FOOD PRODUCT PROLIFERATION:

A MARKET STRUCTURE ANALYSIS

by

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In a recent article in the _American Journal of Agricultural Economics_, Padberg and Westgren chide agricultural economists for failing to analyze the important topic of new food product introductions. As they rightly argue, product proliferation is one of the major modes of competitive conduct exhibited by leading food manufacturers.[1] Not only may this dimension of conduct significantly affect economic performance, but it also may feed back upon industry structure by increasing the market shares of leading firms or by elevating barriers to entry.

Critics of the food system frequently express the frustrations of consumers facing escalating product proliferation (Connor 1980). First, they regard product proliferation as deceptive because most "new" products are mere imitations or minor variants on the existing products and because they are marketed by the same few leading firms. Second, proliferation contributes to inflation because the new products often have lower price/quality ratios than existing substitutes (MacDougall). Third, product proliferation entails waste in the form of self-cancelling advertising and operating at suboptimal production levels. Fourth, the large number of new products introduced may undermine rational decision making by rendering trial purchases and evaluation impossible. Finally, product proliferation may be an anticompetitive strategy designed to reinforce product differentiation and raise barriers to entry (Elsner).

While some food manufacturers might favor a nonproliferation treaty, in the main they profess to regard new product introduction as conferring unequivocal benefits for consumers. Product proliferation both broadens consumer choice and, through market segemntation satisfies consumer demand more precisely. Product introduction is equated with new entry; high failure rates are taken as evidence of strong competitive rivalry.

The purpose of this paper is to examine the extent of product proliferation among manufacturered food products, its relationship to the industrial organization of the food manufacturing sector, and some of the empirical determinants of new food

product introductions. I find that economic theory suggests that product proliferation is an expected outcome in industries displaying a lack of "hard" or price competition. An empirical model demonstrates that departures from competitive market structures are conducive to high levels of proliferation among a large sample of processed food product classes. Finally, there is a brief discussion of the implications for consumer welfare.

The Concept of Product Proliferation

The term product proliferation is itself rather new and variable in useage. However, it appears that a common concept underlying most discussions of the subject is that any given item can be categorized according to several attributes or dimensions; each of these dimensions can be used to create a product space which at any point in time holds some empty or unfilled segments. Product proliferation consists of "filling" or making the space denser.

This concept can be used to distinguish "commodity-type" foods from physically "highly differentiated" foods. Products that need more dimensions to completely define them are more differentiated. For example, raw cow's milk reached the urban consumer of the early nineteenth century with only three or four dimensions (color, creaminess, freshness, and possibly water content). Milk was unpasteurized, unpackaged, unflavored, was unavailable in multiple butterfat levels, and had multiple end uses. Today, milk is more differentiated because, in addition to being branded, it is packaged in three or more sizes, three or more butterfat levels, and chocolate flavored. As a result, most grocery stores carry at least a dozen fluid milk items. In addition, milk is now available in canned and dried forms. Fluid milk has been subject to modest product proliferation in the last one hundred years, though it remains among the least differentiated of processed foods.

A typology of market segmentation adequate to analyze the contemporary grocery product universe would require at least ten dimensions. An example of such a

typology is listed below in the left-hand column; to the right is an example of a particular breakfast cereal:

(1) Basic ingredient or ingredient mix

(1) wheat, bran, and raisins,

(2) Extent or method of preparation (implies method of preparation to make ready for final consumption),

(2) ready to eat, with milk,

(3) Visual properties (shape and color),

(3) flakes, toasted brown,

(4) Organoleptic properties (texture, viscosity, toughness),

(4) crunchy flakes, chewy fruit,

(5) Flavor (extracts, spices, and scents),

(5) salt, vanilla, and sugar,

(6) Packaging (material, shape, size, type, or opener or applicator,

(6) 16 oz., box, waxed-paper

(7) Time (of manufacture of spoilage),

(7) edible for another 7 months,

(8) Intended occasion (cooking ingredient, main meal, side dish, appetizer, breakfast, dessert, snack, ceremonial, supplement, or other food contact),

(8) breakfast food,

(9) Special identity (ethnic origin, "health" food, low calories, other dietary characteristics), and

(9) high-fiber content, and consequent laxative properties,

(10) <u>Target group</u> (age, sex, wealth,   (10) health-concious adults.

   vocation, avocation, aspirations,

   or other consumer characteristic).

Though some of these dimensions may be irrelevant for a specific food (that is, the dimension value is zero), the ten characteristics should fully specify most contemporary food products.3/ Changing any of these descriptors, especially the last three "psychic" attributes, implies a change in the demand segment with which the product corresponds. If the product is presweetened by frosting the flakes, then the otherwise identical unsweetened cereal could become re-aimed at another potential group of consumers, young children perhaps. Such a change in formulation would imply a shift in the identity of close substitute cereals; the "repositioned" product would now compete in the "presweetened childrens" segment rather than the "low-sugar adult" category.

The concept of a multidimensional product-attribute space is in current application by marketing planners to evaluate company product portfolios. One popular version is employed to improve long-run profits by identifying the optimal mix of products based on their growth and market share characteristics (Day; Wind and Claycamp). Similar analytic tools are used to identify or to create new demand segments based on purchasing responses or household demographic characteristics (Smith; Assael and Roscoe). Segmentation analyses help companies select effective advertising appeals, optimal sales-effort mixes, and product designs (Blattberg and Sen).

Product proliferation is intimately related to the state of the arts. With a ' constant stock of available technology, the introduction of physically differentiated products would eventually cease. Every available segment of the product space would become fully exploited; that is, no additional products could be profitably introduced given the associated demand sement. Technological change, however, can <u>expand</u> the product space by making available additional axes or more classifications on existing axes ("longer" axes). It is in this sense that technological change can be said to be a sufficient condition for product proliferation.4/ It is not a

necessary condition, however, because some physical differentiation (e.g., changes in packages sizes) can occur under a static technology. In additional to proliferation due to physical changes, the application of persuasive advertising can create more subjective or psychic differences among products. Advertising can especially alter the intended occasion, special identity, or target group dimensions of an existing product. The increasing importance of psychic satisfaction versus physical needs appears to be related to societal affluence (Galbraith).

To illustrate, consider changes in kitchen appliance technology. The advent of the freezer meant the replication of most canned goods in a frozen form. Microwave ovens will imply the future appearance of microwave-compatible foods and food packaging. Retortable pouches will permit another wave of items to proliferate. In each of these cases, technological innovations were a necessary condition for product proliferation, but consumer acceptance had to be won by convincing users of the inherent convenience, increased palatability, or compactness incorporated by further processing.

Packaging changes may be the most prominent form of food product proliferation (Arthur D. Little). It is certainly one of the most obvious aspects of change to consumers. The last one hundred and fifty years have seen a remarkable profusion of packages, starting with the development of wood-pulp papers and cans. Packaging permits food manufacturers to offer a nearly infinite gradation of size, including multiple units. More importantly, packages can deliver messages to potential users indicating possible uses, additional occasions for use, and convey an idea of the target group. Thus, purchasers can be told that a breakfast cereal can also be used as a snack or baking ingredient.

Two possible dimensions of product proliferation so far not discussed are brand and price. Neither factor necessarily brings about physical differences in a product, but either can create differences in the minds of consumers. An outstanding example of this type of proliferation is the manufacture of multiple brands of

the same product. Generally, private label products are manufactured according to unique specifications of a retailer, but sometimes a change of retailer label is the only difference among products if a given manufacturer serves several retailers.

Within a well defined category of food products, there are likely to be fairly wide and sustained price differences, especially between national brands and private label products. While many consumers use price as a guide to "quality," a reasonably thorough review of the evidence found no such a relationship (Parker and Connor). This finding is also confirmed by two formal analyses of correlations between price and quality ratings by Consumer Reports magazine for a wide array of manufactured products (Morris and Bronson; Swan). As a rule, wholesale price differences among the leading national brands of a given product are so slight as to be nearly imperceptible to consumers at retail. Mass-media advertising by manufacturers is rarely used to inform consumers of such price differences as may exist, particularly television and magazine advertising (Resnik and Stern; Stern, Krugman, and Resnik). Of course, temporary discounts, specials, and deals will create noticable price differences; these reductions may be advertised by grocery retailers.

Economic Theories of Product Proliferation

Interest by economists in the phenomenon of multiple products dates back at least to Hotelling's classic paper on the competitive distribution of sellers. His model imagined consumers equally distributed along an axis representing distance or some qualitative aspect of a product, such as the sweetness of cider. With free entry, established sellers will produce cider of average sourness in order to attract as · many consumers as possible. If, on the other hand, entry is restricted or the sellers agree to avoid price competition, then the cider makers will product ciders differentiated from each other on the basis of their sweetness. Competition becomes localized, in the sense that changes in quality (or price) only affect the demand for adjacent brands. Each producer is in effect an oligopolist, with groups of adjacent producers serving different segments of the cider market based on the sweetness or sourness preferences of consumers.

Hotelling's spatial equilibruim, model has been used to analyze product (nonspatial) differentiation. Of import for industrial organization are the numberous analyses making various assumptions about potential entrants' expectations. These analyses have shown that when products are differentiated even the existence of free entry may not suffice to eliminate excess profits (Lovell; Peles; Hay; Eaton and Lipsey 1975, 1976; Prescott and Visscher).

Schmalensee extended these models by formally examining product proliferation in the context of a differentiated food manufacturing industry. He demonstrated that, if established firms collude to deter entry, then increasing the number of brands of given product is a more (jointly) profitable strategy than limit pricing. Indeed, he showed that in an industry characterized by brand proliferation, an equilibrium is possible in which established brands earn excess profits but no potential entrant can profitably enter. The strategy of brand proliferation also deters entry by unbranded (private label) imitators more effectively than limit pricing. Finally, Schmalensee demonstrated that excess advertising is an alternative to brand proliferation as a means of deterring entry. While Schmalensee's results depend on an assumption of localized rivalry (that is, brands are immobile in the sense that repositioning a brand in quality space is too costly for a seller to consider), relaxation of this assumption to finite costs would not appear to alter his conclusions (Eaton and Lipsey).5/

A second theoretical approach to product proliferation is the concept of "commodity bundling." In a formal model developed by Adams and Yellen, bundling includes products available in different containers, multiple unit packages, and any "...incarnations of the same product, differing in either real or perceived quality" (p. 475). Their model assumes a monopolist selling two products or a single product with two separable characteristics.6/ They demonstrate that pricing strategies can be followed that extract consumer surplus by sorting customers into groups with different reservation prices. Thus, bundling is similar to price discrimination and under some conditons the more profitable strategy. Finally, their normative analysis

of commodity bundling concludes that it generally produces nonoptimal product
quantities and causes significant redistribution of income.

A third, less formal analysis of product proliferation is contained in a recent
paper by Koller. He considers product proliferation one of the three most common
forms of predatory conduct, far surpassing classical predatory pricing in importance.
He asserts that the act conforms to the three criteria of sucessful predation:
(1) the predator earns quasi-rents, (2) the market is restructured, and (3) rivals or
buyers are made worse off. Consumers may be initially better off because of the
availability of a new product, but eventually they are worse off because proliferation
preempts entry by actual or potential competitors. An interesting observation by
Koller is that, because the investment is covert and because the barrier is erected
as soon as the product is marketed, product proliferation takes rivals by surprise,
thereby making it generally more effective than predatory pricing wars.

Therefore, economic theory suggests that new grocery product development is a
form of nonprice business conduct whose roots lie in the structure of the markets
in which the firm operates. A firm that already holds a leading position in a given
market will find it advantageous to develop products in adjacent niches in the product
space for several reasons. First, adjacent products may appeal to a new set of
consumers as well as offer present consumers some variety. Developing product in
adjacent positions is also a good defensive strategy to maintain market share for the
leading item. Second, the firm can eventually offer a "full line" of products. A
full line allows a brand name to be more fully exploited, may justify setting up a
field sales force, and will confer some pecuniary economies of scale in advertising
and promotion. Third, product proliferation of this kind will generally necessitate
the allocation of substantial store shelf space. In order to duplicate or imitate
the line, a new entrant would require a similiarly large allocation of shelf space by
retailers. Since this is unlikely for all but the most powerful of manufacturers,
product proliferation acts as a barrier forestalling entry. Fourth, being the first or
second in a market has been shown to confer several advantages in terms of future high
markets shares.7/

The Measurement of Product Proliferation

The concept of what is "new" in food products varies enormously from writer to writer. Some claim that there are no truly new foods at all, while others estimate that several thousand new foods appear each year.8/ The problem of definition is compounded by the point-of-view of the agent in the food system; as Buzzell and Nourse have argued, manufacturers, retailers, and consumers each have differing perceptions of newness. When a food manufacturer decides to bring a product to market (beyond the testing stage), a change in firm organization must occur. The decision for a retailer in deciding on newness is whether to make space on his shelves for the product. Even small changes affect shelf placement: a new flavor extention or a three-for-the-price-of-two offer, for example. Consumers must decide on whether to make a trial purchase and then to make price-quality comparisons with close substitutes they habitually buy.

Buzzell and Nourse proposed that new products can be classified according to their degree of novelty. Their typology consists of three categories arrayed from the most to the least innovative and from the least to the most frequent:

(a) Distinctly new products are those "...substantially different in form, basic ingredients, and/or method of use in the home from any other product..." (pp. 27-28);

(b) Line extensions or new brands are "...new package sizes, flavors, or shapes of existing products...additions to existing line of products..." (p. 27);

and (c) Product improvements or new items are "...changes in existing products, such as changes in appearance, taste, or texture..." or "...a package with improved performance of characteristics" (p. 17).

Buzzell and Nourse recognize that this typology lacks precision--there are many borderline cases. However, the schema is a useful starting point, for it does roughly capture distinctions made by buyers and sellers in the food industry. This paper

will follow their lead. The rarest and most innovative product introductions will be termed distinctly new products or new types or categories. A more common kind of product proliferation involves brand proliferation (imitations of successful new types of other producers) or line extensions (by the introducing firms). Finally, the most frequent type of proliferation will be termed item proliferation, repositioning or reformulation. These distinctions also fit within a time framework. That is, first, a new category is created; second, brand proliferation or line extensions occur; last, item proliferation and repositioning happen.

One source (OECD) has suggested that distinctly new food products would require the creation of new product class number in the official industrial classification system, such as the U.S. Standard Industrial Classification (SIC) code. These are rather rare occurences; new codes appear only if there is a broad concensus of several departments of government and if the industry has already grown to a fairly large size. An analysis of 5-digit SIC product codes for 1954-72 reveals only 19 codes in 1972 with no direct predecessors; of these 8 were producer goods.9/ Thus, the number of consumer product classes increased by about 12 percent, but some of these product classes contined few new products.10/ Because standards other than innovation are used to create new product classes, this method of measuring proliferation is unsatisfactory.

Table 1 contains two alternative lists of distinctly new products, chosen by writers familiar with food marketing. Not all of these products have been successful in terms of sales (witness breakfast cereals with freeze-dried fruits, unsalted margarine, instant flour, and liquid diet foods); some may have been merely fads. One might quibble with the novelty of a few items on their list--rice premixed with saffron or corn oil margarines, for example. Yet what is striking is how few distinctly new products were introduced over a twenty year period--only one per year.

The second column of Table 1 employs a more liberal concept of newness. Many of the items listed are mere flavor extensions of existing products (for example, flavored

Table 1 — Some distinctly new food products

Products introduced during 1945-65[1]	Products introduced circa 1978[2]
Vitamin-enriched breakfast cereals	Microwave-compatible pancakes
Breakfast cereals with freeze-dried fruits	Cough candy lollipops
Instant oatmeal	Sangria-flavored soft drink
Dehydrated flaked potatoes	Quarter-pound hot dog
Instant-blending flour	Turkey kielbasa sausage
Frozen dinners and specialities	Pizza-flavored sticks
Dehydrated potato specialities	Yogurt bran bread
Synthetic orange drink concentrate	100% fat-free candy
Orange juice concentrate	Soft drink concentrate in aerosol can
Boil-in-bag frozen vegetables	Kosher bubble gum balls
Liquid diet foods	Frozen yogurt bars
Polyunsaturated (corn oil) margarines	Spoonable cheese spread
Soft margarine	Canned egg custard
Unsalted, frozen margarine	Flavored grits
Instant dessert & pudding mixes	Powdered Worchestershire sauce
Precooked rice	Jalapeno pepper jelly
Packaged rice specialities	Honey jelly
Extruded dry pet foods	Carbonated soft drink powder
Semimoist meat pet foods	Smoke-flavored salt
Vegetable-oil coffee lighteners	Aseptically packaged milk
Dry salad dressing mixes	Rice bread
Freeze-dried soluble coffee	Fructose sweeteners
	Frozen quiche
	Powdered isotonic beverage mix
	Powdered cocktail mix
	Pre-molded cranberry jelly

[1] Selected by Buzzell and Nourse (1967) as "substantially different in form, technology, or ingredients..."

[2] Selected by the editors of _Progressive Grocer_ as being especially "ingenious, innovative, and intriguing."

grits, pepper jelly, smokey salt). Other items employ packaging changes that involve no novel technology (quarter-pound hot dog, cough candy sticks). A few products can be best described as frivolous variations designed primarily for memorable advertising copy (Kosher bubble gum, fat-free candy). Yet the list does encompass a few products that seem to incorporate real technological advances (fructose sweetners, aseptic milk).

Table 2 provides New Product News' estimates for the number of new brands and new items of packaged consumer goods, most of them marketed through grocery stores. As expected, brand proliferation exceeds the number of distinctly new products by a wide margin. Also, the extent of item proliferation (excluding packaging sizes) is far greater than bran proliferation. There is a significant upward trend in both brand and item proliferation, particularly after 1973 when item proliferation increased by 20% per year on average. Table 3 shows that brand proliferation among grocery products is largely restricted to a few categories; among food and beverage products in 1977 over 53 percent was accounted for by only four of the 18 food categories: frozen foods (24 percent), candy (12 percent), beverages (9 percent), and snacks (8 percent).

A second source that charts grocery item proliferation is the Neilsen Early Intelligence System (NEIS). Because NEIS counts any new item that enters into wholesale distribution anywhere in the U.S., the figures in Table 4 are considerably higher than those in Table 2.11/ The main difference is accounted for by different package sizes. These data seem to indicate that new item introductions peaked in 1972 or 1973 (McCurry).12/ Thus, while assuming that both data sources are accurate, the number of new items is increasing if one excludes size variations, while the number of introductions of simply package size variations appears to be decreasing.

The new item figures just discussed are gross additions to the entire grocery marketing system. The net increase in items is more modest. At the end of 1976, NEIS

Table 2 — New product and new item annual introductions into grocery and during stores, 1964-78.

Year	:	New brands[1]	:	New items[2]
	:		: Number	
1964	:	720		1,220
1965	:	660		1,075
1966	:	725		1,330
1967	:	860		1,520
1968	:	815		1,330
1969	:	840		1,440
1970	:	775		1,380
1971	:	740		1,340
1972	:	780		1,500
1973	:	810		1,390
1974	:	940		1,750
1975	:	1,025		1,880
1976	:	1,130		2,180
1977	:	1,220		2,650
1978	:	1,255		2,800

[1] Number of new branded products, ingnoring variations in flavor, color, packaging, reformulation, and so forth.

[2] Number of new items, including variations in flavor, color packaging, reformulation, and test marketings, but excluding different package sizes.

Source: Dancer-Fitzgerald-Sample, New Product News, as cited in Progressive Grocer (1978). Data for 1978 are estimates based on six month's data.

Table 3 — New brand annual introductions by product category, 1976 and 1977.

Product categories	New brand introductions	
	1976	1977
	Number	
Health and beauty aids	245	270
Frozen foods	205	200
Candy and chewing gum	98	102
Household supplies	69	87
Beverages	51	72
Chips, crackers, nuts and other snacks	40	67
Breads, cakes, and cookies	45	49
Dairy products	45	47
Sauces, spices, condiments	62	45
Meats and fish	27	43
Pet products	43	39
Baking ingredients (flour, flour mixes, salt, oils, etc.)	17	29
Low-calorie foods	32	29
Soups	27	24
Canned fruits and vegetables	24	21
Tobacco products	20	20
Macaroni, potatoes, rice	19	19
Desserts, sugar, and syrups	7	14
Paper products	11	14
Canned meats	24	14
Breakfast cereals	14	11
Baby foods	3	2

Source: Dancer-Fitzgerald-Sample, New Product News, as cited in Progressive Grocer (1978). Data for 1978 are estimates based on six month's data.

Tabel 4 — New items introduced annually into supermarket distribution, by broad categories, 1973-78.

| Year | New items in distribution | | | | | |
	Frozen foods	Refregerated foods	Other foods	Health and beauty aids	Other non-food grocery 1/	Total
1973	1,008	913	3,466	703	686	6,776
1974	1,014	868	3,690	472	481	6,525
1975	1,167	795	3,310	705	709	6,686
1976	1,012	1,103	2,959	587	388	6,049
1977	1,044	884	2,626	598	327	5,479
1978	940	694	2,446	500	338	4,918

1/ Includes paper products, tobacco products, household supplies, clothing, automobile accessories, and so forth.

Source: A. C. Nielsen Early Intelligence System, cited in Progressive Grocer (1978). Data for 1978 are estimated.

counted 51,939 items in distribution in grocery warehouses; by the end of 1977 a net gain of 2,442 items occurred, or 4.7 percent. During that year, a gross addition of 18.6 percent and a gross deletion of 13.9 percent took place; in other words, a total of 32.5 percent of all items were "churned"--either added or dropped. A similar study in 1976 found that the churning rate was 39 percent (Progressive Grocer). On average, the compound net increase in items per year has been 4.6 percent. For the average supermarket with 15,000 items, the store manager must make decisions on about 100 items each week; if they examined each item in the store, consumer would have to evaluate over 50 each week.

A final data source on product proliferation comes from a report of significant new consumer packaged products compiled monthly for many years by the staff of Advertising Age magazine. Because these data provide information on each individual new product, they form the basis for the statistical analysis in the next section.13/ In particular, it was possible to classify each product by 5-digit SIC number, determine the parent company for each brand, and eliminate the mere "repositioning" (change in advertising appeal or theme) or "reformulation" of products. New flavor varieties were counted, but new sizes and redesigned packaging were ignored. Regional and national offerings of new products were counted, as well as full test marketings. Thus, these Advertising Age data fall into the category of brand proliferations or line extensions, but not mere item proliferations, as I have been using the terms.14/

Five categories account for over 50 percent of all the introductions (Table 5).15/ The high-proliferation categories are generally characterized by high concentration, hish advertising intensities, and other features of oligopolistic markets (Connor 1979).16/ There is a relatively low level of brand proliferation in two nearly monopolized industries, baby foods and canned soups.

Table 5--New packaged consumer food and tobacco products introduced
by product category, 1977-78

Product categories	New product introductions[1]	
	1977	1978
	Number	
Nonalcoholic beverages and mixes	32	38
Alcoholic beverages	21	28
Pet foods	20	19
Flour mixes and baking ingredients	18	10
Frozen foods	18	12
Tobacco products	16	7
Canned fruits, vegetables, and specials	14	12
Candy and chewing gum	11	16
Breakfast cereals	10	14
Meat and fish	10	1
Bread, cakes, crackers, and cookies	9	11
Dehydrated vegetables and soup mixes	9	6
Dairy products	7	4
Chips	5	11
Margarine and oils	3	4
Prepared desserts	3	0
Baby foods	2	0
Canned soups	1	0
Sauces and dressings	1	0
Total	210	209

1/ A simple count of all new brands, flavors, and line extensions.
Minor changes in packaging, different package sizes, reformulations,
and repositionings were not counted.

Source: Compiled by the author from Advertising Age, February 1977
to January 1979.

Most product proliferation can be attributed to firms already established in food processing. Further analysis of the origins of the 419 new food and tobacco products introduced during 1977-78 reveals that 59 percent were introduced by the 50 largest food or tobacco processing firms; 70 percent originated from among the 200 largest; only 11% of products were marketed by firms with no recent products in the category.17/ Since Advertising Age depends to some extent on announcements distributed by the firms themselves, these data may be biased toward larger firms. However, these data concur with Dancer-Fitzgerald-Sample new product data for 1977 (Table 3) that show that only 15 large firms account for nearly 20 percent of all products. By and large, brand proliferation is a pastime of the corporate rich.

The Model

Analytic models of product proliferation were reviewed above, with particular emphasis on the version developed by Schmalensee(1978).18/ These theoretical constructs, based upon a spatial-equilibrium concept of product proliferation, suggest that proliferation is a form of nonprice conduct whose roots are anchored in the substrata of imperfect market structures. Product proliferation flourishes in differentiated product industries where collusion or cooperation among established sellers deters entry. As an alternative to price discrimination, limit pricing, or other pricing strategies, product proliferation strategy can result in an equilibrium in which established sellers set monopoly prices and earn excess profits.

The model tested here is a simple, linear equation which assumes that market structure elements (and control variables) impact additively on brand proliferation. The dependent variable is a simple count of the number of new branded food and tobacco manufactures introduced into a product class during 1977-78 (see Appendix Table 1).

The market-structure variables used refer to 1972-75 data originally developed for Parker and Connor. To model the potential for cooperation among established sellers, the percentage four-firm sales concentration ratio (CR4) is utilized. The presence of a differentiated product class is captured by the U.S. eight-media advertising-to-sales ratio of the top four firms in each product class (ADS). Finally,

the percentage national share of sales by private label products is introduced (PLSHR) as a measure of entry conditions. Schmalensee concluded that brand proliferation would be effective against private label entry as well as branded product entry, thus, the presence of private label products can be interpreted as a measure of the ease of industry entry.

Control variables are also introduced into the analysis. Two of them are quite common in empirical structure-performance studies. The retail dollar size of the product class as a percentage of total grocery store sales (SIZE) is a proxy for the density of potential demand in the product class; all other things held constant, a large industry will be expected to have a larger number of exploitable demand segments than a small industry. Real industry growth during 1967-72 (GRO), too, may exert an influence on brand proliferation. On the one hand, industry growth may be a proxy for increases in demand, which would be expected to increase proliferation; on the other hand, high past growth may signal the presence of already high <u>levels</u> of proliferation, which would dampen the <u>rates</u> of proliferation being explained here. Finally, a rough proxy from Census reports for the proportion of direct production costs incurred for packaging materials (PACKCOST) is included because heavy packaging costs may make physical product differentiation easier.

To summarize, all the independent variables except PLSHR and GRO are expected to exert a positive influence on the extent of brand proliferation. PLSHR should display a negative coefficient and GRO's effect is ambiguous. The units of observation are all 45 of the 102 consumer product classes in SIC 20 for which full data were available.

The Results

The OLS regression are displayed in Table 6. The simplest equation, 6.1, explains only one-fifth of the variance in levels of product proliferation. Both structural variables have the correct signs; advertising intensity is significant at the one percent level, but CR4 is not quite significant at the 10 percent level. A quadratic specification of CR4 in Equation 6.2 improves the overall fit slightly.

Table 6 -- Market structure determinants of the number of new packaged foods introduced, 1977-78

Equation number	Constant term	Independent variables[1]							General statistics[2]		
		CR4	CR4^2	ADS	SIZE	GRO	PLSHR	FOODCOST	R^2	$\bar{R}^2$	F
6.1	-5.48	0.09 (1.26)		1.58^a (2.80)					0.20	0.16	5.1^b
6.2	-18.67	0.60^c (1.48)	-0.004 (1.28)	1.54^a (2.75)					0.23	0.17	4.0^b
6.3	-30.83	0.89^a (2.46)	-0.007^b (2.16)	1.20^b (2.41)	8.32^a (3.70)				0.42	0.37	7.4^a
6.4	-30.91	0.90^a (2.44)	-0.007^b (2.15)	1.22^b (2.39)	8.28^a (3.63)	-0.65 (0.24)			0.42	0.35	5.8^a
6.5	-23.92	0.80^b (2.24)	-0.006^b (2.09)	0.93^b (1.79)	9.06^a (4.03)		-0.17^c (1.64)		0.46	0.39	6.7^a
6.6	-28.20	0.96^a (2.64)	-0.007^b (2.36)	1.02^b (2.00)	8.55^a (3.83)			-0.07 (1.30)	0.45	0.38	6.3^a

1/ t statistics in parentheses; a, b, and c, superscripts indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

2/ R^2 is the coefficient of multiple determination; $\bar{R}^2$ corrected for degrees of freedom; and F is the F statistic.

Source: Data compiled by the author from Advertising Age.

Equation 6.3 represents a marked improvement. The percentage of explained by Equation 6.3 is double that of Equation 6.1, and all four independent variables are significant at the 5 percent level or better. Product class size is positive and highly significant in Equation 6.3 and all succeeding equations. Once SIZE is included, a parabolic specification for CR4 proves quite significant; the critical point is reached at about 65 percent concentration. One ad hoc explanation for the downtown in product proliferation at very levels of concentration may be that tight ologopolies no longer fear entry because of the presence of substantial barriers due to heavy advertising, elaborate national distribution systems, or already high levels of brand proliferation (as opposed to high rates of proliferation).19/ With low technological opportunity, an already densely packed product space precluded many additional introductions.

Among the four other variables tested in Equations 6.4 to 6.6, only PLSHR is significant at the 10 percent level, but FOODCOST has the expected sign and is close to statistical significance. Overall, Equation 6.5 appears to be the best fitting model, explaining nearly half of the variance in brand proliferation among processed foods. An examination of the residuals found no evidence of heterskedasticity, nor did multicollinearity appear to be a problem (see Appendix Table 2).

Conclusions

The empirical results confirm that imperfect market structures do indeed generate high levels of food product proliferation. There is a significant association between brand proliferation and the concentration of sales and advertising intensity, as illustrated in Table 7.20/ This table demonstrates that with an industry structure regarded as workably competitive (CR4 =40, ADS = 1), only one new product is introduced per year. High levels of concentration and advertising, on the other hand, lead to high levels of product proliferation.

The regression analysis indicated that industry growth was unrelated to product proliferation. Several other factors were tested and found to be likewise insignificant. Three variables representing barriers to entry were developed; one

Table 7 — Predicted numbers of new food products introduced annually into a 5-digit SIC product class, 1977-78.

Four-firm sales concentration percentage (CR4)	Eight-media advertising-to-sales percentage (ADS)					
	0	2	4	6	8	10
	Number					
20	—	—	—	—	—	1.1
30	—	—	0.4	1.9	4.1	6.0
40	0.3	2.2	4.0	5.9	7.7	9.6
50	2.7	4.5	6.4	8.2	10.1	11.9
60	3.7	5.5	7.4	9.2	11.1	13.0
70	3.5	5.3	7.2	9.0	10.9	12.8
80	2.0	3.8	5.7	7.5	9.4	11.2
90	—	1.0	2.9	4.7	6.6	8.5

— = Model predicts a negative value.

Source: Equation 6.5 holding all other variables (SIZE, PLSHR) constant at their respective sample means.

was the ease of foreign entry and the others were two economies-of-scale barriers to entry.[21/] Three variables representing industry progressiveness were also tested. One variable, the ratio of research and development expenditures to sales, is an input-side measure of innovative effort. Two others attempted to capture technological progressiveness variables on the output side: food company U.S. patents assigned during 1961-75 and the number of scientific and technical publications by food company employees during 1965-75.[22/] However, neither economies of scale nor technological progressiveness were significantly related to food product proliferation. The latter finding is rather surprising as many writers have inferred that inventiveness (R&D) would lead to innovativeness (as revealed by new product marketings).[23/]

The existence of a trade-off between the increased satisfaction that consumers derive from being able to match their tastes more precisely to market offerings and the decreased welfare effects of higher product prices has long been recognized (Chamberlin 1933).[24/] More recent formal welfare analyses of the question of optimal product diversity have arrived at no clear-cut judgement on the net effects (Lancaster; Dixit and Stigltz; Stern; Spence). Schmalensee likewise argues that there are not necessarily too many products for a given market even though product proliferation deters entry; however, his analysis does suggest that in such markets some reduction in prices would increase net welfare.

The results reported here provide empirical support for the positive economics imbedded in Schmalensee's model. Food product proliferation is only one of many forms of business conduct open to firms in oligopolistic industries with differentiated products. This paper has not dealt directly with the performance impacts of food product proliferation, but they are likely to be profound. Since Pareto-optimal product diversity appears to be beyond measurement and possibly beyond public control, the direct regulation of industry performance or structural improvements may be public policy approaches superior to policies tailored specifically to reduce product proliferation.

Henning and Mann (p. 262) strongly advocate public policies limiting product proliferation, primarily because they consider it a major cause of excess advertising. I am aware of only one piece of U.S. legislation that was prompted by a concern about proliferation; the Fair Packaging and Labelling Act of 1966 directed the Department of Commerce to reduce the proliferation of packaging sizes via voluntary industry agreements. The "unit pricing" programs of many grocery retailers help consumers cope with this king of proliferation. It is possible that consumer and retailer resistance may slow the flow of new products in the future. Unless some radically new technology replaces the shopping cart, the physical size of stores is likely to place a cap on the total number of items that can be kept in stock. However, the most promising public policy approach is simply to continue to encourage market structures and behavior consistent with workable competition.

FOOTNOTES

1/ Industrial organization economists too have decried the lack of attention paid to structure-conduct links, as opposed to the structure-performance relationship (McKie). Other than a discussion of style changes in the automobile industry, Scherer's otherwise comprehensive textbook of industrial organization contains no discussion or product proliferation, market segmentation, or similar topics.

2/ The dimensions or axes can be either continous or classificatory. If all the dimensions consist of exhaustible classes, the space can conceivably be filled. Otherwise, the product space can only be more or less dense.

3/ Brand names and price are discussed below. Padberg and Westgren suggest that novelty _per se_ may be an important product dimension.

4/ This is consistent with Padberg and Westgren's claim that food products proliferate because there exists a body of "redundant" technology.

5/ An alternative approach to product differentiation is the "characteristics" of consumer demand of Lancaster. With three or fewer dimensions, Lancaster's model is formally analogous to the spatial equilibrium model.

6/ They assume further that the two products have equal unit costs of production and are not complements in consumption.

7/ Whitten's (1979) study of cigarettes is an apt case in point. Early entrants have several advantages: (1) advertising costs are lower; (2) they establish minimum quality levels later entrants must meet or exceed; (3) national distribution comes first; (4) they can occupy a market segment which has the densest demand; and (5) the first brand consumed alters consumer risk perception, and if most consumers are risk-averse, the first entrant retains market share.

8/ For example, E. G. Brinker, Director of Research for Armour Food Co., takes the position that "...the word "new" exists (for food products) only in the eyes of marketing groups and their agencies." E. B. Weiss, also has a restrictive concept of the term: "...at least 80% of new products aren't new at all. They are simple modifications--and minor ones at that--of existing products." Padberg, a seasoned observer of the food marketing system, asserts that "attributes of newly introduced · products are generally only incrementally different from existing products" (p. 622). A more liberal view of newness was expounded by Chester Wasson: "...what is new depends on what the consumer perceives, or can be brought to perceive..." (p. 52).

9/ The 19 SIC codes were: 20116, 20117, 20118, 20119, 20171, 20342, 20382, 20383, 20483-20489, 29512, 20668, 29873, 20952.

10/ Especially SICs 20116, 20117, 20118, 20512, and 20668.

11/ NEIS uses the warehouse records of 120 to 150 supermarkets. Anytime the most minor changes occur, even a 1/10 oz. change in size or a special cents-off offer, a new item is recorded. These data are the most quoted numbers on new product introductions.

12/ McCurry reports that NEIS recorded 9,252 new items in distribution in 1972 and 6,714 in 1971.

13/ Disaggregated data on product proliferation from NEIS, SAMI, or Dancer-Fitzgerald-Sample were unavailable to the author. The exact meaning of "signigicant" as used by Advertising Age cannot be determined.

14/ Some possibly distinctly novel product include: flaked coffee, lemonade crystals, canned gravy concentrate, instant pasta, microwave-oven batters, and a slightly alcoholic soft drink.

15/ Of the 732 new product examined, 57 percent were processed foods or tobacco products.

16/ The canned items were predominantly canned ethnic specialities; the frozen foods were mainly frozen pizza and entrees, not frozen vegetables.

17/ That is, these firms had no recorded media advertising of products in the same category, as revealed by 1975 data from Leading National Advertisers, Inc.

18/ Henning and Mann developed and tested an industrial organization model that employs a variable (NPF) that measures the number of distinctly new products per firm marketed over 1952-65. Their primary source is company annual financial reports and industry data for 14 industries, ten of them food manufacturing. However, they were interested in testing a markedly different hypothesis, viz., whether NPF positively affects advertising intensity by destabilizing a competitive equilibrium.

19/ Rather high levels of brand or item proliferation are characteristic of canned soup, baby food, chewing gum, and breakfast cereals--all of which are among the highest in industry concentration.

20/ No claims are made concerning causality because proliferation may restructure markets over time. That is, the direction of causality is uncertain until a simultaneous equations model is developed. However, new item introduction may be seen as a short-run conduct outcome of relatively stable market structure conditions, thus satisfying the assymmetry condition of OLS regression. Moreover, the independent variables are prior in time to the dependent variable by about 2-5 years.

21/ The variables were net product class imports, the midpoint plant size (MES), and the cost disadvantage ratio due to small size (CDR) (see Parker and Connor).

22/ The companies were classified in their primary industries; both indexes of progressiveness were deflated by industry shipments. These data do not capture technological progressiveness deriving from other industries.

23/ However, it is possible that food manufacturing inventiveness affects food product improvements which our data do not measure. Alternatively, progressiveness in other industries (for example, the packaging industry) may improve the quality or increase the quantity of food products. Neither topic was addressed in this study.

24/ Higher prices follows from the monopolistic competition model because of diseconomies due to small scale. Oligopoly also raises prices through the application of market power (see Parker and Connor).

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Appendix Table 1

New Introductions of Packaged Consumer Goods, 1977-78

SIC[1/]	1977				1978			
	Total	By Top 50	By Top 200	Foreign Firms	Total	By Top 50	By Top 200	Foreign Firms
20111	1	1						
20116*	2	2	2		0			
20117*	3	2	5		1	1	1	
20118*	4	3	3					
20222	2	1	1					
20240					1	1	1	
20264	5	3	3		3	1	1	
20322	2	2	2					
20323	1							
20324	3	2	3		3	2	3	
20331	1	1	1	1				
20332	1	1	1					
20334	3	2	2		1			
20336	5	3	5		6	4	5	
20338	1				2		1	
20341	4	3	4	1	1		1	
20342	4	4	4	2	5	5	5	
20354	1		1					
20371					1	1	1	
20372	2	2	2		3	1	2	
20381	7	7	7					
20382	8	5	6	1	6	3	5	1
20383	1	1	1		2	1		
20415*	18	13	16		20	19	20	
20430	10	9	9		14	13	13	1
20471	19	14	19		19	15	15	
20472	1		1					

Appendix Table 1 (Cont.)

SIC[1]	1977				1978			
	Total	By Top 50	By Top 200	Foreign Firms	Total	By Top 50	By Top 200	Foreign Firms
20511	3		2		3	1	2	
20512					1	1		
20513					1		1	
20514	2	1	2					
20521	2	1	2	1	3	2	5	1
20522	2	1	1		3	2	5	
20651	5	2	5		3	1	2	
20652					1			
20653	1			1	3		3	
20658	1				1			
20670	4		2		8		4	1
20752	1							
20762					1	1	1	
20791	1	1	1		1	1	1	
20792	1	1	1		2	1	1	
20821*	12	5	9		16	5	11	2
20840	6	1	2		4	2	3	
20853	3				8	2	4	2
20860	4	1	2		15	7	11	2
20872	3	1	2	1	1	1		
20874	9	5	6		7	5	7	
20951	3	3	3		6	5	5	2
20952	2	2	2	1				
20970					2			
20980	1	1	1					

Appendix Table 1 (Cont.)

SIC[1/]	1977				1978			
	Total	By Top 50	By Top 200	Foreign Firms	Total	By Top 50	By Top 200	Foreign Firms
20991	3	2	2	1				
20992	5	5	5		11	7	8	
20995	7	6	7	1	7	2	2	
20998	4	2	2	1	1	1	1	
20999					1	1	1	
21110	15	7	13	1	7	2	6	
21310	1	1	1					
Total 20	194	122	157	12	202	116	154	12
Total 21	16	8	14	1	7	2	6	0
Total Other	146				167			
Total	356				376			

* Combines two or more product classes.

Source: _Advertising Age_, February 1977 to January 1979.

[1/] Omitted SIC product classes had no new consumer product introduced during 1977-78.

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Appendix table 2 -- Simple correlation coefficients of regression variables, 45 product classes

Regression variables	CR4	ADS	SIZE	GRO	PLSHR	FOODCOST
				Number		
CR4	1.00	0.10	-0.13	0.02	-0.45	-0.11
ADS		1.00	0.16	0.14	-0.31	-0.26
SIZE			1.00	-0.09	0.19	0.02
GRO				1.00	-0.09	0.19
PLSHR					1.00	0.23
FOODCOST						1.00

Source: Data compiled by the author.