framework of the market power-profitability theory to food and other industries (Parker and Connor, 1979; Rogers, 1984; Pagoulatos and Sorensen, 1983). A general characteristic of these studies, however, is that they have involved a cross-section of heterogeneous industries. Conclusions derived from such studies are suspect because economic theory does not support comparability of market behavior among

industries which differ widely in such factors as capital intensity, capacity utilization, technological change, growth rate and demand elasticity (Marion, 1986). As a result, this study avoids the comparability issue by addressing the market behavior of a particular industry over time. Specifically, market behavior in the frozen and potato chip subsectors of the potato industry is the focus of this study.

The primary objective of this study is to examine the structure-performance relationship of the frozen and potato chip subsectors over the 1960-89 period. Data limitations prevent a test of relevant hypotheses for the efficiency-profitability and strategic groups-market power-profitability theories. However, these theories as well as the market power-profitability theory are described in Section II, of this paper. Section III provides a general description of the potato industry, with

particular emphasis on the frozen and potato chip subsectors. Section IV provides the model specification of the structure-performance relationship in the respective potato subsectors. This specification, as will be noted, is most relevant to the market power-profitability theory. Section V provides the empirical results derived from Ordinary Least Squares estimation of the empirical model. Additionally, this section provides some descriptive information which relates to the theories of efficiency-profitability and strategic groups-market power-profitability. Finally, Section VI gives a summary and the conclusions.

Theories of Market Behavior

As noted in the introduction, the market behavior theories of market power-profitability, efficiency-profitability, and strategic groups-market power-profitability offer testable hypotheses about the structure-performance relationship of industries. The market power-profitability theory posits that firms gain market power through methods such as company acquisitions and mergers, product differentiation, product proliferation, and advertising and then use that power to raise product prices and increase their profits (Bain, 1956; Connor, et al., 1985). Profits for an industry are hypothesized to be related directly to the degree of market power as measured by the extent of industry concentration and the height of entry barriers. Entry barriers are raised by methods such as increased product differentiation created through advertising, ownership or control over scarce and relevant resources, and greater economies of large scale or diseconomies of small scale (Bain, 1956; Gilbert, 1989). Hypotheses most frequently tested involve the relationship between profits and concentration, profits and advertising, and profits and plant scale. Positive relationships among these factors, as found most often, support the theory of market power-profitability.

An alternative theory of market behavior, efficiency-profitability or superior efficiency, posits that profits and concentration can be positively related simply because larger firms are more efficient than smaller firms. Stated differently, higher profits for a highly concentrated industry are likely to be unrelated to market power, but to greater efficiency. A testable hypo-

thesis is whether concentration enhances the profitability of all firms within an industry. If the profitability of larger firms is enhanced at the expense of smaller firms, then proponents of the efficiency-profitability theory would conclude that this supports the thesis of superior efficiency for larger firms (Demsetz, 1974; Peltzman, 1977).

The strategic groups-market power-profitability theory, or the theory of strategic groups, posits that economic performance within an industry is determined more from the degree of market power within strategic groups of firms than from an overall level of industry concentration (Caves and Porter, 1977). Unlike the market power-profitability theory which depicts an industry as a closely related group of firms, this theory recognizes closely related firm groups within an industry. Price and/or profit raising entry barriers, which protect incumbent firms from new entrants under the theory of market power-profitability, protect groups of firms within an industry from another group. Moreover, firms within a given group are hypothesized to make investments to raise existing entry barriers and enhance their long-run profitability. Testable hypotheses relevant to this theory involve the profits-concentration relationship among groups of firms, the entry process of firms into groups according to the height of entry or mobility barriers, and the overall mobility of firms among groups over time.

Description of the Potato Industry

The U.S. potato industry is made up of a large fresh market sector and three major processed subsectors: dehydrated, frozen and potato chips. The fresh market sector is reasonably competitive and the dehydrated subsector is so concentrated that data are withheld to avoid disclosing the identity of firms. The focus of this section is therefore on the frozen and potato chip subsectors.

Approximately 40 percent of all potatoes produced go for fresh market consumption. Of the potatoes used for processing, roughly 60 percent go for frozen potatoes, 24 percent for chips, and 14 percent for dehydrated potato products. Frozen potato consumption has shown tremendous growth over the 1960-89 period of

this study, increasing from 6.4 pounds per capita to over 46 pounds per capita. By contrast, potato chip consumption increased during this period from 12 pounds to 18 pounds. Much of the growth of frozen potato consumption paralleled the growth of fast food consumption. Over 83 percent of frozen potatoes today are distributed through institutional establishments, as compared to 66 percent in 1960. Fast-food establishments alone account for more than 60 percent of this institutional use.

At the processing level, the frozen potato subsector is made up of a few large processors and many smaller ones. Of the five large processors, only one concentrates on the retail market. This firm, Ore-Ida, controls more than 60 percent of the retail market and approximately 12 percent of the institutional market. These markets combined gives Ore-Ida a 1990 market share of approximately 18 percent, ranking it second to Lamb-Weston. Rounding out the top five frozen potato processors are J. R. Simplot, Carnation and Universal Foods. Although this subsector showed tremendous growth during the past thirty years, the top firm as well as the leading four firms lost market shares. These changes suggest that industry growth enhances the probability of new firm entry and smaller firm expansion.

Despite a loss of market share during the 1960-89 period, the top four frozen potato processors controlled 69 percent of the market in 1989, a decline of 15 percentage points from a 1960 share of 84 percent. Moreover, the leading processor during the decades of the 1960s and 1970s, J. R. Simplot, relinquished the number one position to its largest competitor during the late 1980s. With institutional establishments serving as the primary outlet for frozen potatoes, it is important to recognize the high degree of concentration within this market, particularly that of the fast-food sector. Thus, market power associated with large market shares for frozen potato processors is tempered or offset by that associated with large market shares of foodservice firms. Moreover, the institutional distribution of a large share of frozen potatoes seems to have limited an important method of enhancing market power, that is, advertising expenditures by frozen potato processors.

Unlike the frozen potato subsector with several national firms competing against each other, the potato chip subsector has just one truly national firm (Frito-Lay), several strong regional firms, and many local firms. Moreover, Frito-Lay as well as its three largest competitors have gained market shares during the 1960-89 period of this study. Market shares for the top four firms increased from a 1960 level of 36 percent to a 1990 level of 60 percent. As a percentage of the market share for the top four firms, the leading firm increased its share from 12 percent to 33.5 percent. Advertising expenditures also showed considerable growth, increasing from less than four-tenths of one percent of sales in 1960 to more than 1.1 percent of sales in 1990. Since theory suggests that advertising is a means of differentiating products primarily at the consumer level, this advertising pattern for chips is theoretical plausible since more than 75 percent of chips are distributed through retail establishments.

Although one national firm controls a large share of the potato chip market, regional and local firms control larger shares than Frito-Lay in some areas. For example, Golden Flake Snack Foods, a Birmingham, Ala.-based company, controls 46 percent of the potato chip market in Alabama as compared to 38 percent for Frito-Lay (Lawrence, 1987). Similarly, Jays Foods, a Chicago-based potato chip company, currently owned by Borden, controlled up to 49 percent of the potato chip market in Chicago during the early 1980s (Dagnoli, 1986). Such large market shares for local and regional firms suggest that national market shares can be misleading as an indicator of a firm's market power. Nevertheless, targeted advertising efforts by Frito-Lay to enhance its market share have been shown to erode market shares for regional and local firms (Lawrence, 1987; Dagnoli, 1986).

Because of the strength of many regional and local brands of potato chips, Borden, the nation's second largest potato chip producer, has implemented a strategy of acquiring brands and companies to strengthen its market position. Brand and company acquisitions by Borden have helped the firm increase its 1990 market share to 16.5 percent, giving the top two firms 50 percent of the market. Yet, new firm entry and continued prod-

uct development by existing firms provide consumers a wide range of alternatives to the product varieties of the two largest firms. Rapid change has occurred in the industry, as reflected by a loss of 245 potato chip plants during the 1960-89 period.

Model Specification

Oligopoly theory posits a positive relationship between industry concentration and price (Koutsoyiannis, 1979). Concentration reflects market power and this power is hypothesized to be exercised through higher prices. Thus, a price dependent model is specified for both the frozen and potato chip subsectors. Specifically, the retail-wholesale price margin forms the price-dependent variable for each of the models. This specification is necessitated because firm-level prices are unavailable. Changes in the retail-wholesale price relationship over time are hypothesized to reflect changes in market power among processors in each respective subsector. An increase in market shares for smaller firms with relative undifferentiated products, for example, is hypothesized to lower the retail-wholesale price margin. That is, a lower price elasticity of demand for undifferentiated products limits the size of margin which can be passed on to consumers.

Several factors are hypothesized to impact the retail-wholesale price margin. For the frozen potato subsector, its advertising-sales ratio (ASRR), four-firm concentration ratio (CRR4), the relative market share (RMSR) of the leading firm, growth in per capita consumption of frozen potatoes (GPCR), and changing distribution between retail and institutional establishments (IPRR) are hypothesized to explain changes in the price dependent variable (PCMR). Increased distribution of frozen potatoes through institutional establishments is hypothesized to have a negative impact on price, but all other independent variables are hypothesized to be positively related to price.

The hypothesized signs for the described variables follow from oligopoly theory. Advertising is considered a means of achieving fancied product differentiation which leads to increased

market power and price-enhancing potential; high levels of concentration and a larger relative market share for the leading firm make firms cognizant of their interdependence and enhances their probability of engaging in tacit collusion to raise prices; market growth facilitates planning and allows better use of all resources; and, as previously described, sellers' market power at the processor level is partly offset by buyers market power at the institutional level. This model is expressed as:

$$\text{EQ. 1: PCMR} = \beta_0 + \beta_1\text{ASRR} + \beta_2\text{CRR4} \\ + \beta_3\text{RMSR} + \beta_4\text{GPCR} + \beta_5\text{IPRR} + U_1$$

where,

PCMR = Retail-wholesale price spread for frozen potatoes, measured in cents per pound (real dollars).

ASRR = Advertising-sales ratio for frozen potatoes.

CRR4 = Market shares of the top four frozen potato processors as a percent of the total market.

RMSR = Market share of the largest firm as a percent of the top four firms' market share.

GPCR = Annual changes in per capita consumption of frozen potatoes, measured in pounds.

IPRR = Share of frozen potato production distributed through institutional establishments.

U_1 = An error term.

An almost identical model is specified for the potato chip subsector. Advertising-sales ratio (ASRC), four firm concentration ratio (CRC4), and relative market share (RMSC) of the leading firm are hypothesized to have the same impacts on the retail-wholesale price of chips (PCMC) as described for frozen potatoes. Unlike the frozen subsector, per capita income changes (PCIN) are hypothesized to provide a better proxy for growth

potential in the sector than per capita changes in chip consumption. An increase in per capita income is hypothesized to have a positive impact on chip prices (PCMC). Similarly, exit of smaller firms from the industry, captured by changes in plant numbers (PCPN), is expected to be reflected in higher chip prices. This model is expressed as:

$$\text{EQ. 2: } \text{PCMC} = \theta_0 + \theta_1\text{ASRC} + \theta_2\text{CRC4} + \theta_3\text{RMSC} + \theta_4\text{CPCP} + \theta_5\text{PCIN} + U_2$$

where,

PCMC = Retail-wholesale price spread for potato chips, measured in cents per pound (real dollars).

ASRC = Advertising-sales ratio for potato chips.

CRC4 = Market shares of the top potato chip firms as a percent of the total market.

RMSC = Market share of the largest potato chip firm as a percent of the top four firms' market share.

CPCP = Annual changes in the number of potato chip plants, measured in numbers.

PCIN = Per capita income, measured in real dollars.

U_2 = An error term.

Empirical Results

Results for the two models are presented in Table 1. For the frozen potato subsector, only two independent variables are significant at the 10 percent level or better. An increase in four firm concentration leads to higher prices. Specifically, the elasticity parameter shows an increase in PCMR of 5.9 percent for each 1 percent increase in CRR4. By contrast, an increase in the market share of the leading firm (RMSR) relative to the top four firms leads to a decrease in PCMR. With the leading firm, J. R. Simplot, through most of the data period, concentrating entirely on

the foodservice market, an inverse relationship between RMSR and PCMR is theoretically plausible if larger differentials exist for the retail grocery-wholesale market than for the foodservice-wholesale market. Because firm level price data were not available, price differences among firms could not be tested. Both GPCR and IPRR have the hypothesized signs, but they are statistically insignificant. Advertising not only is statistically insignificant but also has a theoretically implausible sign.

Table 1

Empirical Results for the Frozen and Potato Chip Subsector Models

Frozen Subsector: Dependent Variable is PCMR

Variable	Coefficient	T-Ratio
ASRR	-1.2279	-1.0962
CRR4	0.00911	4.1531
RMSR	-0.00627	-1.6087
GPCR	0.00265	1.0141
IPRR	-0.00298	-0.028
Constant	-0.3856	-2.9255

R-Square = 0.7749

Durbin-Watson = 1.645

Potato Chip Subsector: Dependent Variable is PCMC

Variable	Coefficient	T-Ratio
ASRC	11.014	2.9446
CRC4	0.002054	0.35977
RMSC	-0.00384	-0.62011
CPCP	0.00124	1.2478
PCIN	-0.00031	-3.1023
Constant	0.1402	0.9863

R-Square = .4325

Durbin-Watson = 1.4137

Estimated results for the frozen potato subsector must be carefully evaluated. Because of

the large distribution of frozen potatoes through institutional establishments, advertising has not been a major factor in differentiating the product. Indeed, Ore-Ida, the one major processor with a focus on the retail grocery market, accounts for more than 80 percent of the advertising expenditures for frozen potatoes. Additionally, it is not clear whether the retail price data from the Bureau of Labor Statistics, as used in this study, clearly reflect the retail price of frozen potatoes distributed through foodservice establishments. Indeed it is not clear if a retail price of these products is meaningful. Retail prices for frozen potatoes at foodservice establishments are of particular concern to this researcher because the prices used in this study show a decline in the retail-wholesale margin over the thirty-year data period of more than 67 percent (real prices). A decline of this magnitude would suggest effective market power by foodservice firms, particularly those in the fast-food sector.

Clearly the results for the frozen potato subsector do not offer strong support for the traditional theory of market power- profitability. Firm entry and expansion of smaller firms have served to erode market shares for the leading firms. Although profits are not a variable in this study, the declining price margins supports the general thesis of the superior efficiency model that profits for large firms are not due to their ability to raise prices, but are due to their lower costs. Using output per unit of labor input as a measure of efficiency, Figure 1 does not offer strong support for the greater efficiency of larger firms. Indeed if one defines the five categories as strategic groups of firms, the second largest group of firms is shown to be more efficient than the larger group of firms for the latest available data period. Additionally, firm growth and relative competitiveness in the frozen potato subsector suggest few mobility barriers among groups of firms. Thus, the empirical evidence for the frozen potato subsector do not offer strong support for any of the previously described theories of market behavior.

Results for the potato chip subsector show advertising to be the only factor which has had a positive and statistically significant impact of price margins. Both four firm concentration and relative firm concentration are statistically insignifi-

cant. Such results suggest that national market shares may not be a relevant measure of market power in a subsector where regional and local brands often dominate. However, as previous studies have shown, targeted advertising efforts by Frito-Lay have served to erode market shares of local and regional firms (Lawrence, 1987; Dagnoli, 1986). As national firms target local and regional markets with increased advertising efforts, these results suggest rising price margins and declining competition from smaller firms. However, over much of the data period, it seems that growth of the larger firms occurred not as a result of an aggressive advertising strategy to dislodge existing firms from the industry.

Although changes in the number of potato chip plants (CPCP) were hypothesized to be a proxy for changing competition from smaller firms, this variable is shown to have a statistically insignificant impact on price margins (PCMC). Yet, it is signed as hypothesized and comes close to being statistically significant at the 10 percent level. Contrasting these changes in plant (firm) numbers with trends by Frito-Lay to develop more targeted advertising efforts, it seems plausible to conclude that firm losses provided opportunities for market share gains over much of the data period. As weaker firms left the industry, more aggressive advertising efforts were perhaps needed to compete with remaining firms.

Because per capita consumption of potato chips have shown only moderate growth over the past thirty years, it was hypothesized that per capita income changes would be a more relevant factor influencing firms' pricing decisions. Per capita income growth (PCIN), however, is shown to have a negative and statistically significant impact on price margins. Unlike the demand for convenience which has driven frozen potato consumption, this estimated price-income relationship suggests that chips are either highly price sensitive or compete with many alternative snacks for a share of the consumer dollar.

Relative to the superior efficiency theory, Figure 2 clearly shows that larger firms are more efficient than smaller ones. Indeed potato chip marketing specialists suggest that most of the firm and plant losses over the past thirty years have

FIGURE 1. EFFICIENCY IN THE FROZEN

POTATO SUBSECTOR -- 1963--77

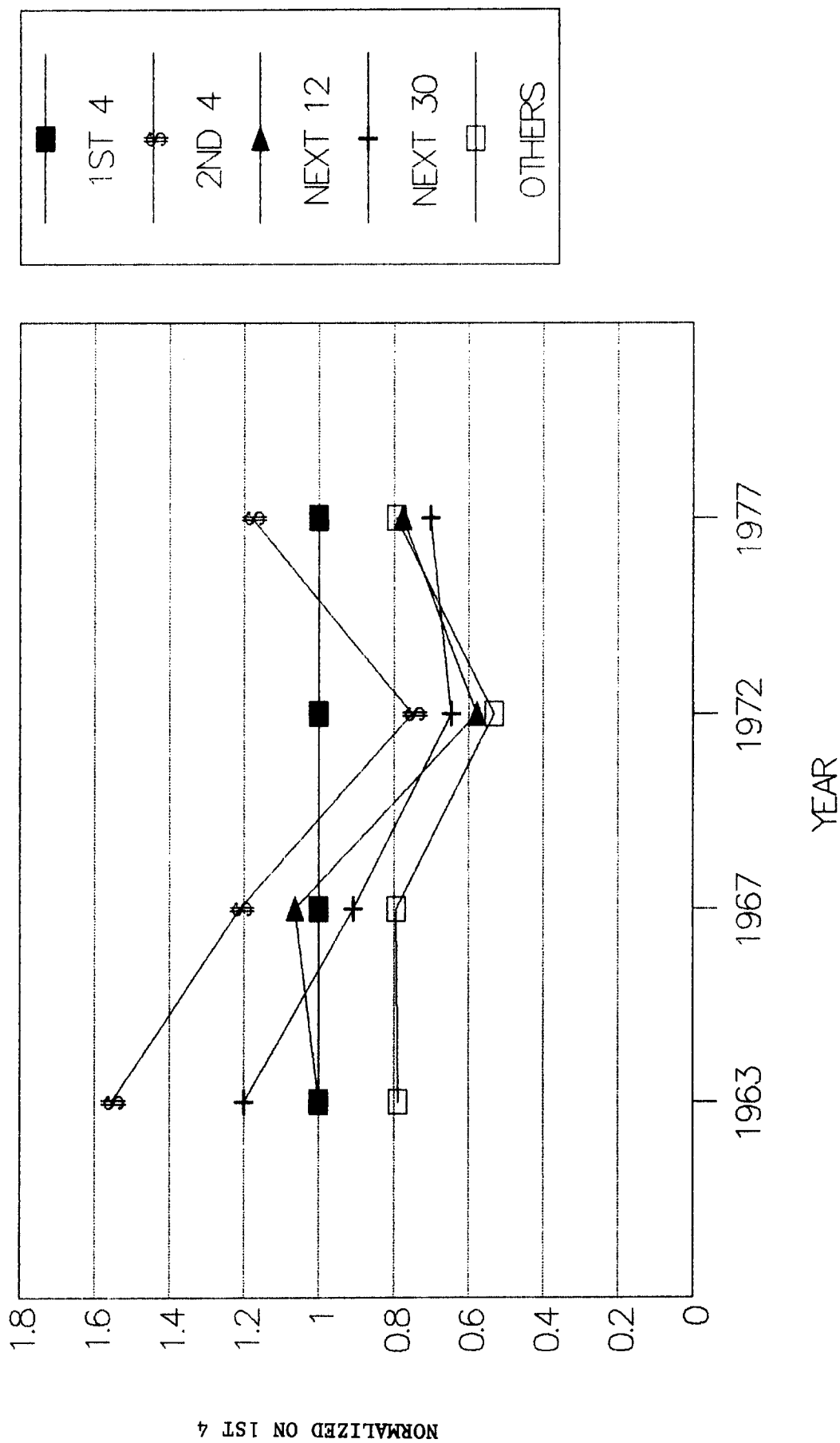
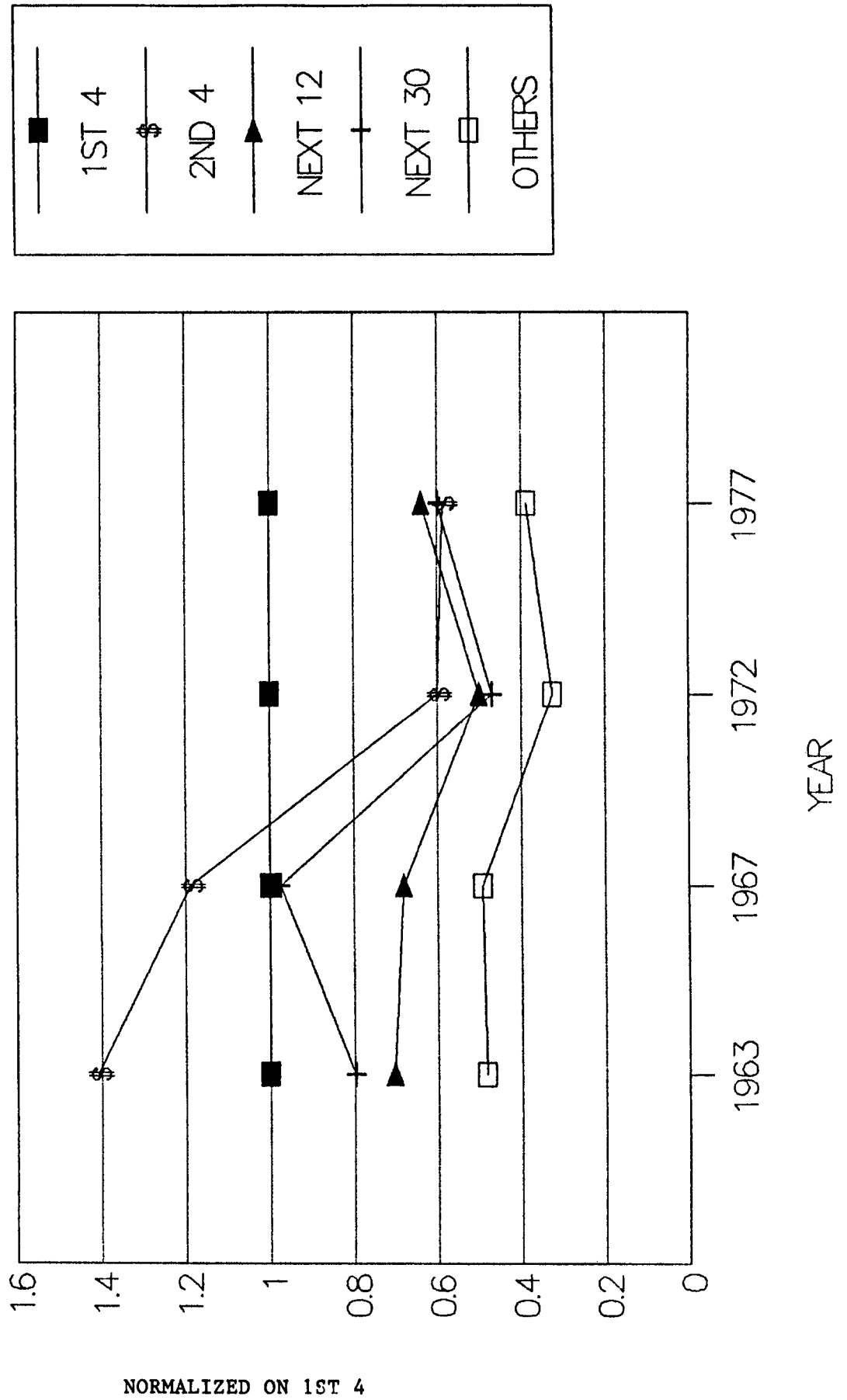


FIGURE 2. EFFICIENCY IN THE POTATO CHIP

SUBSECTOR --- 1963-77



been due to smaller firms' inefficiency. Yet, the large advertising expenditures of this subsector, Figure 3, suggest that larger firms recognize the potential entry barriers which can be erected through product differentiation advertising. The structure of the potato chip subsector, national, regional and local firms, certainly suggests groups of firms as defined by the theory of strategic groups. Moreover, little movement have occurred among groups, suggesting effective entry or mobility barriers. Thus, one could conclude that the potato chip subsector is characteristic of all three theories of market behavior. A more definitive conclusion will require estimation of a richer model which integrates profits and efficiency measures with price margins.

Summary and Conclusions

Results from a time-series study of two potato subsectors within the market power-profitability framework provide weak evidence to confirm or refute the basic tenets of the theory. Four firm concentration is shown to have a price-enhancing effect in the frozen potato subsector, but no effect in the potato chip subsector. Advertising-sales ratio is shown to have a price-enhancing effect in the potato chip subsector, but no effect in the frozen subsector. Such results seem plausible when interpreted in light of structural differences between the two subsectors. Because most potato chips are distributed through retail establishments, advertising is a major expenditure for potato chip firms. By contrast, frozen potato processors rely very little upon advertising because most frozen potatoes are distributed through institutional establishments. Additionally, national market shares can be an inappropriate proxy for market power where regional and local brands have preferences over national brands.

Although the top four frozen potato producers lost market shares over the thirty-year period of this study, while the top four potato chip firms gained market shares, the results show an insignificant statistical relationship between prices and concentration for the potato chip subsector. This insignificant result, when interpreted relative to available statistical data showing larger potato chip firms to be more efficient, support the superior efficiency theory that larger firms have higher

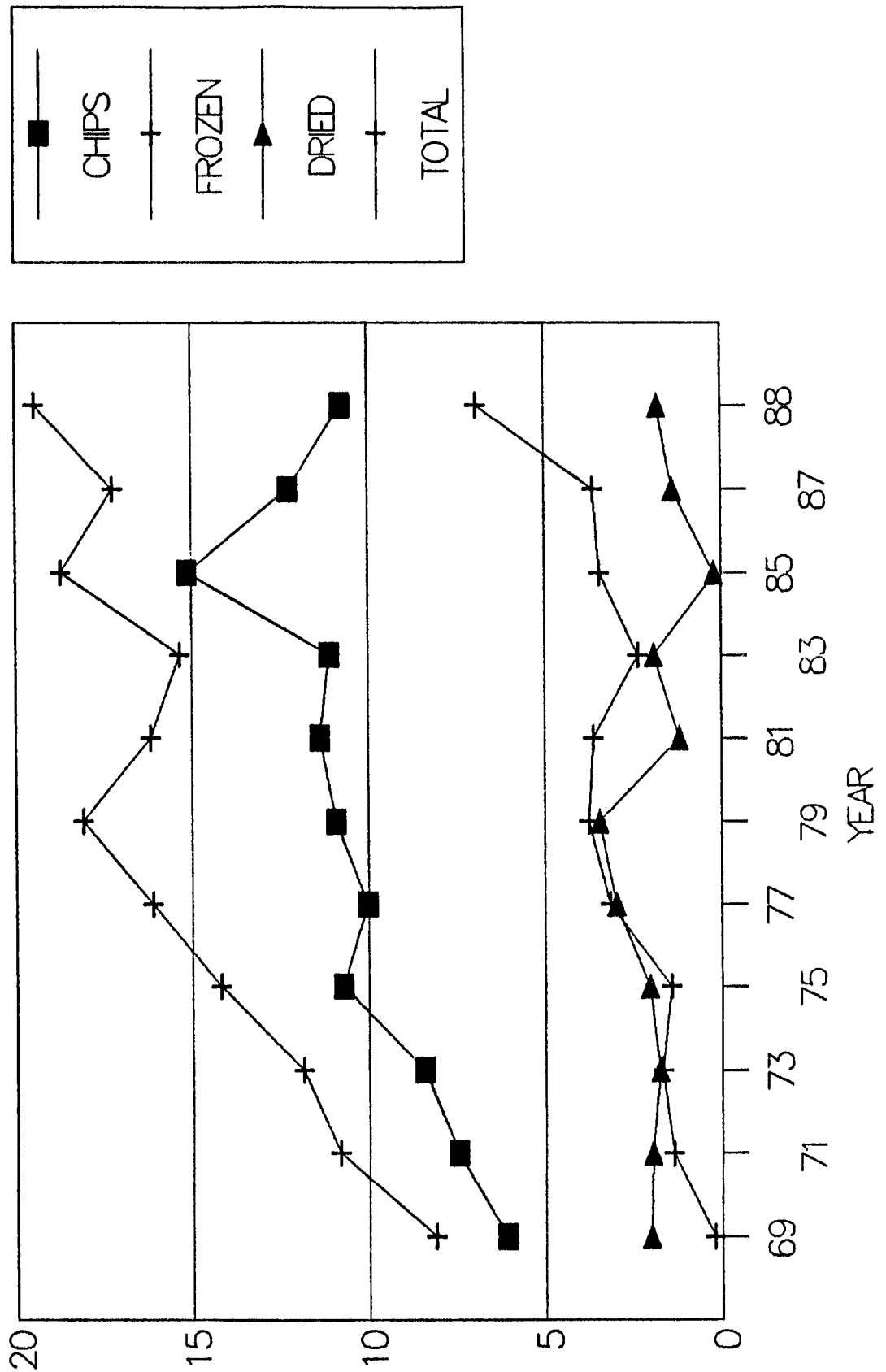
profits because of lower costs. Moreover, the organization of the potato chip subsector into national, regional, and local firms support the theory of strategic groups. Mobility barriers among these groups also seem to exist, since there has been little movement of firms between or among the groups. Overall, results of this study offer support to all three theories of market behavior. Perhaps, as Martin (1988) concluded, the three theories are not necessarily competing alternatives, but complementary to each other when all aspects of an industry are analyzed.

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FIGURE 3. ADVERTISING EXPENDITURES ON

POTATO PRODUCTS --- 1969-88



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