Food

Organization and Performance of World Food Systems: NC-194

OCCASIONAL PAPER SERIES

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STRUCTURE AND PERFORMANCE OF THE FOOD SYSTEM BEYOND THE FARM GATE

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SUMMARY

This paper examines some of the major developments and research issues affecting the structure and performance of the food marketing system as it moves into the 1990's. Since the food marketing system accounts for about 80 percent of consumer expenditures for food, how efficiently and effectively this system performs obviously affects the welfare of both consumers and farmers. Specific developments include changes in: (1) structure and channels of trade; (2) the globalization of the food marketing system; (3) technology demographics and consumer lifestyles leading to growth in food safety concerns, foodservice, and ingredient substitutes. These changes affect the type, quality, price, and variety of foods consumers purchase. They also increasingly affect the characteristics of farm products (leaner hogs and cattle, processing tomatoes with higher solids content, and potatoes bred for frozen french fries).

A brief summary of research issues stemming from the major developments mentioned above include:

Structure

- As a result of growth in firm size, market concentration, and aggregate concentration, has market performance substantially declined, stayed about the same, or improved? If performance has not declined as concentration in a particular industry has increased, why not? Industry and market level studies are needed for each of the four food marketing sectors to address the dynamics of structure-performance relationships.

- What is the short run and longer term effects of high debt loads from LBO's on firm's and industry's ability to invest in new plant and equipment and on research development expenditures?

- What is the magnitude and distribution of economies of size, especially for multi-plant and multi-specie firms?

- What is the impact of meat packers captive supplies on the short-run demand for slaughter livestock?

Globalization

- There is a need to develop a more comprehensive definition and measure of international competitiveness which includes the full range of strategies used by food marketing firms to access international markets.

- Why do many food processors evidently find it more profitable to export capital, know how, and trade marks rather than export branded products from their U.S. facilities? Large U.S. food processors receive an average of 22 percent of their sales from foreign subsidiaries, while exports account for less than 3 percent of sales.

- What is the net effect of foreign investment into the U.S., and conversely, U.S. investment in other countries on U.S. employment, capital expenditures, and on exports?

- How is global sourcing of commodities affecting the well being of domestic producers, marketing firms, and consumers?

Consumer and Environment

- Research is needed to address economic issues related to food safety which would include assessing the economic costs and benefits related to food safety risks and control options.

- Research programs to measure marketing margins, consumers food demand, and impacts of commodity programs require detailed quantity and value data for specific food groups flowing through the food service sector. Such information does not now exist for the food service market.

- What are the intercommodity effects of the growing use of low-calorie sweeteners, fat substitutes, and other ingredient substitutes? We do not have adequate data on the use, costs, and displacement effects of ingredient substitutes.

STRUCTURE AND PERFORMANCE OF THE FOOD SYSTEM
BEYOND THE FARM GATE
COMMODITY ECONOMICS DIVISION

THE ROLE AND IMPORTANCE OF THE FOOD MARKETING SYSTEM

The markets for agricultural products are in the midst of rapid change that increases the demand for intelligence on the scope, direction, and magnitude of current and future changes. Some major forces for change originate with consumers but the biggest changes come from the competitive efforts of marketing firms to adapt to what is happening around them.

Many influential changes have occurred involving:

- Demographics and population shifts.
- Consumer lifestyles.
- Economic conditions--inflation, income, unemployment.
- World financial conditions which alter the competitiveness of American and foreign firms.
- Supply costs, especially the two tremendous jumps in petroleum prices in the seventies.
- Farm policy and programs.
- Public policy and private attitudes on food safety, nutritional labeling, and other food-related issues.

Household and family size have been declining with later marriages, more divorces, smaller families, and less doubling-up (two families in one household). With more young and old people maintaining their own residences, the proportion of single-person households went up from 11 percent in 1950 to 13 percent in 1960, 17 percent in 1970, and 24 percent in the late 1980's.

The proportion of families with more than one earner began to increase sharply after World War II--from 39 percent in 1950 to 46 percent in 1960, 54 percent in 1970, and 58 percent in 1988. With the combined effects of rising real income per wage earner and declining family and household size, average real income per person in households rose 137 percent between 1950 and 1984.

Food choice and propensity to consume food away from home varies by population group. Younger and higher income households eat out more. Their selections of foods differ from older and less prosperous people. Households with children spend more of their at-home food dollars on milk and sweets; the elderly spend more on fruits and vegetables. Higher income families spend more on fish, cheese, and butter. There are also differences between races

and geographic regions. For example, people in the Northeast drink more milk than those in other regions of the United States.

Farmers, manufacturers, and marketers must adjust to these changes, sometimes defensively. But such changes have also created opportunities.

As more specialized retail market segments have developed, the wholesale and food manufacturing sectors have responded. Some companies which once supplied all segments of the market are now specializing in one segment such as branded consumer products, food service products, or ingredients for food manufacturers. In general, only very large firms have the resources to supply and market a broad line of branded consumer foods which requires continuous product development and promotion. Since the vast majority of new products do not succeed, only firms with extensive resources can compete in the branded area.

Other manufacturers have chosen to emphasize products developed for food service or for particular segments of the food service market. Some specialize in products for a particular hamburger chain like McDonalds. Several manufacturers have gone extensively into wholesaling to food service outlets with only a part of the products they distribute made in their own factories.

A massive restructuring of corporate America and the food sector has been going on for 25 years and the pace is accelerating. Throughout the postwar period, mergers have been a major force in changing the organization of food manufacturing and the kinds of business they do. Companies increasingly handle a broader line of products. Specialized canners of fruits and vegetables have broadened their lines to a wide array of food and nonfood products, as have dairy firms and meat packers.

Food manufacturing, like many other lines, has gone international since World War II. Many large food companies are manufacturing and selling abroad--a few have greater sales abroad than in the U.S. Exports of U.S.-made food products (not counting raw farm products like grain or intermediate products like soybean oil and meal) have grown fairly slowly, partly because food product manufacturing by U.S. companies has moved offshore.

Similar to the way American companies have moved into other countries, often by acquiring local firms, European, Canadian, and most recently Australian companies have acquired U.S. food firms. After decades of following a quiet course in the U.S. for fear of antitrust action, world companies such as Nestle and Unilever have made major acquisitions in the U.S.

All of these changes mean that manufacturers are looking for altered products or different products from farmers and farmers must adjust to the changed demands facing them. Farmers are increasingly paid on the basis of how well they perform in providing commodities that meet precise market specifications.

The Marketing System and Its Components

The marketing systems continues to take an increasing share of the consumer's dollar. In 1989, 76 percent of consumer expenditures for domestically produced farm foods went to processing, transportation, wholesaling, retailing, and food service.

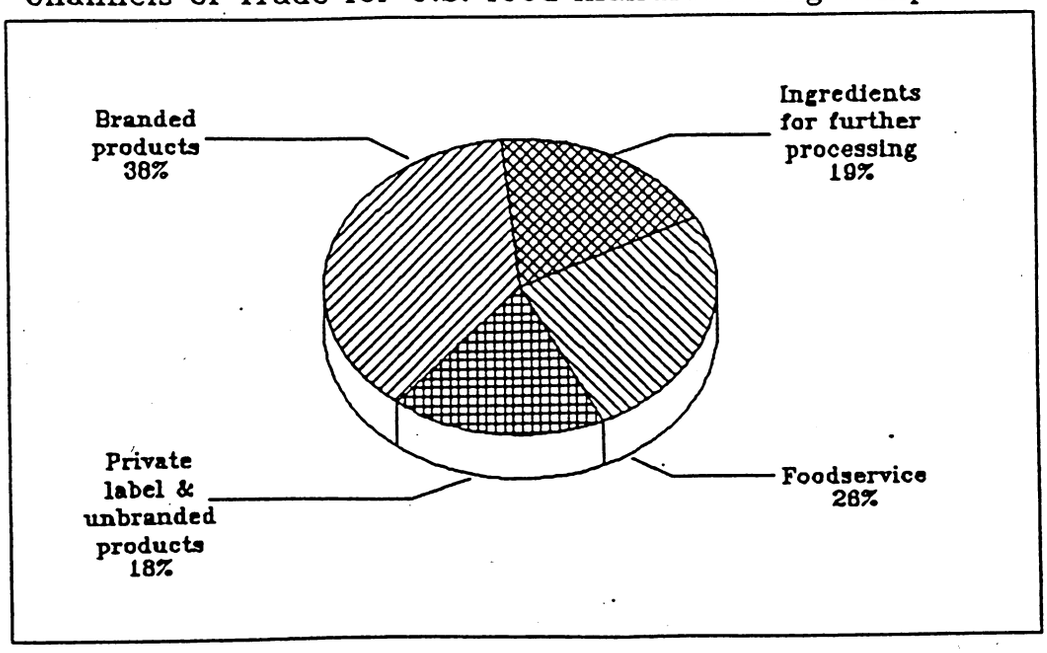
	Billion dollars	Percent
Consumer expenditures for farm food	421	100
Farming	102	24
Processing	106	25
Transportation	18	4
Wholesaling	36	9
Retailing	60	14
Food service	99	24

Channels of Trade for Food Manufacturers

Sales of the 16,000 food manufacturers total $315 billion. For many industries, such as breakfast cereals and wet corn milling, sales are concentrated in a few firms. Many other food processing industries have relatively low market concentration. The strategies used by food manufacturers vary among industries and channels of trade (figure 1).

Figure 1.

Channels of Trade for U.S. food manufacturing companies



Ingredient Channel

The products of some industries, such as sugar and soybean milling, are used as ingredients by other manufacturers. The ingredient channel accounts for about 19 percent of shipments by food manufacturers. Direct buyers are few and purchases are made in larger quantities. The products may meet rigid specifications but are generally undifferentiated and thus not heavily advertised. Prices usually result in narrow margins which places a premium on efficiency. However, there are important exceptions where ingredients are highly differentiated. Aspartame, produced by NutraSweet Company is a prime example. Several companies have become differentiated preferred suppliers in specialized ingredient markets by a variety of strategies including superior technology, cost controls, quality controls, and customer services.

Food Service Channel

The 700,000 food service establishments vary from snack bars to large plant cafeterias and their product and service requirements are equally diverse. Brands are often not important to food service firms, but rigid product specifications including portion control may be required by institutional buyers and fast food chains. There is intense price competition for these large accounts. Small processors may be unable to handle the volume of some food service firms and thus concentrate on the many eating places where service is more important. About 26 percent of food manufacturer sales are in the food service channel.

Private Label and Unbranded Products Channel

Entry into the private label and unbranded products (fresh meat and produce) channel is relatively easy. Food manufacturer sales in this channel are about 18 percent of their total. There is moderate product differentiation and little or no required advertising. Shelf space does not have to be gained by overcoming the brand loyalty of competing products. It is allocated by the buyer. Buyers specify product quality and packaging requirements for many private label products. Price competition in this channel is intense and resembles bidding for a contract. Firms do not have to pay the cost of establishing a consumer franchise and are thus willing to accept lower prices. They have low involvement with marketing decisions and little power in negotiations with buyers.

Some food retailers have integrated back into food manufacturing. They process their own brands, especially in dairy and bakery products. This happens where food retailers can achieve lower cost in processing or distribution than the food manufacturers who are willing to bid for their business.

Manufacturer Branded Product Channel

In contrast, the emphasis of firms in the branded products channel is on marketing strategies which establish their consumer franchise. The consumer franchise is the basis for favorable shelf space and location in retail stores. Smaller companies can and do succeed in this channel, typically

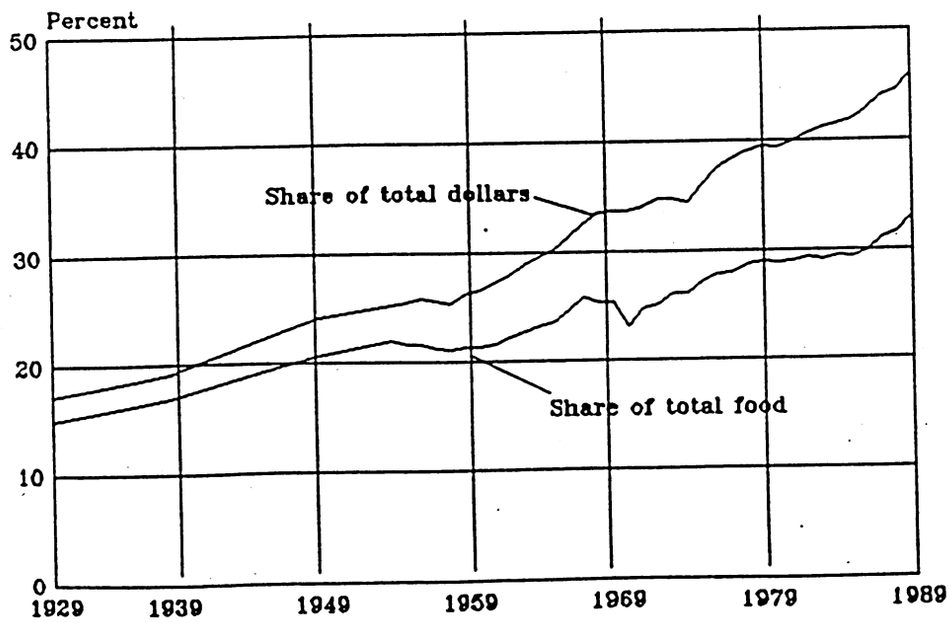
developing products for a particular region. If the new brand becomes very successful, it is frequently purchased by a large food manufacturer. The large purchaser greatly increases marketing expenditures and expands the acquired brand into national and even international markets. U.S. food processors spent about $8.5 billion for advertising, including coupon redemptions, in 1989. Kraft General Foods (Philip Morris) was the leading food advertiser with expenditures exceeding one billion dollars.

Food Service

The most striking change in food consumption and marketing has been in away-from-home eating. From 1948 to 1989, the share of total food dollars spent away from home increased from 24 to 46 percent, and the share of total food quantities from 21 to 33 percent (figure 2). The two most important factors affecting the choice between food at home and away from home are rising real incomes (which made increased away-from-home eating possible) and the increase in working women (which boosted family incomes and increase the opportunity cost for preparing food at home).

Most of the growth in the away-from-home market has occurred in the fast food industry. Its share of the away-from-home market grew from 8 percent in 1948 to 32 percent in 1989. Over the same time span, the share of table-service restaurants, lunchrooms, and cafeterias--the more traditional eating places--declined from 48 to 38 percent.

Figure 2.
Foodservice as a share of all food



Fast food restaurants were largely a creation of the 1950's. Their rapid penetration into every community led to market saturation by the late 1970's. Building additional outlets was no longer the profitable route for the major fast food organizations. Instead, many have tried other avenues of growth, such as salad bars and breakfasts. Hamburger chains added chicken nuggets. Pizza establishments that serve only the takeout trade became common, some with large delivery networks.

MAJOR STRUCTURAL DEVELOPMENTS--TRENDS AND ISSUES

In this section, we will identify the major changes in the structure of the food processing and distribution industries. More importantly, we will identify and discuss some of the major issues that arise from these changes in industry structure. Industry structure includes the number and size distribution of companies, the degree of product or service differentiation, and the relative ease with which firms may enter or exit industries.

Why Examine Market Structure

Industrial Organization (IO) is a branch of applied price theory which provides a conceptual framework for examining the organization and performance of imperfectly competitive markets. The IO framework postulates that the structure of a market (industry) influences the competitive conduct of firms within the market, which in turn influences market performance. In practice, researchers generally develop and test structure-performance models since conduct is so difficult to measure.

But the IO paradigm remains imprecise and controversial. Joe Bain, considered the "father" of IO, cautioned that:

> market structure and conduct clearly represent only a small fraction of the total determinants of market performance...When we infer that structure and conduct may determine market performance, the most we can mean is that, given the character of all other and more basic determinants, they make a difference in how performance will emerge.

Most IO studies have been cross-section economic analyses of industry structure-performance relationships. Because of data problems, little attention has been given to determining how changes in market structure over time within an industry affects the performance of firms within that industry. So one must be extremely cautious in transferring structure-performance relationships from cross-section studies to predicting how a change in a particular industry's structure over time will influence that industry's performance.

Number of Establishments and Firms

Tables 1 and 2 show changes in the number of establishments and firms for the processing, grocery wholesaling, grocery retailing, and food service sectors of the food marketing system. Most of the 49 food processing industries have

Table 1--Number of food marketing establishments

Year	Processing	Wholesaling	Eating and drinking places 1/	Retailing	Total
			Number		
1963	37,521	41,890	334,481	319,433	733,325
1967	32,517	40,005	271,182	294,243	637,947
1972	28,193	38,531	359,524	267,352	693,600
1977	26,656	37,960	368,066	252,853	685,535
1982	22,130	40,391	379,444	241,737	681,827
1987	20,624	42,075	391,303	248,243	702,245

1/ Excludes all noncommercial eating facilities and commercial outlets such as hotel restaurants, department store coffee shops, and ballpark food concessions. These eating facilities numbered over 397,000 in 1982 and over 343,000 in 1977.

Table 2--Number of food marketing companies

Year	Processing	Wholesaling	Eating and drinking places 1/	Retailing 1/
			Number	
1963	32,617	35,666	175,117	162,273
1967	26,549	33,848	170,851	131,926
1972	22,171	32,053	179,578	122,592
1977	20,616	31,670	186,625	120,102
1982	16,800	31,290	198,088	109,567
1987	15,500	2/	34,155	102,498

1/ Firms with paid employees.
2/ Estimate.

experienced a decline in both numbers of establishments and firms. The number of establishments dropped to 20.6 thousand in 1987 from 22.1 thousand in 1982 and 37.5 thousand in 1963. The number of firms fell to an estimated 15.5 thousand in 1987 from 32.6 thousand in 1963. For both establishments and firms the rate of decline slowed in 1982-89 compared to previous census periods. As expected, the largest decline occurred in local market industries. For example, the number of fluid milk plants dropped from 2,015 in 1972 to 654 in 1987.

What do these declines in establishment and firm numbers mean in terms of performance? Is it good, bad, or indifferent? Or does the answer vary with each situation? Too often we just report that the number of establishments or firms have declined and then move on. The strong unstated (and sometimes stated) implication is that this decline is "bad." Writers often compare and contrast the decline in the number of food manufacturing firms with firms in the entire U.S. economy. But, why should changes in the number of food manufacturing firms and establishments mirror changes in the economy as a whole? U.S. manufacturing includes many relatively new and fast growth industries such as electronics and computers in which one would expect number of firms to grow--where as food manufacturing is a mature, slow-growth industry with a large number of plants with less than 20 employees facing rapid technological change. There is no reason why the market structure of the 1950's or 1960's was ideal or should be preferred to the market structure of the 1990's. If 40,000 food manufactures is a "better" market structure than 15,000, is 50,000 "better" than 40,000? Why not 60,000?

For the other three sectors, the number of establishments increased in 1987 from 1982. For food wholesaling, the number of firms also increased. for both the retailing and food service sectors, the number of firms with paid employees declined. As supermarkets have grown larger, their numbers have declined from a peak of 31 thousand in 1977 to 23.2 thousand in 1988.

Concentration

There are two separate ways of measuring concentration. Aggregate concentration measures the combined share of economic activity (sales, assets, value added) in a sector such as food processing controlled by the largest firms. The second, market concentration, measures the share of sales controlled by the largest firms in a particular industry or local market.

Food Processing

The 50 largest food processing firms in 1987 controlled an estimated 48 percent of all U.S. food processing sales, up from 43 percent in 1982 and 35 percent in 1967. Value added provides a more accurate measure of aggregate concentration in food processing because the level of purchased inputs varies widely across the 47 individual processing industries. In 1982 (1987 concentration data is not yet available), the top 50 food processing firms accounted for 50 percent of all value added, up from 39 percent in 1967. But when broken down by size of firm two interesting points stand out. First, all the increase in top 50 concentration was accounted for by the top 20 firms whose share of value added increased from 13 percent to 34 percent. The 21-50

largest firms' share of value added remained unchanged--16 percent in both 1967 and 1982. Second, the 21 to 500 largest firms' share of value added remained virtually unchanged at 46 percent during the entire 1967-1982 period. Thus, while food processors are becoming larger and, especially for branded consumer products, competition is becoming more and more a "battle among giants"--a very large number of mid-tier firms are holding their own very well. The increase in the aggregate concentration of the 20 largest firms came entirely at the expense of smaller firms ranked below the 500 largest.

Market concentration varies widely among the 49 food processing industries. The share of industry sales accounted for by the four largest firms ranges from about 95 percent for the chewing gum industry to the low 20's for the canned fruit and vegetable, fresh or frozen seafood, and prepared feeds industries. While four-firm concentration has increased for most processing industries, the change has been uneven. In 15 of 47 food processing industries between 1977 and 1982, four-firm concentration declined. The most dramatic increases in concentration in the late 1980's occurred in the meat and poultry packing industries. Changes in the meat packing industry are highlighted in the sub-sector section of the paper. Alternatively, concentration has declined in some highly concentrated industries. For example, in the breakfast cereals industry, the top four firms' share of sales fell from 89 percent in 1977 to 86 percent in 1982 and to an estimated 75-80 percent in 1988.

Food Wholesaling

Aggregate concentration has increased faster in food wholesaling than in the other three food marketing sectors. The top 50 food wholesalers increased their share of sector sales from 48 percent in 1972 to 71 percent in 1987. The top four wholesalers' share of sales rose even faster, from 10 percent to 26 percent during the same period. Large wholesalers have transformed themselves from primarily local firms to multi-regional and national firms. Large wholesalers provide independent retailers and small chains with a variety of marketing and financial services and are one of the major reasons small retailers have been able to remain competitive with large chains.

Food Retailing

Aggregate concentration in food retailing grew very slowly from 1963 to 1988. The top 20 food retailers' share of sales inched up from 34 percent in 1963 to 35.8 percent in 1988. All the increase occurred among the 9th-ranked through 20th-ranked firms. The sales share of the largest 4 and 8 grocery retailers declined during this period to 15.4 and 24.5 percent respectively. The share of grocery store sales controlled by chain stores (firms with 11 or more stores) grew rapidly from 47 percent in 1963 to 61.5 percent in 1982. Since that time, however, the chains' share has grown very slowly, increasing only one percentage point to 63 percent in 1987 before falling back to 62 percent in 1989.

Four-firm concentration at the local (SMSA) market level has increased faster than aggregate concentration. Average four-firm concentration across all SMSA's increased from 45.4 to 58.3 percent between 1954 and 1982 and has most

likely continued to slowly increase through 1990. However, there is considerable diversity in the concentration trends in individual SMSA's. Of the 289 comparable SMSAs between 1977 and 1982, more than half had very small changes in four-firm concentration (+ or - 5 percentage points or less). Concentration increased more than 5 percentage-points in 79 SMSAs, but concentration declined more than 5 percentage-points in the remaining 55 SMSAs.

Foodservice

Aggregate concentration in the foodservice sector is quite low, but increasing. The top 50 restaurant firms controlled 13 percent of total eating place sales in 1972, increasing to 22 percent in 1987. The share of sales of the top four firms more than doubled from 3.6 percent to 8.1 percent during this same period.

Mergers

Between 1982 and 1988, the years during which ERS has monitored complete data, nearly 3,400 mergers, divestitures, or leveraged buyouts took place in the food marketing system. Food processing had over 2,000 of these transactions during that period, while food wholesaling mergers numbered nearly 400. Food retailing and foodservice each had nearly 500 mergers. In 1988, the food marketing system announced or completed the largest dollar magnitude and number of mergers and leverage buyouts in U.S. history, costing a total of over $60 billion. The nearly $25 billion leveraged buyout of RJR Nabisco, Inc., the largest in U.S. economic history, exceeded the combined value of history's five largest food marketing mergers. Also, in the food processing sector, Phillip Morris Companies, Inc., which owns General Foods, acquired Kraft, Inc., at a cost of nearly $13 billion. Food wholesaling underwent its largest merger when Fleming Companies, Inc., acquired Malone and Hyde, Inc. In the largest food retailing merger in 1988, the third largest chain, American Stores Company, acquired the seventh largest chain, Lucky Stores, Inc. for $2.5 billion. American Stores thus becomes the largest food retailer, surpassing Kroger and Safeway.

In total there were 573 mergers and acquisitions in the four food marketing sectors in 1988, up from 514 acquisitions in 1987 (table 3). Merger activity in 1989 appeared to be down about 15 percent from the 1988 peak. There is a tremendous amount of restructuring occurring as firms continually add and discard businesses and brands in an on-going process to adapt to new financial and market conditions. In 1988, 22 foreign firms bought into the U.S. food marketing system, while U.S. food marketers made 14 foreign acquisitions.

One reason aggregate concentration hasn't increased faster is the large number of divestitures that go along with acquisitions. For example, food marketing firms made 273 divestitures in 1988 following 197 divestitures in 1987. Beatrice made 55 divestitures between 1980 and 1988, while RJR Nabisco divested 25 operations. In retailing, Safeway Stores divested over 1,000 supermarkets since its leveraged buyout (LBO) in 1986.

Table 3--Mergers and divestitures in food marketing, 1987 and 1988

Sector	Acquisitions		Divestitures	
	1988	1987	1988	1987
		Number		
Processing	351	301	161	116
Wholesaling	71	71	32	12
Retailing	76	65	51	34
Food service	75	77	29	35
Total	573	514	273	197

One consequence of this restructuring has been a large increase in debt levels for many food marketing firms.

Total liabilities of food processors and retailers rose from about $160 billion to nearly $245 billion between the third quarter of 1986 and the third quarter of 1989. More than half of the increase occurred between late 1988 and late 1989. Inflation, several successive years of major capital expansion, and normal asset growth accounted for a small portion of that growth. But the overwhelming portion of liabilities growth was due to leveraged buyouts and mergers, and at that, several firms accounted for much of the increased debt. Furthermore, a selloff of some of these assets should further reduce debt; and in the case of LBO's, after tax proceeds which would normally be paid out as dividends are now paid as interest. The equity to debt ratio of food manufactures fell from 1.13 in 1988 to 0.94 in third quarter 1989, considerably below the 1.40 ratio for all manufacturing corporations. The ratio for food retailing fell from 0.56 to 0.33 during that same period. By comparison, the equity to debt ratio was 0.67 during third quarter 1988.

The restructuring and increased debt load may also be affecting the short run behavior and performance of many food firms. While new product introductions increased to an all-time high in 1989, food processors spent 3.5 percent less on advertising than in 1988. After-tax profits of food retailers and processors dropped significantly from 1988, due largely to higher interest payments. Food processors' return on equity for 1989 fell to 16.9 percent compared to 21.9 percent in 1988. Food processors increased expenditures on new plants and equipment 16 percent in 1988 over 1987.

Research Issues

Several issues stem from the major structural changes occurring in the food marketing system. Probably the most fundamental issue is: As firm size, market concentration and aggregate concentration have all increased over time,

has market performance in the food processing, wholesaling, retailing, and foodservice sectors substantially declined, stayed about the same, or improved? According to the IO structure-conduct-performance model, market performance should be substantially worse in 1990 than it was in 1980, or 1970, or 1960. As concentration and market share increase, firms' ability to exercise market power should be much greater. But has performance declined? If not, why not? Evidence is very spotty and uneven. The basic questions are: What is happening to competitive intensity? To rivalry? To competitive pressure to innovate, reduce costs, and develop new products and services? Are large food processors such as Borden, Heinz, IBP, and Gerber and large distributors such as Super Valu and Kroger operating in a competitive environment which over time has allowed more lax cost controls, inefficient plant size, and other examples of X-inefficiency?

Industry and market level studies are needed for each of the four food marketing sectors to assess the dynamics of structure-performance relationships. A recent ERS study found no statistical correlation between concentration, firm market share and supermarket prices in a national random sample of cities and supermarket firms. Additional studies are needed for the wholesaling and food manufacturing sectors. The unprecedented increase in concentration in the beef, sheep, and to a lesser extent, hog processing industries would provide excellent case studies. Separating the effects of greater concentration from the effects of higher product differentiation on market performance would be an important contribution. At present, only a small (but rapidly growing) share of beef packing output is composed of highly differentiated branded products.

A second major issue stemming from restructuring is: What will be the impact of sharply higher debt and interest obligations on the competitive position of food marketing firms? What is the short run and longer term effects of high debt loads from LBO's on firm's and industry's ability to invest in new plant and equipment and on research and development expenditures. A sufficient number of food system LBOs have occurred in recent years to allow ERS to begin developing a data base to answer these questions. The Securities and Exchange Commission is conducting a similar study of LBOs across all industries.

Another issue deals with the location of food processing and farm production operations. Are processing industries moving away from higher wage metropolitan areas toward lower-wage nonmetro areas, but perhaps close to major cities? The rate and extent of industry consolidation has not been the same across the United States. Overall employment in food processing establishments has declined. However, the decline was felt primarily in metropolitan areas. What are the implications for changes in food processing location and employment for rural and community development?

Finally, how has the move to consolidation and larger plant size affected economies of scale and average unit costs? In an effort to achieve lowest cost producer status in particular product lines, many large processors are consolidating production into very large "superplants." We need to better understand the production and marketing economies associated with different size plants to anticipate changes in industry structure. One example of changing cost structure is the apparent decline of food chains' vertical

integration into food processing. For example, Winn-Dixie (the country's fourth-largest chain) sold its bakery plants to the largest commercial baking firm in the Southeast. Winn-Dixie concluded it was cheaper to buy its bakery products than to continually invest in new equipment to keep its plants cost-effective.

The following section illustrates these structure-performance issues stemming from rapid changes in the meat packing and flour milling industries.

Meat Packing Structure and Performance Issues

Concentration and monopsony power in meat packing have been a subject of scrutiny since the beginning of the century. The famous Packer Consent Decree of 1920 ended the beef trust and placed stringent controls on the "Big-Four" meat packing companies affected.

Structure

Following the Consent Decree concentration declined. The 1950's saw an era of independent "kill, chill, and ship" plants springing up farther west nearer the sources of livestock and the growing cattle feeding industry. In the 1960's the boxed beef revolution began and so did a pattern of mergers and acquisitions. Concentration began to grow slowly at first and later accelerating.

The meat-packing industry in the United States finished the last 4 years of the 1980's with a spate of mergers and firm exits leaving an already concentrated industry much more concentrated and with fewer but larger firms and plants (table 4). Concentration is especially high in the steer and heifer beef slaughter, sheep and lamb packing and beef fabrication segments. The direction of trend holds for most livestock but the degree varies by type of livestock (table 5). The pork packing industry may be poised to replicate the beef experience, as the major beef firms are now becoming important in pork packing also.

Table 4--Number of firms reporting purchase of livestock for slaughter to Packers and Stockyards Administration

Year	Steers &	Cows & Heifers	Bulls	Sheep & HogsLambs
1975	656	714	440	193
1980	561	579	446	190
1985	389	426	338	154
1988	321	345	298	127

Source: P&SA unpublished data

Table 5--Percent of slaughter accounted for by 4 largest firms

Year	Steers & Heifers	Fed Beef	Boxed Bulls	Cows & Hogs	Sheep & Lambs
1975	25.3	NA	10.5	33.1	57.5
1980	35.7	52.9	9.7	33.6	55.9
1985	50.2	61.5	17.2	32.2	51.2
1988	69.7	81.0	18.4	33.5	76.5

Source: P&SA unpublished data.

The meat packing structure has been shaped by many forces. These include livestock inventory cycles, labor strikes, strategies for lowering labor costs, bankruptcies, mergers, and acquisitions. Cycling livestock inventories cause low margins to squeeze out higher cost operations when livestock are in short supply. Firms saddled with high cost labor contracts and labor strife were casualties in the late 70's and early 80's. But perhaps most important, significant economies of size in meat packing plants made it more and more difficult for smaller firms to compete with the national packers. The squeeze caused many packers to either get big, get out, or find a market niche. Many old line packers chose to give up their commodity slaughter operations and specialize in branded processed meats.

Significantly, the merger trend was tested in court in the mid-1980's. Cargill/Excel Corp. gave pre-merger notification that it was about to acquire all three of Spencer Beef's beef plants in Iowa and Nebraska. The U.S. Justice Department did not challenge the transaction, but Monfort and Co. brought suit under Section 7 of the Clayton Act to stop the acquisition. The District Court first ruled in Monfort's favor but the decision was overturned in the appeal, so the acquisition was allowed to proceed. Soon after Monfort joined with ConAgra which now controls all or parts of former SIPCO, Monfort, Armour, Sterling Colorado, and Miller Meats.

The big three firms (Cargill/Excel, ConAgra, and IBP) now further process nearly all beef and most pork. Boxed beef subprimal cuts have almost completely supplanted the carcass as the wholesale trading unit. In fact USDA Market News is expected to cease publishing beef carcass prices this summer.

The trend also has a horizontal and vertical components and includes horizontal mergers or coordinated operations which extend several large firm's control into multi-species and multi-industry operations. Poultry, pork, and beef are now processed by single firms, some of which also have interests in livestock production, grain merchandising and processing, and other interests.

Conduct

Despite high concentration, rivalry among the large firms has been intense. To this point there have been few allegations of collusion or soft competition, to the contrary, competition has been characterized as brutal. Certainly most developments are consistent with efforts to reduce total costs, improve product quality, and possibly to increase market share.

Two important (and to some observers troubling) changes in large firm behavior have accompanied the changes in structure. Both pertain to market coordination and pricing.

First, many more fed cattle are procured on a forward basis. Either through advance purchase, contracting, profit sharing or other means of coordination, beef packers are scheduling purchases with what is commonly termed "captive supplies". Estimates vary but at times, some packers may have more than half of current slaughter requirements arranged weeks ahead. Some cattlemen worry that reduced need for current cash purchases will soften demand and lower cash prices for cattle, or at least affect the variability of prices.

The second change is wholesale pricing. IBP has inaugurated a new formula pricing system for its Cattle Pak or boxed carcass product. Under the system the price for an order to be delivered sometime in the future, will be depend upon a formula based on the price of live fed cattle on or near the delivery date. The new program raises eyebrows of those who see this as a way for IBP to lock in a slaughter margin on a cost plus pricing scheme. IBP of course, disputes such claims.

Performance

The performance impact from changing structure is unclear. ERS and university research has shown that significant economies of size exist for meatpacking plants. Large plants, when run efficiently, will likely have lower slaughter and processing costs than small ones. Large plants can therefore improve marketing efficiency and lead to higher prices for livestock producers or lower prices to consumers.

Changing structure can also mean fewer bidders for livestock, and lead to fear that packers will gain market power and non-competitive prices may emerge. Such fear has caused industry groups and others to examine concentration in meatpacking.

Some studies have reported some (usually small) price effect in livestock prices or meat prices owing to concentration but most have produced little evidence of poor performance in the meat packing industry whether measured in terms of uncompetitive price or output, excess profits, or research and development.

ERS price spread data indicates that the farmer's share of the retail value of beef (with high and increased concentration levels) has changed little in the last eight years. The farmer's share for hogs has declined in the same period (with low and stable concentration levels).

Research Issues

Research is needed to estimate the magnitude of, and distribution of, economies of size, especially for multi-plant and multi-specie firms. and how those benefits are likely to be distributed across industry participants. The work should include any cost-reducing technologies for procurement, processing, merchandising, and distribution.

There is a need to assess the effects of the emerging system of integrated and contractual activity. This includes research to determine the impact of captive supplies on the short-run demand for slaughter livestock and on the level and variability of livestock prices over time. Also important is assessment of the long term impact on price as the primary coordinating mechanism in livestock and meat.

Research is needed to clarify the relationship between structural changes in the livestock industry and overall performance of the industry. Work defining relevant product and geographic markets is especially important.

Research is also needed to assist adjustment and accommodation of firms, especially small firms, to the changing environment.

Milling and Baking Structure and Performance Issues

Concentration in the flour milling and baking industries has increased substantially in the past 15 years as the largest milling firms and bakers have expanded their holdings. In addition, the relatively high costs of transporting flour have encouraged the location of new flour mills near metropolitan areas.

U.S. flour mills have been dropping in number, reflecting a long-term trend toward consolidated production. The total number of plants milling hard-, soft-, and whole-wheat flour fell from 279 in 1973 to 211 in 1987, a decline of 24 percent. Number of large mills (those with a daily capacity of 10,000 hundredweight or more) rose from 24 in 1973 to 42 in 1987. Small flour mills (less than 1,000 hundredweight daily capacity) are frequently shutting sown. Those that remain in business are often carving our niches in specialty markets. Durum mill numbers, in contrast, climbed from 13 to 19 plants over the same period, reflecting the jump in pasta consumption in the early 1980's.

As the number of U.S. flour mills grinding hard-, soft-, and whole-wheat flours has declined, average mill capacity has increased. The average capacity at these mills in 1987 reached 5,311 hundredweight, up nearly 60 percent from the level in 1973. A substantial increase in per-capita wheat flour consumption and economies of size may have explained the expansion of the productive capacity.

Concentration in the flour milling industry became especially pronounced since the late 1970's. In 1987, the 4 largest milling companies owned about 52 percent of total milling capacity, up from 36 percent in 1978. Similarly, the top 12 companies owned 84 percent of total milling capacity in 1987, up from 74 percent in 1978. The top 4 firms (currently ConAgra, ADM, Cargill, and

Pillsbury) are collectively increasing their market share at the fastest pace. In the baking industry, the top 4 firms in the bread and cake industry accounted for 34 percent of the value of shipments in 1982, up from 29 percent in 1972.

Issues

Industry analysts agree that flour millers historically have experienced low margins as a percentage of sales. They contend that the flour milling industry has not paid enough attention to market segmentation and strategies to differentiate their products. Others hold the view that this industry focuses more on expanding capacity use than market planning. Again, research is needed to clarify the dynamic market structure-performance relationships in this industry.

In addition to the increasing concentration and low profit margins, flour quality is one of the most pressing issues currently facing the flour milling and baking industries. Baking analysts contend that flour quality, when measured by baking performance, has dropped substantially in the past 25 years. Of all factors that have contributed to the decline in flour quality, the most important was efforts by plant breeders to produce high-yielding semidwarf varieties and to put a low priority on flour quality in the breeding process. In addition, protein content of wheat crops declined in the 1980's.

GLOBALIZATION IN FOOD MARKETING

The rapid internationalization of our food economy is forcing renewed attention to the rules affecting the players in the global market place. These rule changes include the Uruguay Round GATT negotiations to liberalize trade by reducing tariff and non-tariff trade barriers; bilateral agreements, such as the U.S.-Canadian Free Trade Agreement, to reduce trade barriers; and the continuing debate over the pros and cons of direct foreign investment.

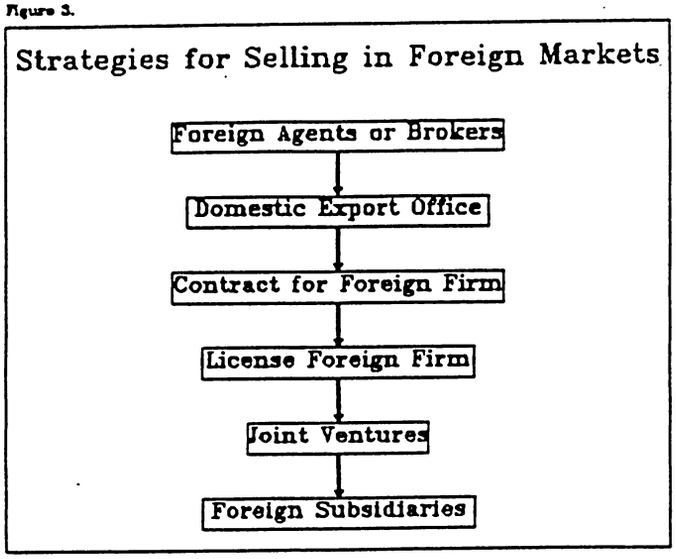
But in assessing the international competitiveness of the U.S. food marketing system, we need to broaden our concept and definition of international competitiveness. Too often, trade is the only measuring tool by which competitiveness is judged. For raw agricultural commodities, focusing primarily on trade may be adequate. But for manufactured food and agricultural products, trade is only one of several strategies used to access international markets.

Strategies to Access International Markets

There are many alternative strategies that firms can use to enter foreign markets. Some involve considerable more investment in time, money, risk, and expertise than others. Figure 3 ranks these strategies roughly by degree of investment and involvement required by U.S. food marketing firms.

The first three strategies relate primarily to exporting U.S.-produced products, while the last three strategies involve varying degrees of direct

Figure 3.



investment. Most firms enter the export market for the first time by using foreign agents or brokers. As export sales increase, many firms take the next step of setting up a separate export office or division within their U.S. company. U.S. processors can also decide to pack under contract for a foreign firm. For example, several Japanese manufacturers of soda and fruit drinks are contracting out production of their Japanese brands to American bottlers. This is nearly identical in concept to co-pack operations for private label accounts. Firms may also choose to have their branded products produced and marketed in foreign countries under a licensing agreement with a foreign firm. While this generally requires no direct investment in foreign production facilities, considerable investment is required to identify appropriate licensees, develop production and marketing procedures, and establish quality control safeguards. Joint ventures allow a U.S. firm to tap into the production, marketing, and regulatory know-how of a host-country firm without the expense of acquiring a wholly-owned subsidiary. Finally, a U.S. processor can acquire or build foreign manufacturing facilities and operate them as a wholly-owned subsidiary. In actual practice, a firm can use any one or all of these strategies at the same time.

Of these six strategies, licensing and joint ventures are often nearly invisible as far as being reported in public statistical series. Data on licensing and joint ventures are generally not included in trade and investment statistics. They are also frequently omitted from company annual reports.

International Profile of U.S. Food Processors

From a trade perspective, the U.S. food processing industry is still domestic-market oriented. Exports in 1989 accounted for about 4 percent of domestic production. Likewise, since 1972, we have imported between 3.5 percent and 4.5 percent of our processed food. While processed food imports and exports account for a relatively small share of domestic production, in absolute terms

the U.S. is the world's largest importer and exporter of processed food. In 1989, U.S. processed food exports increased 13 percent to $17.8 billion, while imports rose 9 percent to $20.2 billion.

Japan, by far, is our largest market for processed food followed by Canada and the Netherlands. Mexico leaped to our fourth largest export market in 1988. Exports to Mexico rose 106 percent in 1988 over 1987 and continued to grow rapidly in 1989.

However, exports reflect only a small fraction of the total position or "presence" of U.S. food marketing firms in foreign markets. Likewise, imports do not reflect the total presence of foreign firms in the U.S. food system. According to the Department of Commerce, U.S. firms had sales of $74 billion from their foreign food marketing affiliates in 1987. In contrast, foreign firms received sales of $59 billion from their food marketing affiliates in the United States. In a ranking of the world's largest food processing firms in 1989, U.S. firms dominated the list. Of the 10 largest food processors in the world, 7 were U.S. firms. In addition, 12 of the 20 largest and 22 of the 50 largest food processors were U.S. firms.

Data for 64 of the largest U.S. food processing firms, which account for nearly half of all U.S. food processing, give us some insight into their international activities. Total processed food sales for these firms were $182 billion in 1988. Of this total, 78 percent came from U.S. processing plants, while 22 percent came from foreign subsidiaries owned by these U.S. firms. These 64 firms' exports amounted to only 2.7 percent of their domestic sales. Thus, large U.S. food processors receive an average of 22 percent of their sales from foreign subsidiaries, while exports account for less than 3 percent of sales.

It appears that many large food processors use foreign investment as the major strategy for gaining sales in international markets rather than rely on exports. Indeed, 38 of the 64 firms in our data set owned food processing plants in foreign countries. These 64 firms operated a total of 2,518 processing plants--73 percent located in the United States and 27 percent located in foreign countries.

Two companies, CPC International and Coca-Cola, receive over 50 percent of their processed food sales from their foreign subsidiaries. And 14 U.S. food processors receive over $1 billion in annual sales from their foreign subsidiaries.

Even combining export sales with sales from foreign subsidiaries still understates the full international presence of U.S. food marketing firms. Most U.S. food firms do not include international licensing, joint venture, and franchising operations in reporting their foreign sales data. For example, many U.S. brewers license Canadian and British firms to produce their brands in the U.K. and Canada. Joint ventures will continue to expand rapidly into the 1990's. General Mills recently entered the European cereal market by licensing Nestle to produce and market its ready-to-eat cereal brands. Many food processors evidently find it more profitable to export capital, know how,

and trade marks rather than export branded products from their U.S. facilities.

Food processing companies give several reasons, in addition to trade barriers, for producing finished consumer products in foreign plants rather than exporting from domestic plants. One reason is to reduce transportation costs. This is especially important for products where consumer packaging adds considerable weight. Second, firms find it easier to deal with local governments and regulatory agencies when the product is produced in the host country. Third, for consumer value-added products, it is easier to keep abreast of local tastes and opportunities for new product development or reformulations when products are produced in the foreign country. Fourth, some firms prefer to acquire established brands in foreign countries and use those facilities as a base for further expansion. Fifth, producing a product in a foreign plant may improve access to local food distribution firms and facilitate a variety of marketing and promotional activities involved in marketing a branded consumer product. Finally, a firm that initially exports to a market may decide to switch to foreign production once the export market becomes large enough.

Thus, for a variety of production cost and marketing reasons, the majority of U.S. food processing exports are in lower value-added and bulk semi-finished products such as grain mill products, cattle hides, bulk fats and oils, and fresh or frozen fish and seafood. This is likely to continue.

However, exports of high value-added products are increasing and are likely to continue to expand. Many smaller and medium-sized processors have developed significant export markets. Food wholesalers and retailers are also expanding their exports of processed products.

Many of the largest U.S. food processors report very modest export sales of finished consumer food products. They generally do not expect large growth in their exports of these products. Rather, these firms continue to expand aggressively in foreign markets by increasing their investment in foreign plants, developing joint ventures, or expanding licensing arrangements with foreign firms to produce and distribute their branded products in foreign markets.

Research Issues

Major issues stemming from the above discussion are as follows.

1. The need to develop a more comprehensive definition and measure of international competitiveness. A conceptual framework is needed that incorporates the complexities of imperfectly competitive markets and two-way intra-industry trade. Such a framework must also include the full range of strategies used by food marketing firms to access international and domestic markets.

2. Even for highly processed branded products, some U.S. food processors have chosen export strategies over direct investment. More detailed information in needed about why a few firms seem to succeed at the export strategy and why

several European firms have developed successful export strategies to the United States. What factors affect the export and import propensity of different firms and industries? To what extent would (a) attracting more foreign investment in the U.S.; and (b) encouraging foreign firms to replace exports to the U.S. with joint venture or licensing arrangements increase economic activity in the U.S. food system?

3. What is the net effect of foreign investment into the U.S. on employment, technology and R&D, and competition? Conversely what is the net effect of U.S. investment in other countries on U.S. employment, capital expenditures, and on exports?

4. As both centrally planned economies and less developed economies restructure politically and economically, it is highly likely that emphasis will be placed on increased production of consumer goods and, in many cases, on expanded production and diversity of food products available to consumers. Initially, the demand for western processing, packaging, and distribution equipment and technology will be affected the most. U.S. involvement in providing these goods and services will depend on the competitiveness and our ability to negotiate joint venture agreements.

The challenge is to evaluate the pattern that multinational food marketing firms will take in entering these markets and how their strategies will effect our near term and long term trade flows in raw commodities and in processed products.

5. World concerns for food safety are increasing but they tend to stress different aspects in different countries. If standards differ considerably from region to region, the effect is to reduce product trade and encourage foreign investment in production facilities. On the other hand, as information flows more freely across borders, tastes and preferences and safety concerns may become more homogeneous; hence facilitating product trade.

Related to food safety are environmental concerns that may effect where food will be produced; that is, may alter comparative advantages of countries in world markets. To the extent that raw commodity production advantages change, processed food production may change regionally with subsequent impacts on trade. The fact that food processors tend to use foreign investment as their way of entering markets reflects the relative ease with which raw agricultural commodities are sourced locally in most areas. If environmental concerns change that, we may see foreign market development strategies change.

6. Global sourcing of commodities by large multinational companies may be affecting the well being of domestic producers, marketing firms, and consumers in either positive or negative ways. However, we do not know the number and size of firms involved in this globalizing of sources and the driving forces behind the internationalizing of supplies, much less the effect on participants in the sector. For example, broccoli and cauliflower processors have moved some of their production and freezing operations to Mexico, reportedly to take advantage of lower labor costs. Such moves place U.S. growers at a competitive disadvantage, but may deliver more frozen product to consumers at lower prices.

CONSUMER AND ENVIRONMENTAL DEVELOPMENT

This section reviews a variety of external factors such as changes in consumption behavior, food safety, product fabrication and demographic factors which affect the food marketing system and particular commodity subsectors. Two of these topics--food safety and the growing importance of foodservice channels of distribution relative to the food retailing sector--are subjects of USDA budget initiatives.

Food Safety

Safety of the food supply is of paramount importance to the producer, processor, distributor, and consumer. Concern with food safety has increased sharply due to a rash of highly-publicized incidents. This concern is becoming strong enough to affect the U.S. competitive position in the world market and alter how some products are produced, processed, and distributed in the domestic market.

USDA has developed plans for an integrated research agenda to address a broad spectrum of economic issues related to food safety. The broad areas covered include economic analysis of:

- Economic Dimensions of Foodborne Risk and Assessment
- Foodborne Risk and Consumer Behavior
- Food Marketing Industry Strategies and Responses
- Food and Commodity Programs, Policies, and Regulations

The projects are interlinked where possible to provide coverage through the marketing system of particular commodities and to complement other planned Division, Agency and Developmental food safety activities.

Economic Dimensions of Foodborne Risk and Assessment. This project would characterize the economic costs of the human health risk from various sources: fungicides, herbicides, insecticides, animal drug residues, other farm chemicals, such as hormones and wood preservatives, bacteria, viruses, parasites, food additives, and natural toxins. Using NASS/AMS and HNIS data on pesticide application, residues, and food consumption, the human health risk would be characterized for specific food and the economic costs of the human illnesses would be estimated for specific foods. The goal in developing this information is for use in estimating the benefits and costs of alternative public and private control strategies for the food production, processing, and delivery system.

Foodborne Risk and Consumer Behavior. Several projects are proposed that would provide the consumer economics research necessary to conduct cost/benefit studies related to food safety risks and control options. This would involve research on consumer perceptions about (a) chemical and

microbial contaminants in food that pose potential human health risks, (b) food derived from animals injected with synthetic growth hormones (e.g. bST and pST), and (c) food subjected to contamination with natural toxins (e.g. Aflatoxin). Critical assessments include the willingness to pay for higher quality.lower risk products; the trade-off between safety characteristics, price, appearance, and other product attributes; and other demand characteristics related to food safety.

Food Marketing Industry Strategies and Responses. Firms and interest groups at all levels of the food production and marketing system are increasingly active in evaluating food safety risks and devising alternative control and marketing strategies. This is true in both domestic and international markets. Food retailers, owing to their visible position and competitive industry structure, have become the focal point of many non-Federal food safety initiatives. For example, several retailers and wholesalers have hired private firms to test selected produce items for pesticide residues. With many different and often conflicting strategies, better understanding is needed of the potential role these groups will play in affecting the economic efficiency of the food marketing and governmental regulatory system.

The analysis would assess alternative food safety strategies, including their possible effects on consumer prices, product availability and variety, marketing costs, and overall economic performance. Also, data will be collected on pesticide use within the commodity and food marketing system to help "link" AMS pesticide residue data with NASS pesticide use information.

Commodity Marketing Program, Policies, and Regulations. This activity would involve a program of research examining product grades and standards and the economic implications for tradeoffs between agricultural chemical usage, chemical residues, and product characteristics for producers and consumers. The research would also include market implications of product labeling such as "organic" and "residue free" products for producers and consumers. The work on product grades and standards would be closely tied to the work on consumer demand for product characteristics. There is also a linkage to work in RTD and NASS on farm chemical practices and usage levels as well as with the residue data to be collected by AMS.

Contemporary economic models of risk would be adapted to analyze issues of market failure for food safety and the implications for optimal regulation and efficiency of the food production and marketing system.

Food Service

The growing importance of food service in food marketing and of public eating places within food service have meant that the performance and behavior of the food marketing system are quite different than they were twenty years ago. The vertical relationships in the food processing and distribution chain are longer for food service and quite different than for supermarket foods.

Behavioral relationships differ widely between the food service and grocery store channels. The standard models are based on grocery store channels and

simply assume that behavioral and economic relationships are the same for food service. But they are not.

For example, for many years most head lettuce has come from the Salinas area in California for many months out of each year. A crop loss in Salinas due to weather or disease drove prices up to the point that many consumers stopped buying lettuce. But since salad bars became so widespread in fast food places as well as table-service restaurants, demand is much more inelastic in the short run. Eating places are determined to have lettuce on the salad bar, driving prices up sharply and contributing to wider price changes in the lettuce market.

The dominance of chains--owned and franchised--in fast food means that menu items are locked in. A hamburger emporium will have hamburger every day, a pizza place will serve pizza, etc. So, demand for specific foods is much less responsive to price. Fixed-menu eating places now do more business than restaurants with more flexible menus which can be adjusted away from items with rising prices.

The emphasis in all types of away-from-home eating establishments has been strongly on the side of reducing labor inputs. In fast food establishments, kitchen labor is greatly reduced by a streamlined menu and labor out front by self-service. In many more conventional restaurants, full service is maintained in the dining room but the emphasis on reduction in labor requirements in the kitchen is nearly as great as in fast food establishments.

This is not to say that all restaurants are moving in this direction. There is a counter-trend with emphasis on quality and service. For those who are willing to pay the price, many new restaurants have sprung up which emphasize quality, variety, and service. But within the quality restaurant area, many--especially the chain operators--emphasize a limited line. These developments, of course, appeal to a different segment of the market than fast food. This different segment of the market may be different people, differentiated by income, taste, etc., or it may be the same people in different circumstances. One day the family with all the kids in tow may go to a hamburger stand or pizza place and a few days later the husband and wife may go out to dinner at a full-service restaurant.

All of these changes are having a marked impact on the supplies to the away-from-home market. The emphasis on getting labor out of the restaurant or institutional kitchen has created a strong demand for a new class of supplier. While these new types of suppliers are known by many names, one common term is "fabricators." Fabricators are supplying increasing quantities of food in prepared and semi-prepared forms, which will permit the restaurant or institution to put the item on the table with a minimum of labor input. Meats are being cut, wrapped, and boxed at the packing plant and delivered to the kitchen ready to go into the oven or onto the stove. The operator can buy steaks, roasts, or hamburger as he needs them. Other operators are going into the business of preparing main courses or complete meals in a fashion analogous to the TV dinners available in the supermarkets. The furnishing of complete meals or at least the main course in the form which required only heating prior to serving is particularly important in the case of captive

audiences, such as those on airlines, in school lunchrooms, and similar establishments.

Business relationships between suppliers and their customers at several levels are quite different in the food service channel from those in the grocery store channel. Contracts, agreements, and established practices differ, so measures of economic relationships will vary.

In order to assure a dependable supply for their stores, food service chains are contracting with shippers for price, quantity, quality, and product form for part of their produce needs. The practice of contracting may reduce variability in grower's average returns because contract prices are less variable than open market prices. Contracting likely has little or no effect on the variability of prices for the remaining share of output sold in the open market--or does price variability increase in the residual retail store segment?

Increased away-from-home eating has resulted in more vegetables being retailed through food service outlets. Frequently fresh vegetables are sold directly to food service chains, bypassing terminal markets and grocery store outlets. Sometimes the product is partially prepared at the shipping point. Lettuce, for example, is shredded and marketed to fast-food chains for use in sandwiches and salads.

Increasingly the traditional procedures for estimating price spreads for fresh produce, based on the raw product moving from shipping point to terminal market to retail grocery to consumer, are becoming obsolete due to changes in the market channel and the form in which the product is sold. Growth in food service sales and the practice by food service firms of contracting with fresh vegetable shippers for their produce needs bypass terminal wholesale markets and retail grocery stores, eliminating some of the traditional marketing service for which charges are computed in the current price spread formulas.

Information collection on the away-from-home market has traditionally been limited and hence is in the greatest need of expansion. The farm value of a dollar's worth of food consumed AFH is 16 cents compared to 30 cents for food consumed at home (AH). The added services further insulate farmers from consumers, making supply adjustments to demand changes more difficult. USDA is mandated to measure marketing margins, consumer food demand, impacts of commodity programs on consumers and marketing firms, and nutrient availability. These functions require detailed quantities and value for major food groups in all market outlets. Such information does not now exist for the AFH market, a fact that interferes with accurate fulfillment of USDA mandates.

Improved data is needed to measure marketing margins, marketing costs and farm-to-retail price spreads for major commodity groups which currently include meat products, fruits and vegetables, dairy products, poultry and eggs, grain mill products, and miscellaneous products. The product allocation between at-home (AH) and away-from-home (AFH) consumption is critical to the computation of consumer expenditures, margins, and the marketing bill because margins differ drastically in the two markets. Currently, estimates of the

market split are benchmarked to 1967 and 1979 surveys of the foodservice industry. Updates have not been possible due to funding limitations.

In carrying out evaluations of commodity and food programs, researchers need to have detailed and accurate measures of consumer demand for food. Currently, consumption responses to price changes are estimated using "disappearance for food use" data in the supply-utilization tables. Food use is usually a "residual" after accounting for production, stock changes, and net trade. Few direct measures of food use are available. Disappearance data encompass all market outlets and lacks information specific to AH and AFH segments. Because margins differ greatly, consumption responses to raw commodity price changes can differ significantly in each market segment. The ability to measure price elasticities in each market could lead to more precise estimates of commodity program impacts and of factors contributing to farm price variability.

Public information on product flows is essential to business strategic planning, as well as to assessment of nutrient availability and welfare of consumers. We have some evidence that consumption trends are not identical for some major commodities (cheese and poultry) in the AH and AFH market segments. Yet both industry and public efforts to secure reliable and continuous data on the AFH market have been thwarted by lack of funding and coordination of effort.

The large majority of business planning decisions and policy/program assessments require a knowledge of how markets are linked vertically; that is, the relationships between prices at different levels in the marketing chain and between prices for related inputs. Critical to this is information on how commodities are allocated to different end products and markets. Preliminary research now underway suggests that input substitution occurs within the marketing system and that accounting for this results in different relationships between farm level and retail level price elasticities than current estimates suggest. Because of the additional services, the relationships can be quite different for food sold through the away-from-home markets. Failure to accurately measure farm-to-retail linkages can result in erroneous assessment of commodity and food policies/programs.

Ingredient Substitution/Engineered Foods

In many products, traditionally used ingredients are being replaced (partially or totally) by a variety of substitutes. These substitutes range from low-calorie sweeteners, to fat substitutes, to protein substitutes. Many of these products are in the development stage. But in the 1990s, the food marketing system will have a vast array of new ingredient substitutes available for use. The development will cause a variety of data problems for analysts. It raises questions about standards of identity and labeling. The use of fat and other ingredient substitutes could also have major intercommodity effects. Two examples illustrating this development are changes in the sweetener industry and the introduction of fat substitutes.

Sweeteners

Traditional sources of sweeteners data have become inadequate to monitor and appraise the industry's structure and performance due to the development of new products--high fructose corn syrup (HFCS) and improved low-calorie sweeteners (aspartame, saccharin, and acesulfame-K) for which reliable production data are not available.

The sweetener industry, at one time primarily a sugar industry, now consists of a sugar segment, a corn sweetener segment, and a low-calorie sweetener segment. Seventy-two percent of U.S. sweetener consumption (calculated in sugar-sweetness equivalent) in 1975 came from refined sugar. Corn sweeteners made up 22 percent of the total and saccharin 5 percent. Honey and edible syrups accounted for the other 1 percent. By 1988, refined sugar's share had declined to 40 percent, while corn sweeteners' share rose 46 percent and low-calorie sweeteners supplied an estimated 13 percent.

U.S. per capita consumption of corn sweeteners surpassed sugar in 1985, as lower priced HFCS replaced sugar, mainly in soft drinks. Per capita sugar use has leveled off since that time, while corn sweeteners consumption has crept up further, based mainly on the increasing popularity of soft drinks.

Researchers needs a system for collecting data on the low-calorie sweeteners. ERS generates working estimates of low-calorie sweetener use based on fragmentary data such as revenues, estimated prices, and occasional estimates by the trade. Current estimates indicate that U.S. per capita use of low calorie sweeteners has about tripled during the 1980's to a level approaching 20 pounds per year (sugar-sweetness equivalent). The low-calorie sweeteners are currently thought to account for 12-14 percent of sweetener use. In order to adequately track sweetener use and reliably assess the effects of alternative sugar policy proposals, monitor structural changes, and assess economic performance of the sweetener sector, ERS must have solid date on the use and production costs of the low-calorie sweeteners.

A key development in the future for low-calorie sweeteners will occur after 1992 when NutraSweet Company's patent on aspartame production in the United States runs out. The price for aspartame will likely drop and competition will intensify as other companies begin marketing aspartame. Actual cost data are unavailable, but industry analysts have suggested that the price of aspartame could drop from current levels, around 30 cents a pound (sugar equivalent), to perhaps as low as 10 cents. Such a development could result in a faster use of low-calorie sweeteners, particularly in place of HFCS.

Fat Substitutes

For general health as well as weight control reasons, consumers are being urged to eat less fat. The fat present in foods such as milk, meats, eggs, and nuts occurs naturally, but may be altered through breeding or feeding practices. Other fats and oils are added to foods, either directly, such as dressings on salads or butter on bread, or as ingredients, such as shortening or cooking oils, in bakery products and other processed items. Processed foods--like cheeses, ice cream, shortenings, and salad dressings--are the

candidates for fat substitutes because food processors control the fat content.

Three types of fat substitutes in current use or under development are: (1) starch-based; (2) protein based, and (3) fatty-acid based.

Starch-based substitutes. These are mixtures of starch derivatives and water and can only replace part of the fats and oils without a loss in quality. These products include N-OIL, a tapioca dextrin and maltodextrins made from corn starch. They can partially replace fat in salad dressings, margarines, and frozen desserts and cut calories in these products by a third.

Protein-based substitutes. Mixtures of protein and water are also used as partial fat substitutes. Thomas J. Lipton, Inc. has developed a technology that used either gelatin or milk proteins to halve the number of calories in margarine. Lipton has test-marketed a low-fat "butter" made with the fat substitute and is evaluating the results. The product can withstand some heat, so it can be used for baking and light frying and sauteing.

Another protein-based substitute, which has received a lot of publicity, is Simplesse, developed by the NutraSweet Company. Simplesse is made from egg whites or milk proteins. Simplesse can be added to dairy products--like ice creams, yogurt, cheese, sour cream, and dips--and oil based-foods--like salad dressing and mayonnaise. However, the compound cannot be used to cook foods because heat caused the protein to gel and lose its creamy quality. FDA approved the use of Simplesse in frozen desserts in February 1990.

Substituting Simplesse for most of the fat in leading premium (high fat) products reduces calories by 50 to 80 percent and fat contents by 85 to 97 percent. The declines are so dramatic because one gram of fat has 9 calories, while Simplesse has only 1 to 2 calories per gram.

In May 1989, Kraft General Foods petitioned FDA for GRAS affirmation of its new fat substitute in frozen dessert products. According to the company's petition, a frozen dessert with this new fat substitute will have less than two-thirds the calories and 5 to 10 percent of the cholesterol of an average ice cream product.

Fatty acid-based substitutes. Other fat substitutes use fatty acids that have been chemically altered to provide fewer or no calories. Many of these are still under development.

Polyglycerol esters have 6 to 6.5 calories per gram, about one-third less than a gram of fat. They are used in low-calories versions of ice cream, other frozen desserts, margarines, shortenings, peanut butter, shipped toppings, and bakery items.

Another type of fatty acid-based substitute functions and tastes like fat but passes through the body unabsorbed because the molecules are too large for the body's enzymes to break down. The most important of these undigestible fatty acid-sugars is olestra. The Procter & Gamble Company has been developing olestra since the 1960's. Olestra would replace up to 75 percent of

traditional shortenings and oils for deep fat frying in restaurants and other foodservice outlets and preparation of commercial snack foods, like potato chips.

The ARCO Chemical Company is working on a fat substitute called esterified propoxylated glycerol (EPG). Like olestra, EPG is undigestible. The company is testing it in a wide variety of foods including frying oils, ice cream, baked goods, and dressings.

Whether products containing new fat substitutes will replace existing low-fat items on supermarket shelves or even expand the popularity of low-fat foods depends on several factors--FDA approval, the substitutes' quality and versatility, strength of consumer demand and willingness to pay for reduced-fat products, and marketing strategies.

Issues and Concerns

The likelihood of a plethora of reduced-fat products raises several nutritional and food safety concerns. Many nutritionists are wary of fat substitutes.

Labeling issues will also emerge. Many of the target foods for fat substitutes, such as margarine, mayonnaise, and ice cream, are covered by FDA-enforced standards of identity. Standards of identity specify what ingredients and quantities these products must contain to be called by their traditional names. For example, a frozen dairy product containing less than 10 percent milk fat cannot be called ice cream.

Another set of issues would involve the intercommodity effects of fat substitutes. A growing market for fat substitutes would increase the demand for the ingredients used in their manufacture and displace demand for traditional fats and oils. Compounds, such as olestra, made from traditional vegetable oils would have a smaller economic impact on the oils industry than those made from other ingredients. Vegetable oil-based substitutes would also raise demand for other ingredients used to make the substitutes. In the case of olestra, this would be sugar. If such a fat substitute caused demand for fat-containing foods to increase substantially, sales of vegetable oils would rise.

On the other hand, if a protein-based substitute, such as Simplesse, is used in oil-based products, demand for traditional vegetable oils would fall and demand for the ingredients used to make the substitute would grow. For example, if Simplesse were used in retail low-calorie salad dressings, it would displace about 9.5 million pounds of vegetable oil. If 10 percent of regular salad dressings, which contain more than five times as much oil, also switched to Simplesse, another 17.6 million pounds of vegetable oil would be displaced.

Simplesse's use in ice cream would not affect the vegetable oil market but would displace milkfat. For example, if Simplesse were used in 25 percent of U.S. ice cream, about 123 million pounds of milkfat would be displaced by 40

million pounds of milk or egg protein, adding to the current surplus of milk fat.

The potential for fat, sugar, and other ingredient substitutes is promising. Consumers are likely to support research and development efforts because they want to follow the health guidelines without changing their eating habits.

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Additional information on NC-194 and a complete list of project publications can be obtained from:

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