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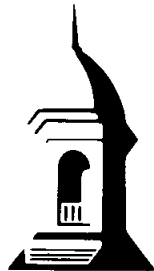
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**Broilers —
Differentiating A Commodity**

by
Richard T. Rogers

Food Marketing Policy Center
Research Report No. 18
December 1992



The University of Connecticut
Department of Agricultural and Resource Economics

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Acknowledgements

I owe many people involved in this project a debt of gratitude. Jim Hoagland, now with Rocco Incorporated, was a graduate student at the time of this project and provided much needed research. His past work experience in the broiler industry made his advice most valuable. Clark Burbee of the U.S. Department of Agriculture also had a vast knowledge of the industry and read and commented on every phase of the research; from the proposal to the final draft. Lee Schrader, Purdue University, and William Roenigk, National Broiler Council, read and commented on the entire manuscript. Agnes Perez of the U.S. Department of Agriculture provided much needed data and answered numerous questions.

The work was done as part of the regional research project NE-165, "Private Strategies, Public Policies, and Food System Performance," and was supported in part by a subgrant from the Food Marketing Policy Center at the University of Connecticut from its grant from the U.S. Department of Agriculture's Special Grants program.

This work will appear as a chapter in *Industry Studies*, edited by Larry Duetsch, to be published by Prentice-Hall in 1993. His encouragement and editorial advice were fantastic. Darleen Slys and Eileen Keegan of the University of Massachusetts prepared the text and figures for the final electronic version. Ron Cotterill of the Food Marketing Policy Center at the University of Connecticut has been encouraging and helpful in preparing this manuscript for the research report series. Andrew Franklin and Irene Dionne prepared the manuscript for publication.

Despite all the help and advice I received, I did not learn all they had to teach, and hence I am responsible for the final version.

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Broilers—Differentiating a Commodity

"A chicken in every pot."

Herbert Hoover, 1928

1. Introduction

A broiler is the industry's name for a young chicken grown for meat rather than for eggs. The name does cause some confusion. Fryers were the industry's first widely used term for young chickens sold for their meat reflecting the most common method of cooking chicken before health concerns reduced interest in fried foods. Kentucky Fried Chicken introduced fast-food chicken in the 1930s and its growth has made the Colonel's recipe famous worldwide. Now owned by PepsiCo, which explains why you never get a Coke there, it has changed its name to KFC to de-emphasize the word fried. Even the National Broiler Council, at their Fall 1990 board meeting, debated a name change to include the word chicken. They decided not to change the name but to continue to use chicken in its promotions aimed at consumers, like the "September is National Chicken Month."

1.1 The Early Years

The chicken has a long history with its first recorded reference being in China around 3300 B.C.¹ The ancestor to the modern chicken is thought to be from Asia and these colorful and aggressive birds still populate parts of Burma and Northern India. The ancient sport of cock fighting was the sport of choice among Emperors, Kings, Noblemen, and common folk as well, with prized fighters selling as thoroughbred race horses do today. The birds were valued by armies, traders, and explorers for their minimal needs and many uses—eggs, meat, entertainment, and even the feathers had great value.

Although chickens arrived in America along with its first European settlers, the raising of chickens primarily for their meat is a relatively new industry. In the early 1900s, the United States was still a country of small farms and chickens were a sideline venture of most farms. Although the number of chickens on each farm was small, it was a huge business in the aggregate. Chickens were easy to raise and the

extra eggs were sold to the town people providing supplemental money for the household. The cockerels, the young male chickens, were sold in the spring as frying chickens, a springtime treat for any family.

Farmers in rural areas close to major population centers, like Philadelphia and New York City, saw opportunities in the spring fryer business. Also, farmers from poor cotton land states, like Georgia and Arkansas, began to seek better returns from chickens than from struggling with cotton. New England states and the Delmarva Peninsula, a region formed by parts of the three states of Delaware, Maryland, and Virginia, started raising broilers for the big city markets. There was sufficient money being made that the industry grew and support services, like trucking, became viable businesses.

The New York City market was the center of poultry distribution during this period. Its large Jewish population provided a ready market since their faith required they eat meat, preferably a luxury meat, on the Sabbath and other holidays. Frying chicken was considered such a luxury for most city people. New York City and poultry became inexorably linked with marketing terms like "New York Dressed" being used by the entire industry.[^]

The two world wars were good for the chicken business. Both World War I and II provided high demand for poultry products and input suppliers helped the industry gear up with "defense chicks" and feed supplies to respond to the war effort. One enthusiastic feed supplier's ad proclaimed, "It is YOUR DUTY to help win this battle for increased production."² These were profitable years but after the war the industry suffered as the war demand vanished and beef rationing was lifted. Although many enterprises cashed out after earning war profits, others braced for the hard times that would come but convinced that better times would return to the broiler industry.

2. Production and Consumption Trends

Herbert Hoover's 1928 "A chicken in every pot" slogan was quite a political promise, few of which have been so well fulfilled. In 1935 broiler production stood at just 43 million birds and per capita consumption was only 0.7 pounds (Table 1). Chicken was still a luxury item to most people. By 1990 per capita chicken consumption had increased 100-fold to 70.1 pounds per person and rivaled beef for

[^]A "New York Dressed" broiler is slaughtered and bled with feathers removed but not the entrails.

Table 1. Broiler Production and Per Capita Consumption

Year	Production		Per Capita Consumption
	Number	Liveweight	
	millions	million pounds	pounds
1935	43	123	.7
1940	143	413	2.0
1945	366	1,107	5.0
1950	631	1,945	8.7
1955	1,092	3,350	14.6
1960	1,795	6,017	23.5
1965	2,334	8,111	29.8
1970	2,987	10,819	36.9
1975	2,950	11,096	37.1
1980	3,963	15,539	47.4
1985	4,479	18,851	55.7
1990	5,841	25,522	70.1

Source: USDA.

the highest per capita consumption of any meat. Since population had increased dramatically over this 55 year period and the industry had begun exporting, production volume increased over 200-fold, a staggering rate of growth.

2.1 Consumption

By 1987 food writers were claiming that per capita consumption of poultry, chicken plus turkey, had displaced beef as the most consumed meat. Although per capita beef consumption has fallen since its record highs of the mid-1970s in contrast to poultry's growth, the headline was a bit ahead of its time. The red meats are sold with most of the bone and fat trimmed prior to retail sale whereas chickens are sold as whole dressed birds with much of the product being discarded as waste (e.g., bones, necks, etc.) after the retail sale. On a boneless, trimmed weight basis, it was not until 1990 that per capita poultry consumption reached that of beef consumption (Table 2).

Per capita meat consumption has increased over time as expected in an affluent society but may be leveling off near 190 pounds per capita

Table 2. Pounds Per Capita on a Boneless, Trimmed Weight Basis.^a

Year	Beef	Red Meat		Chicken	Poultry		Fish	Meat Total
		Pork	Total ^b		Turkey	Total		
1966	73.7	44.3	123.8	24.6	6.3	30.9	10.7	165.4
1971	79.0	52.6	135.5	27.7	6.6	34.3	11.5	181.3
1976	88.9	39.2	132.1	29.3	7.2	36.5	12.9	181.4
1981	72.7	46.8	121.9	35.4	8.5	43.9	12.7	178.5
1986	74.1	41.6	118.3	40.5	10.5	51.1	14.5	183.8
1987	69.2	41.8	113.3	43.2	12.0	55.3	15.5	184.1
1988	68.2	44.7	115.1	44.5	12.6	57.1	15.0	187.2
1989	65.0	44.3	111.3	47.0	13.5	60.5	15.7	187.4
1990	63.9	42.6	108.5	49.7	14.2	63.9	15.8	188.2

^a Which subtracts all bone and fat normally trimmed before retail sale.

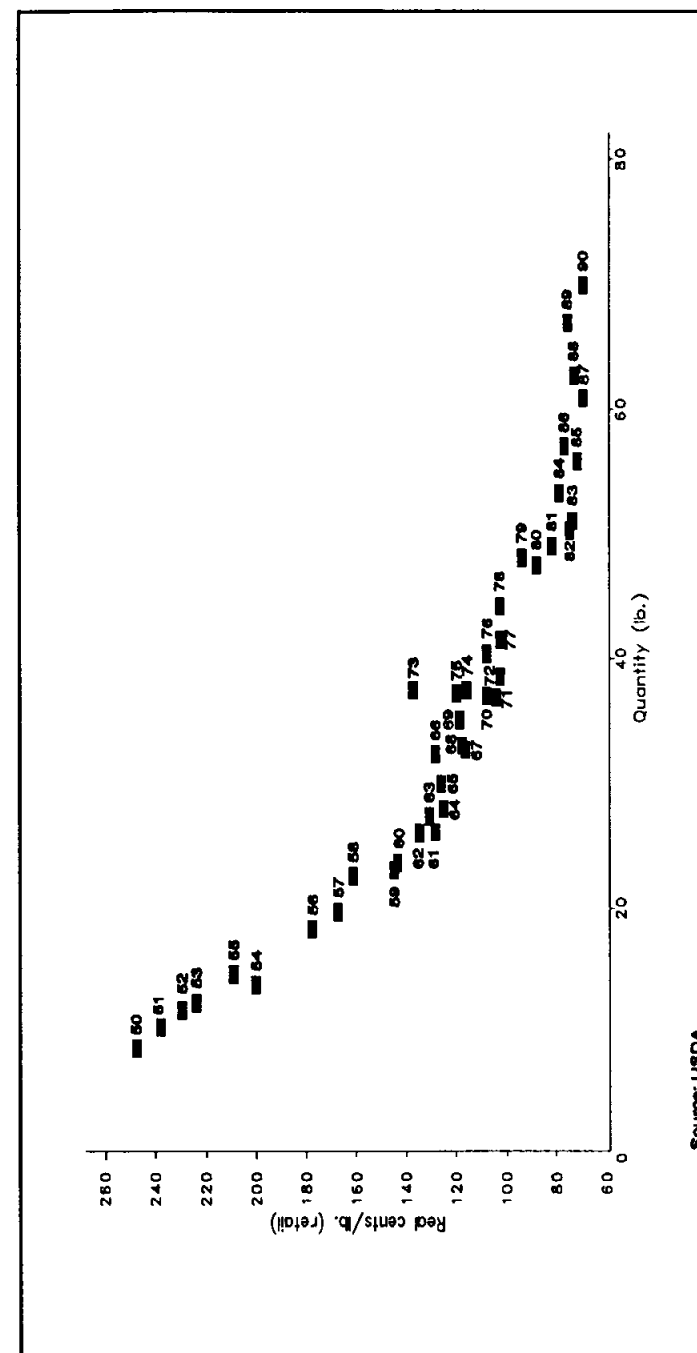
^b Includes veal and lamb.

Source: USDA.

on a boneless, trimmed basis. Since these meats are substitutes, each meat's future growth will be based on population growth, exports, and success at taking share from each other. Poultry has taken a growing share, mainly at the expense of beef consumption, pork consumption has been nearly stable since 1966, and fish consumption has increased to nearly 16 pounds per capita. Although much has been written about increased fish consumption, turkey consumption is nearly as high and has a much higher growth rate. The new aquaculture industry, especially catfish, has many similarities to the broiler industry, but success now depends on consumer preferences.

2.1.1 Price-Quantity

To take market share from competing meats requires increased consumer demand for a particular meat, usually from income changes, relative price changes among the substitutes, and changes in tastes and preferences. The real price of broilers has been lowered dramatically over time which increased consumption, but the negative relationship between real price and per capita consumption has flattened over the 1950 to 1990 period (Figure 1). By the 1980s increases in per capita broiler consumption were occurring with little to no decreases in broiler prices. This suggests that either the price of substitutes was high



Source: USDA.

Figure 1. Broiler Price-Quantity Relationships, 1950-1990

relative to broilers or a shift in consumer tastes and preferences was taking place. Both explanations are true, as well as an income effect as more affluent consumers purchased premium parts and more value-added product forms.

The price of ready-to-cook chicken has increased in the 1980s, especially late in the decade (Table 3), with bone-in breasts leading the way. Beef prices declined from 1980 to 1986 and then recovered by 1989 for no major net change for the decade. Canned tuna prices declined from 1980 to 1987 and then increased slightly but not enough to regain the levels of the early 1980s. Chicken breasts are the premium chicken part with the bone-in breast selling at over twice the price per pound of the whole chicken. Currently, boneless and skinless breasts are the luxury fresh chicken cut and usually sell at twice the price of bone-in breasts. These relative prices demonstrate the increased consumer appeal of chicken as the industry continued to expand production during the 1980s.

2.1.2 Elasticities

Research has shown that the income elasticity of broilers has declined over time as it shifted from luxury status of the early periods to a more common meat item. Some studies done with 1950 data found estimates exceeding +1.0, while nine recent studies have an average income elasticity of +.38.³ Cross-price elasticities with beef and pork have shown more agreement, with most estimates around +.20 for beef and +.28 for pork. Research on the broiler own-price elasticity shows that the long-run price elasticity is inelastic and has become more inelastic over the last 40 years, with an estimate between -0.5 and -0.6 being most supported by recent studies. With the industry in the inelastic portion of its demand curve, production expansions should reduce industry revenue by depressing price more than increasing consumption unless other factors shift the entire demand curve.

2.1.3 Consumer Preferences

Broiler consumption has benefited during the last decade from consumers' interests in health and concerns over dietary fat. Compared to both beef and pork, chicken is a healthier product, especially when the skin is removed and it is not fried. Since the mid-1950s, health associations have been warning people about the increased health risks of a high fat diet. Although awareness is up, average fat consumption remains above the recommended 30 percent of calories from fat. Like the experience with smoking warnings, fundamental change in consumer behavior is a long process. Consumers have made greater

Table 3. Retail Price Per Pound

Year	Chicken Whole	Bone-in RTC	Bone-in Legs	Bone-in Breasts	Ground Chuck	Bone-in Chuck Roast	Canned Tuna Light, Chunk
1980	70.9	106.7	127.1	183.3	181.9	235.5	
1981	73.2	111.9	148.5	180.4	181.7	255.3	
1982	71.4	106.9	148.5	177.5	178.9	246.9	
1983	72.5	104.2	151.7	173.1	173.3	230.9	
1984	81.0	115.4	170.2	171.7	168.1	211.8	
1985	76.3	107.7	166.1	167.8	157.1	200.6	
1986	83.5	116.7	184.8	163.3	158.5	199.8	
1987	78.5	108.8	180.4	170.7	167.8	197.2	
1988	85.4	114.1	193.2	176.1	173.1	215.6	
1989	92.7	120.6	209.4	182.7	188.2	207.5	

Source: ERS, USDA, Bureau of Labor Statistics.

changes among the sources of fats than in reducing total fat intake. Red meat consumption has been reduced, but high-fat ice cream consumption increased. Butter consumption fell, but margarine and cheese consumption advanced. A 1990 Gallop poll found that over two-thirds of adults make food choices on a simple perception of foods being either good or bad.⁴ Such perceptions are often wrong. Cholesterol is often considered bad by many consumers who will respond positively to labels touting "No Cholesterol" on such products as potato chips and peanut butter despite their being high in both fat and calories. If consumers were aware that all food products without animal ingredients are cholesterol free, then the marketing value of manufacturers' "Cholesterol Free" would be greatly reduced.

Today's food consumer is changing. Fewer are educated in food selection, handling, and preparation. Consumers are busier with fewer meals eaten in the traditional family setting. A premium is placed on convenience resulting in a shift of meal preparation tasks to food processors and store deli departments. The traditional family applies less to modern households where children often zap their own meals in the microwave. New products emerge at a blinding pace providing variety but making it more difficult to keep up. There are over 60,000 items in some of the most modern supermarkets and consumers cannot be experts in all of them. They need help and marketers and retailers are helping with store displays and shelf tags that provide consumer

information. Consumer advocates prefer a neutral third party to be involved in this educational process and have called for changes in the Government's food labeling laws that would reduce the marketing hype and provide easier access to information.

More meals are eaten away from home—about a third of food is consumed in restaurants, fast-food outlets and other away-from-home food-service establishments. Consumers are provided with much less information from food-service firms than is found on the packages in the grocery store. Food-service firms, however, are getting the message as well. For example, McDonald's was blasted by a wealthy industrialist in a full-page advertisement in leading newspapers for its hamburgers being too fat, and now the company has launched the McLean burger with only 9 percent fat.⁵

2.2 Production

2.2.1 Regional Concentration

Broiler production is concentrated in the "broiler belt" of states which start at the Delmarva Peninsula and swing down through the Southeast to east Texas (Figure 2). Only California is a top 10 state in production that is outside this region. Most of these states were part of the original broiler industry but the Northeastern states have declined as production moved south to lower costs of production. The leading 10 states account for about 85 percent of all broiler production. That figure has been stable for 25 years and continued growth in the industry has started to spill into adjacent states like Kentucky and Tennessee. Processing plants tend to locate close to broiler production as advances in transportation allow shipping dressed broilers to the population centers.

2.2.2 Vertical Structure

Broiler processing is highly integrated with the processors controlling the vertical stages in the broiler industry either by owning or contracting each stage of the vertical system—from breeding stock to market ready products (Figure 3). The vertical process begins with the eggs from the breeder farm sent to the hatchery. The hatched chicks are then sent to the grow-out farm where they will grow to market weight in 6 to 8 weeks. Growers are usually under contract to the integrators. Feed is provided by the integrator and represents about 70 to 75 percent of the costs of grow-out. Feed costs are so important to the total cost of production that market analysts use feed costs as a proxy to forecast broiler prices and processors' returns.

Once the birds reach market weight, they are sent to a slaughtering plant, often called by the softer name of a processing plant, where they

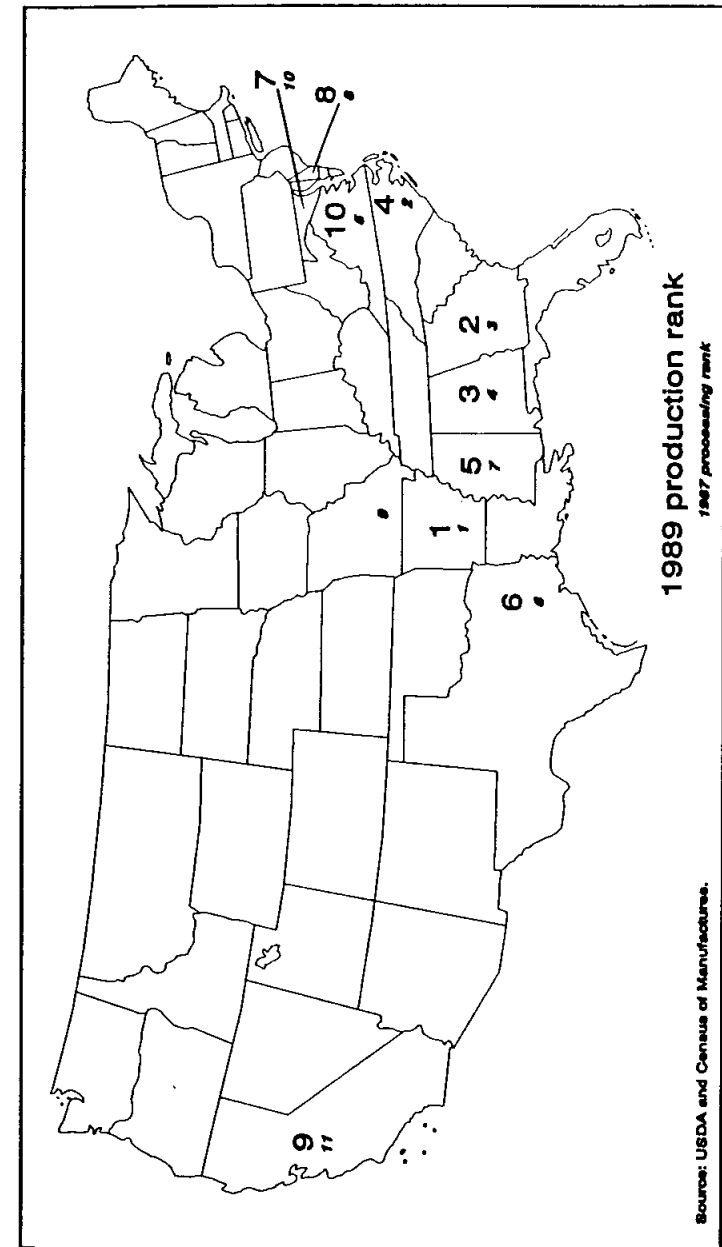


Figure 2. Top Broiler States

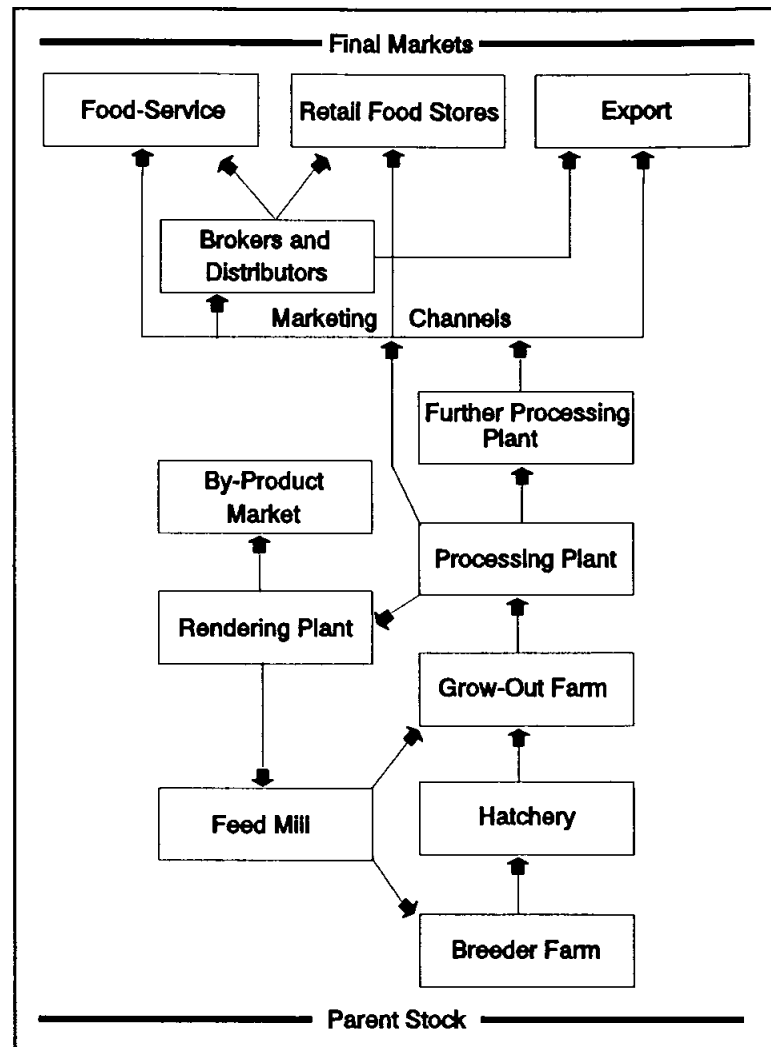


Figure 3. Vertical Structure of the Broiler Industry

are processed into "dressed broilers." The live birds enter the plant to be hung by their feet, electrically stunned, bled, have their feathers, feet, entrails, hearts, livers and other parts removed before emerging as dressed broilers which are then ice packed or chill packed, either as the whole birds or as the cut up parts familiar to all who shop the supermarket's meat case. Others are quick frozen either whole or as

individual pieces and some are shipped to another company owned plant for further processing into value-added products.

Further processing is the fastest growing segment of the poultry industry. Since fresh broilers are highly perishable commodities, processors would like to increase the shelf life and create additional value which makes broilers less of a commodity product. Freezing is a traditional method of increasing shelf life but consumers prefer to buy fresh chicken. However, many food-service companies prefer the product frozen since it gives them more control and less waste without negative reactions from consumers who seldom even know the product was once frozen. At present only about 7 percent of the broiler volume is frozen, but it is likely to increase as consumers increasingly accept frozen value-added products like frozen nuggets and dinners.

2.2.3 Marketing Channels

The final products are either sold to distributors or marketed by the processors in two main marketing channels—food-service (combining institutions and restaurants) and retail grocery stores (Figure 3). In 1989 the retail market accounted for 51 percent of broiler volume, food-service 34 percent, export markets took 3.5 percent with the remaining volume entering nonhuman consumption markets (e.g., feed and pet food).⁶ The export market increased significantly in 1990, when the U.S.S.R. became the largest buyer, with Japan slipping to second largest buyer of U.S. broilers. By the end of 1991 another new export record was set at 1.26 billion pounds, over 6 percent of total broiler volume and Japan returned to being the largest buyer.⁷ The growing export market has been welcomed by the industry because it not only moves a significant amount of product but it helps balance the demand for different chicken parts.

2.3 Defining the Market

We have managed to this point without providing a clear definition of the market. Market definition is complex yet fundamental to meaningful analysis and many antitrust cases bog down over market definition since it has a critical effect on such important economic concepts as market concentration. Market definition has two critical components—product definition and geographic definition. Economists want to include those products that compete directly with each other in the same market. Unfortunately, the cross-price elasticities needed to check the degree to which products are substitutes are not available for most products.

We define our product market as broilers, but others could argue that this product definition is too narrow and should at least include

turkeys and perhaps even all meats. We choose to define the market as broilers and treat the other related products as imperfect substitutes. Once product form is included, the definition becomes less clear. Broilers are sold as whole birds, or in parts, or in a value-enhanced form. Ground chicken, for example, probably competes more directly with ground beef than with chicken breasts. Although we will discuss such problems where appropriate, our primary focus will be on broilers.

The geographic scope of the broiler market is the national U. S. market. Some firms, including leading firms, do not sell nationwide and maintain regional companies, but modern transportation methods make national shipments possible and the distance fresh broilers are shipped has dramatically increased over time. Frozen and canned chicken have always been shipped larger distances than fresh products. Imports from outside the country are minimal and exports, although advancing, are treated as a factor affecting the domestic market rather than enlarging the geographic scope of the market.

3. Market Structure

Market structure refers to the organizational characteristics of a market that largely determine where it falls on the competitive spectrum between monopoly and competition. Market structure has several important elements that reflect the competitive environment of the market. In this chapter, we will focus on four key elements: concentration, vertical integration, product differentiation, and conditions of entry. These elements of market structure have a strong theoretical justification, as well as a long empirical history as crucial determinants of the market conduct and performance.

3.1 Concentration

The broiler market has been one of the most unconcentrated industries in the food system. Although data specifically on broilers are limited by availability and comparability over time, one can use the broader poultry dressing industry (SIC 2015) to capture major trends. Fortunately, chickens dominated the poultry dressing industry, especially in the early Census years. Also, the data are for the entire United States despite evidence of regional markets existing in parts of the country.

The first reported Census concentration ratios were for 1935 and the four largest firms (CR4) accounted for 30 percent of the poultry industry. The next Census came after WWII in 1947 and showed 330

companies with \$479 million in poultry shipments and a CR4 of 32 percent. The 1954 Census reflected the post-war growth as the number of poultry processors more than tripled to 1,189 with shipments of \$1,258 million, a growth rate exceeding 23 percent per year. This rapid growth and influx of new entrants reduced CR4 to 17 percent. In subsequent Census years the number of companies continually decreased from this 1954 record number. Despite the continual fall in the number of companies, concentration remained low and reasonably stable.

Beginning with the 1954 Census, concentration ratios were available for the major product markets comprising the poultry dressing industry by using the Census' 5-digit product class data with separate product classes for both chickens and turkeys. The last published Census data are for 1982, but other data from the USDA Federal inspection records and from *Broiler Industry* compare well with the Census data and provide annual concentration figures.

Concentration in broilers remained very low from 1954 to the mid-1970s (Figure 4). The CR4 was 18 in 1954, reached a low of 12 in 1958, and stayed nearly constant at 18 from 1964 to 1976. The CR8 followed a similar path suggesting that the largest firms were just holding their share of a growing market. The CR20 advanced suggesting that larger firms held an economic advantage, but an advancing CR20 without an increasing CR4 and CR8 is no cause for concern as it reflects growing equity among the top 20 firms as more firms reach a larger more efficient level of operation.

Starting in 1977 concentration began a slow increase, as reflected by the CR4 cresting the important benchmark value of 40 in 1989. Many economists view a CR4 of 40 as a threshold level below which represents workable competition.⁸ Broilers met Bain's definition⁹ of an unconcentrated industry until 1983 when it advanced to the low-grade oligopoly class. Even with the recent increase, concentration in broilers is dramatically less than is generally found in food manufacturing industries.

The rise in the concentration in the 1980s was the result of mergers among the leading firms. Marion calculated that the increase in concentration in broilers from 1977 to 1989 was almost entirely due to mergers.¹⁰ Tyson Foods is the current number 1 broiler processor (Table 4). Started in the 1930s as a family business trucking live broilers from other growers, the business grew as it recognized the efficiencies that would accrue to those who coordinated the broiler operation. It grew by acquiring others; as the company points out in its 1990 annual report, 50 of their 53 plants were acquired.¹¹ In 1989, in an acquisition tussle with rival ConAgra, it emerged as the

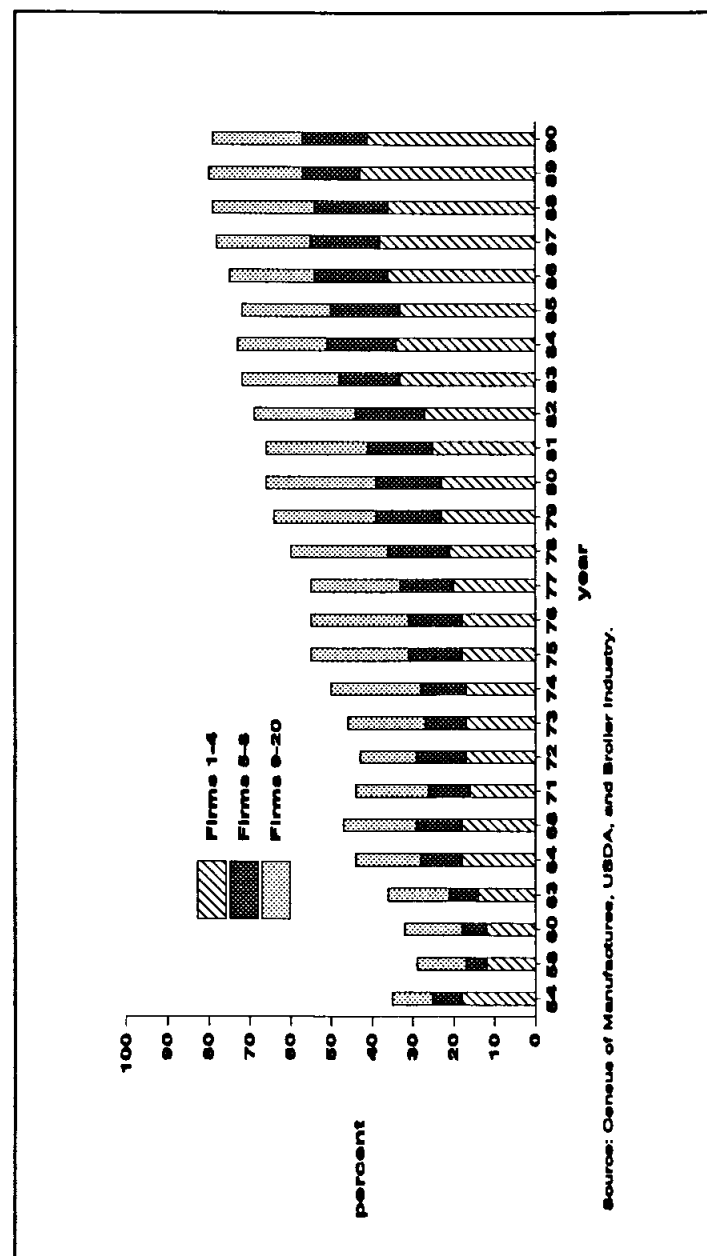


Figure 4. Broiler Concentration, 1954-1990

Source: Census of Manufactures, USDA, and Broiler Industry.

Table 4. Leading Broiler Companies

	Rank and Market Share Based on:			
	Production		Advertising	
	Rank	Share	Rank	Share
Tyson Foods	1	20.1	2	24.0
ConAgra	2	8.5	3	21.3
Gold Kist	3	6.9	5	4.1
Perdue Farms	4	5.8	1	28.4
Foster Farms	10	2.8	4	10.0
Top 4		41.2		83.7

Source: *Broiler Industry*, December 1990, and *Leading National Advertisers*, 1989.

acquirer of Holly Farms Foods and its 6.9 percent share of the market and gained the number 1 spot.

ConAgra, a large diversified agribusiness firm, lost its number 1 ranking that it held in 1982 after Tyson Foods made three major acquisitions. However, ConAgra was also actively engaged in mergers and the fight with Tyson over control of Holly Farms was a struggle for number 1. The merger battle was major business news for nearly a year as who would emerge with the prize was unclear until ConAgra withdrew from the bidding and courtroom escalations by accepting a cash settlement.

Gold Kist, an agricultural cooperative, was the second largest broiler processor in both 1977 and 1982. It made no acquisitions but rather grew internally. The merger activity by the other broiler leaders left Gold Kist as the third largest firm in 1990. Perdue Farms entered the broiler business in 1968 and has made two small acquisitions since 1977. It has been among the top six broiler firms for over a decade.

The mergers among leading firms went unchallenged by the enforcers of the Government's antitrust laws because the broiler industry was unconcentrated. In 1984 the Department of Justice developed its *Merger Guidelines* based on a market's Herfindahl-Hirschman Index (HHI)—calculated by summing the squares of each firm's market share (expressed as a percent).¹² The *Guidelines* state

that mergers will not be contested in markets where the HHI is under 1,000. In 1988, the HHI for broilers was 511, in 1989 it had increased 200 points to 711, with Tyson accounting for 433 of the total.¹³

These merger guidelines are based on a national seller market. If the appropriate market is regional, then the true HHI for each regional market is likely to be much larger. Also, mergers among broiler processors impact buyer concentration for the live broilers to process. Most broilers are raised under contract to the processors but one would expect less favorable terms for the growers as the number of processors competing for growers' services declined. Since processors prefer a 20-mile radius to assemble live broilers from, most growers face oligopsony or even monopsony buyer power.

The leading broiler companies in 1950 were quite different from the current leaders with the large meat packing companies holding the leadership positions in the poultry business.¹⁴ The leader was Swift and Company, followed by C. A. Swanson & Sons, and then Armour & Company. Also involved in 1950, were General Foods Company, Wilson and Company and the Cudahy Packing Company. Each of those companies no longer exists as an individual operation. The Swift brand, especially its Butterball turkey, is now sold by ConAgra after the breakup of Beatrice Foods following a leveraged buyout. Swanson was acquired by Campbell Soup Company but the brand name remains a leader in the further processed poultry products categories. In the narrow canned poultry market, for example, the Swanson brand holds a 64 percent market share.¹⁵ The Armour company followed the conglomeration trend of the 60s and 70s and at one time was owned by Greyhound, but ConAgra acquired the brand line in 1983. General Foods, which acquired Oscar Mayer in 1981, which had acquired Louis Rich Turkey Company in 1979, is now part of Philip Morris Companies.

It was not just the large meat companies that once held leadership positions in the broiler business. Major feed companies, with their obvious interest in the growing broiler business, became major players in the industry. Their role began as supplier of birds and feed to growers under business agreements that reduced the grower's risk but positioned the feed companies as the main coordinators of the industry. Once they organized the input side of growing broilers it was a logical next step to become involved in processing.

Ralston Purina, Pillsbury, and Central Soya were such companies in the 1960s.¹⁶ Ralston Purina ended up owning many broiler businesses that fell into financial trouble during the broiler depression in 1961 and was the largest broiler processor by 1968.¹⁷ Then in 1971 it announced that it would withdraw from the broiler business citing its

volatility and its poor fit with the diversified food processor image it was cultivating in the investment community. The decision shocked the industry and came just after Ralston had announced an aggressive marketing plan for a branded line of broilers including pre-cooked and frozen products. Some ex-Ralston Purina people formed new companies that have become successful. For example, Hudson Foods was formed by Red Hudson after leaving Ralston Purina and was ranked 25th in 1975 but was seventh in 1990.

The largest broiler companies are among the largest food manufacturing companies, especially when ranked by sales rather than value-added. Based on 1990 sales data, at least 13 of the 50 largest broiler companies make the 100 largest food manufactures list.¹⁸ ConAgra is the second largest U.S. food manufacturer behind number 1 Philip Morris Companies. Cargill, the 24th largest broiler company, is the 3rd largest food manufacturer.¹⁹ Both ConAgra and Cargill are more similar to the large diversified food firms that once led the list of broiler companies. The other broiler companies differ by being more specialized in poultry and closely related products. Many of the 50 largest broiler companies still carry the family name of its founder: names like Tyson, Perdue, Pilgrim, Hudson, Townsends, Foster, and Zacky.

An additional feature of most of the broiler firms is regional specialization. Although both Tyson and ConAgra brands are nationally distributed, most of the top 50 broiler companies are far more regional in their sales area. For example, Perdue is heavily committed to the eastern seaboard and Foster Farms and Zacky are similarly committed to the west coast markets.

The further processed part of the poultry industry is more concentrated than the fresh broiler market, despite having a larger number of companies. Most of the leading 20 broiler slaughterers own further processing plants as well, but smaller companies do not.²⁰ The increase in the number of companies is from companies involved in further processing but do not operate slaughtering plants and thus buy dressed broilers from others. In 1988, data from Information Resources Inc., IRI, for the frozen poultry products (mainly frozen prepared poultry products, but not frozen whole turkeys), show Tyson Foods (including Holly Farms' market share) and ConAgra (including Beatrice's share) in a close race for number 1. On a dollar share measure Tyson/Holly is number 1 with a 38.9 percent share, but on a volume basis ConAgra/Beatrice is number 1 with a 34.2 share. The CR4 for this category that had sales of \$630 million in 1988 was 77 percent. In addition, product differentiation and marketing expertise become important to succeed in this market segment. It is in this

market, as opposed to broiler slaughtering, that Campbell Soup Company has a leadership position (third).

To close the section on concentration, we note the low but increasing concentration of broilers. Were it not for the recent mergers, the industry's concentration would rank among the lowest in the food manufacturing sector. These broiler processors sell, directly or indirectly, to an ever more professional and sophisticated retail sector that can place its own demands on the processors.

3.2 Vertical Integration

The most distinguishing feature about the broiler industry from most agricultural sectors is the degree of vertical integration the processors have achieved. The modern broiler firm is often referred to as an integrator rather than as a processor to underscore their involvement in the entire broiler subsector. Prior to the integrator the broiler subsector shown in Figure 3 was linked by a series of cash markets. Growers bought chicks from hatcheries, who bought their eggs from specialized breeder stock companies, and then sold the live birds to the processor. The stages were linked by markets, with demand and supply determining the price at each stage. The growers disliked the risk involved in the volatile market price for live broilers and others saw inefficiencies in markets providing the coordination function for the subsector. Firms began seeing opportunities in internalizing the market's coordination role through vertical coordination under a firm's management.

The feed companies, anxious to expand the market for their feeds, were the first to become involved in coordinating the broiler industry by supplying chicks to contract growers and eventually to arranging for the processing of the birds. Farmer-growers were eager to reduce the price risk that was inherent in broiler rearing and were receptive to the arrangements with feed companies that lowered their risk in exchange for more stable earnings. Further coordination efficiencies led feed companies into processing as well. Some feed companies reluctantly entered the grow-out stage when their affiliated farmers went under.

Over time most of the markets that linked the various stages of the broiler subsector were replaced by either internal firm transfers or by contracts. Processors seeking efficiencies and improved coordination took ownership control of almost all stages of the broiler subsector. They typically left the basic breeding of the parent stock to a few specialized firms, the most concentrated part of the subsector, but today most of the major companies have acquired this function as well. The integrators have basic breeding programs to produce the hatching eggs for their own hatcheries. The chicks are then delivered by the

integrator to growers who raise the birds, called grow-out, in housing designed to the specifications of the integrator. Over 90 percent of the grow-out farms operate under contract to the integrator with the remainder raised on company owned grow-out farms. Under the contract arrangement the integrator retains ownership of the birds, supplies the feed and medication, and provides supervisory field personnel. In return the grower is provided a payment for her or his managerial skills, labor costs, and investments in housing and equipment. The contract often has incentives to encourage quality broilers with minimal feed. The major integrators typically own their own feed mills to control and customize the feed to their needs. The birds reach market weight in 6 to 8 weeks and are loaded and transported by the integrator's employees. The timing of the next batch of chicks delivered to the grower is determined by the integrator.

The traditional function of the integrator's operation is the processing plant where the broilers are "dressed" for market. The waste products from processing are sent to a company-owned rendering plant and processed into by-products, including pet food and feeds. Additional further processing of the value-enhanced products is done in either company-owned plants or sold to processors who do not have their own slaughtering plants before moving into the marketing channels. Some of the low-valued products like necks and backs are processed into mechanically deboned poultry meat for chicken hotdogs and luncheon meats. Plants are typically specialized for a primary product form whether it be cut up, deboning, or preparing products for food-service companies.

3.3 Product Differentiation

The degree of product differentiation is another key element of market structure that shapes market conduct and performance. In the absence of product differentiation, consumers consider the products from competing sellers as perfect substitutes and thus make their purchases based on price comparisons. As the degree of product differentiation increases, consumers view the competitors' products as imperfect substitutes, with the distance between competing offerings increasing with the degree of product differentiation. Sales of the differentiated brand are less sensitive to price changes, which provides sellers with some discretion in pricing their products that would not exist if products were homogeneous.

Product differentiation has both a market structure and market conduct component. The degree of product differentiation in a market is a structural fact of the market, although its precise measurement is difficult. Sellers of undifferentiated products must accept this and

cannot extract price premiums from informed buyers. However, firms often pursue conduct strategies to create a degree of product differentiation.

Physical differences provide a basis for product differentiation, but product differentiation may also arise from subjective attributes. Broiler processors have created both real and subjective product differentiation. The real product differentiation efforts have included product quality, product form and the level of services provided the retailer. The latter is often called enterprise differentiation as opposed to product differentiation since its focus is the retail buyer rather than the final consumer. It was the first form of product differentiation in broilers as processors realized that consumers had difficulty distinguishing one brand of chicken from another. Processors knew the importance of the retail buyer and strived for favored status by making the retailer's job easier or less expensive. Holly Farms was the first processor to interest retailers in receiving tray packed chicken, the *Holly Pak*, ready for the meat case in the early 1970s.²¹ Although retail meat cutters and their unions disliked the loss of final preparation at the retail store, the tray pack method has become a standard practice. The processor-retailer relationship continued to shift services from the retailer to the processor. Today it is common for a processor to apply the retailer's own scanner pricing labels to its order before it leaves the processor's plant.

Chicken sold through food-service markets (e.g., restaurants, fast-food outlets, and institutions) accounted for 34 percent of broiler marketings in 1989. Product differentiation in this marketing channel is controlled by the food-service company since the consumer will not know the identity of the broiler processor and will associate the product with the food-service company. The actual chicken product may be differentiated itself or only through its association with the outlet. Clearly, Kentucky Fried Chicken and McDonald's McNuggets are differentiated products that have brand awareness, but the differentiation is not associated with the broiler supplier. The broiler processor achieves differentiation through services directed at the food-service company and can achieve a degree of enterprise differentiation by supplying a product that best meets the needs of the food-service company. Nevertheless, the product is being sold to professional buyers who will not pay price premiums that exceed the extra value they receive. In short, price will still be a critical factor in determining who supplies the account, but other services including reliability, the willingness to supply specific products, and the commitment to the account will be considered.

Physical differences can provide a method of differentiating a

product from the competition's offerings. In the fresh chicken market skin color has been used to differentiate chicken. Consumer preferences for different skin color vary by region with the South and West usually preferring a pale color and the Northeast a yellow color. Perdue Farms made the yellow color the first theme in its advertising campaign. It copied the idea from a Maine firm that fed its chickens marigold petals because the xanthophyll in the petals enhanced the skin's yellow color.²² Of course, others followed and some even tried to turn the theme against Perdue. Holly Farms suggested in its advertising that Perdue's color was unnatural and also complained to National Advertising Division of the Council of Better Business Bureaus that the Perdue ads were misleading consumers to associate skin color with quality.

Fat content replaced skin color as the next physical difference that firms used to differentiate their products—my chicken is leaner than your chicken. The leaner birds did receive a price premium as consumers responded to the healthful low-fat image. However, these physical differences could be matched by competitors and price always returned as central to buying decisions.

Physical differences are not necessary for product differentiation to exist. In many cases, product differentiation stems from intangible differences. Although these illusory and subjective differences can have many sources, most are created by firms' advertising efforts.²³ Images are much harder to imitate, or to counter successfully, than physical differences. Engineers, chemists and food scientists can usually duplicate actual differences but a successful image advantage is more difficult to offset. Even firms that have been successful with one campaign can find themselves unable to repeat their past success. It is becoming increasingly rare in the food system to find products with product differentiation that are not advertised heavily.

Subjective product differentiation is less likely to prove an advantage when selling to knowledgeable buyers, since they will be able to debunk any hype and base any price premiums on true quality/service factors. Thus, such efforts are not employed in the marketing channels that sell to professional buyers. However, the modern household is a busy place and no one person can be an expert on the some 60,000 items sold in a modern super-combo grocery store. It is in this marketing channel where subjective product differentiation usually created and maintained through advertising plays an important role.

This association between product differentiation and advertising allows researchers to use brand advertising expenditures as a proxy measure of the degree of product differentiation. Food products that do not lend themselves to product differentiation (such as fresh beef)

usually receive little if any brand advertising. They may receive industry-supported generic advertising aimed at increasing market demand and benefiting all sellers of the product but such industry-wide advertising campaigns have no effect on brand differentiation. Products that can be differentiated so that individual brands are not perfect substitutes usually receive moderate to heavy amounts of brand advertising depending on the degree of product differentiation. For example, soft drinks are highly differentiated and are heavily advertised. Thus, a researcher can array food products from undifferentiated to highly differentiated by using the advertising intensity associated with the products.

There are several reasons to expect less product differentiation in broilers than in many food industries. First, processors pay for USDA graders to grade their broilers and essentially only USDA Grade A are sold to consumers as fresh chicken. Although firms believe that quality variations still exist among Grade A birds, consumers have not shown strong preferences or even the ability to distinguish such differences. Most taste-tests, whether done using professional food critics or average consumers, have revealed little to no differences between brands of chicken.⁸ Second, although over 80 percent of broiler processors offer branded fresh chicken, over half of the fresh chicken sold does not carry the processor's, or even the distributor's, brand.²⁴ Most every retail store offers both processor branded chicken and its own store label, called private label, chicken. The store label is either the grocery chain's name or another name that is exclusive to the chain's stores. These store-brand labels emphasize price competition rather than product differentiation claims.

In addition to government grading and retail private labels, a substantial amount of chicken is eaten away from home in restaurants and fast-food outlets where the consumer does not know the brand's identity. Thus, unlike soft drinks where the consumer knows the brand served by the food-service establishment,^c the brand awareness of chicken is de-emphasized by the food-service segment of the market. Lastly, the large number of chicken processors and the relatively low market concentration should make price competition the primary competitive tool.

⁸More information on taste-tests is presented in the performance section of this chapter.

^cIn fact, Coca Cola Company has often sued restaurants for serving a customer another brand of cola when the customer ordered a Coke, regardless whether the customer cares.

Despite these reasons to expect less product differentiation in broilers than in much of the food industry, the industry has reached a degree of success in its efforts at brand marketing and product differentiation. During the 1950s and 60s, the attempts were made by the large food manufacturers who were in the broiler business. Ralston Purina, Swift, and Armour advertised branded chicken during this period, but the expenditures were quite minor; less than 0.1 percent of total broiler sales were spent on major media advertising.^d During this period, turkeys were more intensely advertised primarily because they were mainly sold frozen which provided a branded package and a longer shelf life. Campbell Soup advertised its frozen Swanson Fried Chicken and other frozen chicken dinners, including the traditional chicken pot pie, but these were all further processed products.

It was during the 1970s when serious efforts began at using advertising to create and maintain product differentiation for broilers. Although the discussion of advertising strategies will be delayed until the conduct section of this chapter, Frank Perdue of Perdue Farms is often credited with starting the use of advertising to create product differentiation.²⁵ In 1972, major media brand advertising for broilers was less than a million dollars with Perdue Farms accounting for over 40 percent of the total. In the same year, branded turkey advertising amounted to nearly two million dollars for an industry one-fourth the size of the broiler industry. By 1975 the broiler industry was outspending the turkey industry in absolute dollars and by an increasing margin in each successive year. By 1990 the industry was spending over 30 million dollars on fresh broilers and Perdue Farms was still the largest advertiser with a 41.6 percent share of the total expenditures.

The more a product is processed the greater the likelihood for product differentiation. Further processed poultry is more differentiated than fresh broilers for several reasons. Processed poultry has a longer shelf life either from adding preservatives, freezing, or better packaging. Further processed poultry usually carries a processor's brand name and is packaged, providing a way to distinguish it from the competition's offerings. In addition, much of the processing is aimed at creating differences. Much of the motivation of new product development is to pioneer the next new market segment

^dMajor media advertising is consumer oriented and is the main instrument for creating and maintaining product differentiation in food products. By 1989 it included advertising expenditures in network, spot, syndicated, and cable television, consumer magazines, some newspapers, and outdoor billboards. It excludes advertising expenditures directed at trade buyers. For more details see Connor et al., *The Food Manufacturing Industries*, pp. 80-90.

and firms invest heavily in new product development and product differentiation.

The traditional processed products were modernized from the canned and frozen fried chicken of the 1960s to frozen nuggets, breaded microwaveable chicken sandwiches, marinated chicken, fully cooked breaded formed chicken patties as well as other convenient products. These more processed poultry products began attracting larger advertising expenditures. In 1972, they amounted to a million dollars in major media advertising, but that figure grew to \$52 million by 1987.

Although brand advertising expenditures grew from an insignificant amount in the 1960s to 30 million dollars for fresh broilers and nearly 100 million dollars for the broader poultry industry definition that includes turkey and further processed products, the totals are low relative to sales and to other food industries. Even by 1975 the broiler industry's advertising-to-sales ratio, A/S, was only 0.1 percent in major media advertising. This ratio increased to 0.3 percent in the late 1980s. The A/S for the smaller turkey industry was slightly higher at 0.7 percent in 1989 after being near 0.3 percent for most of the 1970s and 1980s. As expected, the largest A/S was in the further processed poultry market where the A/S increased from 0.3 percent in 1972 to 1.4 percent in 1987 and then fell back to 0.7 percent in 1989 as frozen dinners became a larger recipient of some of the advertising dollars from poultry firms.

These low A/S ratios reflect low levels of product differentiation in broilers. The fresh broilers A/S ratio of 0.3 percent compares to the average for all food and tobacco industries of 2.0 percent. Although much less than the average, the broiler industry has achieved a degree of product differentiation that is higher than in most commodity food industries. For example, brand marketing is quite rare in the fresh beef and pork industries where USDA grades (e.g., USDA Choice) and the retail store's reputation for meats are the crucial factors influencing consumers. Both their A/S ratios round to 0.0 percent. Even in the canned tuna industry where brands have a long history, advertising created product differentiation has diminished over time and marketing has a more commodity orientation as private label tuna now outsells the leading brands.

Despite the modest accomplishment in creating some product differentiation, the broiler industry remains near the bottom of the food industries in advertising created and maintained product differentiation. The industry pales in comparison to those food industries known for high degrees of product differentiation. Food industries with the highest measured media A/S ratios include: chewing gum (18%),

breakfast cereals (13%), chocolate candy (11%), and instant coffee (7%).

3.4 Conditions of Entry (and Exit)

Thus far we have discussed three major elements of market structure, but now we turn to a market's entry conditions—the most important element of market structure but also the most difficult to measure. Entry conditions are usually referred to as barriers to entry and include anything that provides established sellers an advantage over potential entrants.²⁶ Barriers to exit, which also affect entry conditions, depend mainly on the extent to which fixed costs are sunk costs.

The impressive growth of the broiler industry has made both entry and exit easier than in much of the food manufacturing sector. Exit decisions need not take place at depressed prices in a growing market whereas in a declining market few buyers are attracted until the asking price is reduced significantly. Even though the number of firms has continually fallen since the record high in 1954, entry barriers remain low in broiler processing and new firms have entered the market.

The relationship between average cost of production and firm output size is captured by the economist's long-run average cost curve. Such cost curves contain vital information about the production process and the likely competitive outcome. Much attention is focused on the minimum output level that minimizes a firm's average cost. This output size is called the minimum efficient size, MES, and is often presented as a percent of the total market size. Unfortunately, it is no easy task to determine an industry's MES.

Such is the case with broilers, although some information is available. A 1964 study showed processing costs decreased continually with output size over a relevant range but after 10 million birds per year the decrease was small.²⁷ Marion and Arthur conclude from the study that an output of 10 million birds per year, representing 0.33 percent of 1969 broiler production, captured most of the efficiencies.²⁸ A more recent study was done by a Michigan State University research team to determine the feasibility of an integrated broiler operation in Michigan.²⁹ Engineers determined that a technically efficient and cost-effective processing plant should process 8,400 birds per hour. Expanding this processing rate to an annual production volume results in an estimated MES value of 0.4 percent.

A totally different method using Census plant data finds similar results.³⁰ This Census-data approach estimates the MES value by the percent of total sales made by a plant of median size and has proven itself a reliable proxy.³¹ The Census data MES estimate for the

poultry industry in 1987 is 0.42 percent of total sales. These different methods of estimating MES yield similar results and suggest that the MES in broilers does not represent a substantial barrier to entry. Using an MES estimate of 0.4 percent of output would allow for 250 efficiently sized plants.

The above MES calculations are for a plant and not a firm. Less is known about estimating multiplant economies of scale. The 1982 Michigan State study used only one processing plant for their cost-effective integrated broiler complex. Although the majority of the 50 largest broiler companies operated just one slaughtering plant in 1990, the leading firms are multiplant firms.³² Tyson operated 30 slaughtering plants, the most of any firm. For the top 10 firms, the number of slaughtering plants varied from 3 to Tyson's 30, with most having between 4 and 7. Although leading firms are not necessarily the low-cost producers in an industry, it suggests that efficient firms typically operate multiple plants. If one assumes that an efficient firm needs 2 to 4 plants that operate at the MES value of 0.4 percent, then the broiler industry has room for 60 to 125 efficiently sized firms. Such a range estimate does bracket the current number of significant broiler companies and further suggests that barriers to entry are low in the broiler industry. Even though entry barriers are low, any entry into the broiler industry would still likely include acquisitions of existing firms to gain managerial talent and information.

4. Market Conduct

Managers choose strategies based on their assessment of the market's basic conditions and structure. Firms in classic competitive markets offer managers little choice in matters regarding pricing and promotion. Managers of firms in oligopolistic markets face many more strategic decisions. All strategies must be selected with an eye on the competition since the interdependence of firms in oligopolistic markets makes each firm watchful of its rivals' actions. However, managements differ in their assessment of their market situation and some will choose strategies that seem incorrect to others given the current setting, but in time they may be viewed as brilliant moves that eventually altered the givens of the market.

Our discussion of the broiler industry's market structure found low, but increasing, concentration, low product differentiation with relatively low entry barriers. Such a structure predicts firms will display competitive conduct strategies. Greater concentration, product differentiation and growth were found in the more value-enhanced

products and hence we expect greater use of advertising strategies for these products.

There are submarkets within the broiler industry called strategic groups. These groups are characterized along two major dimensions: the marketing channel used and the extent of value-added processing involved. The two principal marketing channels for chicken are food-service and retail food stores. The extent of value-added processing varies from unbranded fresh whole chickens to the branded, value-enhanced products like breaded nuggets and marinated prime parts. Firms within a strategic group share similarities with each other and differ in important respects with nonmembers. Different strengths are needed to succeed in a particular strategic group. The theory of strategic groups contends that firms strive to drive other firms out of their strategic territory and to create mobility barriers to limit other firms from entering their group. Spence contends that "most strategic investments are entry- or expansion-detering".³³ When strategic groups with high mobility barriers exist within an industry, then industry structure may prove misleading. As Porter states: "An industry need not be concentrated overall for a particular strategic group to have enormous market power."³⁴

These two dimensions—the extent of processing and the marketing channel used—determine which strategic group a firm belongs to. Of course, some broiler processors, and all of the larger ones, operate in more than one strategic group. In fact, the firm's decision on which strategic group to emphasize is itself a strategic choice. Since the market conditions and structural characteristics differ somewhat between the market segments, we expect to find different firm strategies being used.

4.1 Product Strategy

A firm's product strategy depends on the strategic group it operates in. The most competitive strategic group supplies further processors with basic dressed broilers and parts as inputs into their finished products. The characteristics of this strategic group are standardized quality, bulk shipments, no branding, less marketing emphasis, and selling to informed professional buyers. Price and service are critical for success in this strategic group and this places efficient and low-cost operations at an advantage.

Marketing to food-service companies, especially the major chains, requires a commitment to meet their needs with dependable service. Some restaurants continue to buy whole broilers and do their own preparation in the restaurant, but the trend is to shift more of this

preparation back to the processor, especially for the fast-food companies. This reduces labor costs and helps standardize the product—a repeat of the evolution that first took place in the retail food store's meat department. The food-service companies that sell a bone-in product prefer smaller broilers while growers and processors prefer larger, more meaty birds requiring companies like KFC, Churches, and Popeyes to contract directly with a processor for smaller birds suited to their needs. Other fast food outlets that sell boneless products use meat from deboning plants. Suppliers to food-service companies must be price competitive since the professional buyers are fully aware of prices and qualities that exist in the marketplace. The processors that market to the fast-food sector often use the export market to help balance the excess chicken parts, usually legs and leg quarters.

Processors who supply food stores with unbranded or store-label chicken operate in a strategic group much like those who serve food-service companies. Their emphasis must be on price and service to the retail buyer. Processors who offer a line of branded chicken form a more marketing-oriented strategic group where although price and service are critical other non-price forms of competition become important—new product introductions, advertising support and product differentiation.

The other dimension of product strategy is the degree of value-added processing to offer. As consumers get busier and less knowledgeable about food preparation, processors have stepped forward with complete "meal kits." Traditional food processors and retail food stores have lost food business to food-service outlets and chicken products are no exception. To stem the tide many convenient forms of chicken food are now sold in retail stores. These products offer processors the greatest product differentiation potential and, hence, advertising support is expected. Although the store's retail buyer is an informed professional, the final consumer is less knowledgeable than in years past. Price is not the key consideration, but convenience, taste, and health motivate these purchases.

The more value-enhanced products are the fastest growing part of the business and offer more stable earnings since they are less influenced by the whole bird price fluctuations. New product introductions involving chicken continue to grow. The traditional chicken pot pie now competes with numerous frozen, microwaveable products. Processors now offer marinated fully cooked chicken wings, precooked chicken patties, nuggets, fillets, tenders, fried chicken, and all of them can be breaded or unbreaded. The traditional luncheon meats and hot dog products have their chicken-based equivalent versions. Marinated chicken finger foods are offered in several spices

and ground chicken now competes against hamburger. Premium frozen dinners also represent a major product category for processors.

A couple of niche markets in the traditional fresh chicken section of the grocer's meat case are of interest. First, kosher chicken, which has a longer history than conventional chicken, has gained wider consumer interest because of concern caused by factory-farming techniques. The kosher process, where Jewish dietary law controls the methods, is slower than conventional practices and is meant to be more humane. Kosher chicken does cost more than conventional chicken. Empire Kosher Poultry has been selling and advertising kosher chicken at least since the 1960s and now offers value-enhanced products as well as fresh chicken and parts.

The second niche is a new attempt to benefit from consumer concerns over modern factory-farming methods. These firms claim a return to a more natural growing environment where the chickens are given fewer, if any, antibiotics or growth hormones. At present the effort seems more marketing hype than true reversion to barnyard farming. But these free-range chickens have their supporters, including customers willing to pay \$75 for a dinner of grilled free-range chicken.³⁵ Sunny Southern California is a perfect setting for one such venture; "Rocky the Range Chicken." Rocky's tag shows a macho chicken wearing a cowboy hat, boots with spurs, and toting a gun. A reporter, however, found that Rocky's day is "not exactly a blaze of activity. . . . It's eat, drink, and sit down."³⁶

Despite the tranquil image, the chickens get two square feet of space, about twice the conventional practice.

4.2 Firm Strategies

Don Tyson of Tyson Foods succinctly puts his company's strategy as, "Segmentation, concentration, and domination."³⁷

Tyson's struggle to outbid ConAgra for Holly Farms in 1989 demonstrated its resolve to that strategy. Holly's brands were leaders in the fresh broiler market whereas Tyson's brands were leaders in food-service and in precooked and frozen value-added chicken products. The acquired leadership position is the fresh market enhances its image in its value-enhanced products. The combined firm is evenly split between food-service sales and retail grocery sales.

Tyson entered the red meat business when it acquired Holly Farms and plans to expand its beef and pork business. It provides its food-service customers a full meat line and Tyson sees additional opportunities in the red meat industries, especially if the marketing techniques learned in broilers are applied to red meat. Don Tyson has

stated, "We want to control the center of the plate for the American people."³⁸

ConAgra is the second largest broiler processor but a much larger overall company than Tyson. ConAgra was a major player in the restructuring of the beef industry during the 1980s.³⁹ It acquired its first beef plant in 1983 from Armour Food Company. By 1988 it was the second largest beef packer with a 21.1 percent of industry capacity. Had ConAgra won the merger battle for Holly Farms, it would have been the number one broiler processor. ConAgra became the largest turkey processor by acquiring Beatrice's Swift turkey operations in 1990. It also has pork and lamb processing plants, and has seafood and catfish operations. Its meat products span from fresh cuts to highly processed prepared meats (e.g., bacon, ham, hot dogs, lunch meat, and surimi). Its non-meat food brands include: LaChoy, Hunts, Orville Redenbacher, Peter Pan, and Wesson. It is easily the most diversified of the broiler companies with its family of companies ranging from agricultural chemicals to financial services to specialty retail stores.

ConAgra, like Tyson Foods, is heavily committed to the more processed, value-added meat products. In broilers it has the complete line of fresh cuts that sell under the Country Pride label, but it has aggressively pursued prepared foods that emphasize convenience, taste and health. It is a major player in frozen dinners with its Healthy Choice, Banquet, Chun King, Amour Classics, Morton, Patio, ZAP, and Kid Cuisine labels—numbering over 350 branded products in total. According to its annual report, "Consumers buy more than 30 individual ConAgra Frozen Foods products per second—24 hours a day, 365 days a year."⁴⁰

Gold Kist is an agricultural cooperative that operates businesses that support farmers, primarily fertilizer and feeds on the farm input side. On the output side it markets poultry products through its subsidiary, Golden Poultry Company, under the Young'n Tender brand name. Golden Poultry also supplies private label chicken to retail stores, a practice known as dual branding. Although they market a full line of fresh chicken products, they have not expanded into prepared and precooked, value-added products that characterize both Tyson's and ConAgra's broiler operations.

Perdue Farms is a privately held company that has remained specialized in poultry. It started as an egg company, expanded into broilers in 1968 and acquired a turkey operation in 1984. It was the first company to adopt the mass-media marketing practices used for branded, heavily differentiated products for fresh chicken. Perdue has been a major innovator in new product development with its line of "Perdue Done It." These are prepared, precooked breaded chicken

products—nuggets, tenders, patties, cutlets, and spicy wings. They were also one of the first companies to offer ground chicken and turkey.

Of the four leading broiler companies, ConAgra has the most strategies available to it due to its diversification and the number of leading positions it holds in major markets. It openly states that it is looking for more acquisitions with CEO Harper saying, "That is part of our strategy to establish leading positions across the food chain."⁴¹ It can shift resources from stable, profitable operations to bolster other operations. Competitors fear such powerful firms mainly due to their deep pockets. In addition, retailers may be influenced by the size and market presence of such a large diversified food firm and yield concessions unavailable to specialized firms.

On the other hand, specialized firms can be tenacious competitors willing to make huge sacrifices to survive. Private family-controlled operations can be more committed to the business than to earning the largest return possible on their investments. Agricultural cooperatives involved in the processing and marketing of their farmer-member agricultural outputs make decisions about the processing stage based largely on farming considerations. The largest broiler companies of the 1950s and 1960s were among the largest food marketers, but they exited seeking better returns and have been replaced by smaller more specialized firms—like Tyson Foods and Perdue Farms. ConAgra is the exception, but many of the commodity industries have concentrated⁴² and ConAgra has pushed its commodity businesses toward the more value-enhanced products rather than remain primarily with the commodity products. Both Tyson and Perdue, but especially Tyson, have reduced their dependence on fresh chicken since it is the "least profitable, most volatile side of the poultry business."⁴³

4.3 Advertising

Since broilers have little product differentiation and market concentration is low, advertising expenditures should be relatively low as well. Although some very modest advertising for broilers existed before the 1970s, it really began after 1970 when Perdue Farms began advertising and its major competitor, Holly Farms, retaliated with counter advertising. Since 1972 Perdue Farms has either been the advertising leader in broilers or placed second to Holly Farms (or Tyson Foods since the merger). This was still true in 1989, with Perdue Farms the leading major media advertiser with a 28.4 percent share, Tyson Foods was second with a 24.0 percent share, and ConAgra third with 21.3 percent (Table 4). These three firms dominate broiler advertising, dramatically more so than they do

production. Gold Kist, the agricultural cooperative, was the third largest broiler processor yet ranked a distant 5th in advertising share with only a 4.1 percent share of the advertising. The four largest advertisers account for nearly 84 percent of broiler major media advertising in 1989. The top two, Perdue and Tyson, have accounted for over 50 percent in every year except in 1981 when they slipped to 48 percent.

The advertising rivalry between Perdue and Holly Farms caught the imagination of several writers as they depicted the chicken ad wars in wonderfully written essays.⁴⁴ Such interest needs to be placed in perspective though. The interest in the advertising was not because of its massive dollar expenditures but because it was rare for such a commodity product to be pitched as if it were a soft drink. Also, the ads themselves were clever and quite successful in garnering attention in a cluttered advertising market. Frank Perdue was a hit as he starred in his own commercials, such as the "It takes a tough man to make a tender chicken."⁴⁵ His advertising agency convinced him to be the company spokesperson stating: "This was advertising in which Perdue had a personality that lent credibility to the product. If Frank Perdue didn't look and sound like a chicken, he wouldn't be in the commercials."⁴⁶

Although the advertising generated interest in the media and was larger than previous expenditures for fresh broilers, it was still relatively minor compared to most food products. In 1987, over 20 broiler processors advertised their fresh chickens in the major media covered by Leading National Advertisers, Inc., LNA. Their combined expenditures reached \$21 million, a record to that date, but PepsiCo's Kentucky Fried Chicken chain spent \$109 million, over five times that spent by all the broiler companies combined. Philip Morris Companies spent \$171 million advertising just its beers, mainly Miller, in the same major media in 1987. Thus, although much has been written about the advertising of broilers, it is still a minor player in advertised marketing.

The 1990 major media advertising by the four largest broiler companies supports underlying company strategies. Perdue Farms spent \$13.5 million with all of it allocated to the poultry industry. Most, 95 percent, was spent advertising fresh broilers and the remainder was about evenly split between advertising turkeys and further processed poultry. Gold Kist only spent \$1.5 million with all of it spent on advertising its Young and Tender brand of chicken. Although Perdue remained the leader in broiler advertising, it was dramatically outspent by both ConAgra and Tyson Foods in total firm advertising. ConAgra spent \$110 million across its growing product line and nearly \$7 million, or 6 percent, on its broilers, which moved it past Tyson

and into second place for the first time behind Perdue in broiler advertising. However, its major expenditure, \$30.6 million or 28 percent of its total advertising, was in support of its frozen dinners, especially Healthy Choice. Tyson Foods spent a total of \$25 million, with 13 percent on broilers, 54 percent on further processed, value-enhanced chicken products, 26 percent on its Looney Tunes and other frozen dinners, and the remaining 7 percent on its non-poultry related foods.

Over 80 percent of the 48 broiler firms responding to a 1989 industry survey by the National Broiler Council claim to have a branding program in place, but only 37 percent of broiler volume is marketed with the processor's brand name on it, which is the minimal condition for potential advertising support paid for by the processor. In 1990, 18 broiler processors, roughly one-third of the total number, advertised their fresh chicken in the major media, but the three largest advertisers did nearly 75 percent of the total. Two of these three were Perdue and Tyson Foods who have been locked in an advertising rivalry since the early 1970s. But despite this long rivalry and the addition of ConAgra to the marketing fray, advertising created and maintained product differentiation is very low in broilers. It exists to a greater extent in the more value-enhanced products.

4.4 Pricing

Markets generate prices through the unbiased interplay of supply and demand. The resulting price is the best indication of the product's economic value. But not all transactions take place in public markets where the resulting price is public knowledge. Price discovery, knowing the true economic value of a product, is difficult without open markets with many buyers and sellers. With the widespread practice of vertical integration in the broiler industry, a market price does not surface until the processor-retailer (or distributor) exchange. It is at this stage that basic supply and demand conditions finally generate an economic price. Prices are negotiated daily for ice-packed, ready-to-cook, whole broilers by processors and major retail buyers. This price generates an important base price which is widely reported through the 12-city price reports of the USDA and the "Georgia Dock" price released weekly by the Georgia Department of Agriculture. Prices of processor tray-packed products, including cut-up broilers and the various chicken parts (e.g., breasts, thighs, legs, and wings), are often tied to this base whole-bird price by a formula. The prepacked form of marketing has grown in volume share over time, but it is estimated that negotiated trades account for about half of broiler volume.

Although there is some concern about the heavy use of formula pricing in the industry, the USDA 12-city broiler price has wide acceptance as an accurate reflection of broiler values. In 1991 the Chicago Mercantile Exchange started trading a broiler chicken futures contract tied to the USDA price. Although a full discussion of the futures market is beyond our purpose, the futures contracts allow those seeking to avoid the price risk associated with volatile markets, called hedgers in the jargon of futures, to transfer the chance to profit from the price volatility to speculators in exchange for a locked-in price. Thus, the speculators hope to profit from the price volatility that the hedgers seek to avoid. Firms involved in chicken processing and selling, both retail stores and food service outlets, are the likely hedgers. The speculators are from all walks of life and thrive on the risks involved in futures trading. Broiler prices are volatile and the new contracts provide a new method for managing risk.

The price reporting to the broiler industry provides a good evaluation of the price of the basic broiler commodity—the ice-packed whole bird. As the products become more processed, the price information weakens. Although there are useful formulas to evaluate the relative value of the major chicken parts (e.g., breasts and legs), as further processing is added (e.g., breaded nuggets and patties), market prices become less available. Many food-service firms have entered contract arrangements with processors or distributors and the terms of the contracts are not disclosed, although some are known to be cost-plus formulas. Most food-service firms want stable menu prices and, hence, the price volatility of the broiler market is a management problem that long-run contracts with processors help avoid. The new futures market should also interest such firms.

The final price consumers face varies considerably by both product form and marketing channel. Those firms in the producer goods strategic group that supply whole birds to further processors have little pricing discretion and are tied to the commodity prices. Since they sell a standardized product (e.g., Grade A whole birds) to informed, professional buyers, these firms make money by emphasizing cost efficiency and managerial skill in dealing with price risk.

Those firms in the strategic group of firms that supply food-service accounts must be price competitive but also need to meet tightly specified quality requirements, provide reliable service and often show a willingness to tailor products to meet the needs of the buyer. Brands are not important, but the reputation of the firm in meeting the needs of the food-service buyer is critical. The food-service buyers are

professionals who have an excellent knowledge of the industry and follow the commodity prices.

The firms that supply an unbranded or store labeled product to the retail food stores operate in a similar manner to those that supply the food-service accounts. Price and service are the critical factors that determine success in this strategic group. Firms that supply a consumer branded product to the retail food stores that has some national or regional product differentiation are able to earn a price premium over the commodity prices—ranging from 5 to 15 cents per pound for the basic broiler and standard tray packs. Such firms still emphasize service to the retailer since, unlike the Perdue brand, most do not have sufficient product differentiation that a retailer fears losing the brand. Nevertheless, success in this strategic group goes beyond price competitiveness to include such things as advertising support, new product development, and the ability to increase their presence in the meat case.

Chicken prices in a retail food store vary dramatically with product form. It is not unusual for unbranded or store-label leg quarters to sell at prices as low as 49 cents per pound, lower than the price per pound of the whole bird. Breasts are sold in many forms—whole breasts, split breasts, with and without ribs, boneless and skinless—and carry the highest price of the chicken parts. Breaded chicken breast products and marinated chicken breasts carry the highest price per pound—exceeding \$6.00 per pound for some marinated, skinned, boneless breasts. Such prices begin to rival premium steak prices. The popularity of breast meat has created a supply problem since each whole chicken has a fixed number of parts—a fixed proportions production function. Genetics has produced broilers that have more breast meat, but it remains a marketing challenge to move the nonbreast products. The industry has responded with numerous products that have proved popular. Marinated chicken wings, deboned thigh strips, and ground chicken have become important outlets. In addition, the export market has provided a valuable lesson in understanding, and profiting, from diversity of consumer preferences. Not everyone prefers white meat. The Mexicans and the Russians have become major importers of U.S. chicken, especially important since they predominately buy the dark meat parts.

In summary, pricing is very competitive in the broiler industry especially in the primary forms. The more value-enhanced products that have achieved some product differentiation have reduced the price sensitivity for their products and are able to compete somewhat on nonprice terms.

5. Performance

Just as people in business look to the bottom line to evaluate firm performance, industrial organization economists look to market performance to evaluate how well a market has accomplished its task of coordinating society's resources to meet consumer demands. Our models predict that market performance is determined by the market's basic conditions, structure, and conduct, but confirmation of such predictions requires empirical assessment. The broiler industry does not disappoint a theorist's expectations as its performance is consistent with its competitive structure of low concentration, low product differentiation, vertically integrated firms and low barriers to entry.

Economists want market prices to reflect costs of production in the long run, whereas those involved in business could imagine no finer world than one where prices exceed costs forever. Profits, and how industries react to profits, are central to the proper functioning of a capitalistic system. When prices exceed costs, the industry is profitable and more resources should flow into the production of the good or service—by existing firms or new entrants. When the opposite happens, resources should flow out until only normal profits are available. It is this market adjustment mechanism that is the marvel of the free enterprise system. The system fails only when such market problems as excessive firm market power, barriers to entry, and governmental restrictive policies interfere with the corrective mechanism. Profit is the key driving force in this self-adjusting mechanism that aligns society's marginal benefits with the societal marginal cost of supplying the product.

5.1 Allocative Efficiency

Economists refer to this process of allowing supply and demand to determine the market's price and output level as allocative efficiency. The key empirical check on a market's allocative efficiency is to examine the industry's response to profits. When profits are above normal in a period, expansion is expected in the following period. When profits are below normal, contraction is expected. The broiler industry is a textbook model of allocative efficiency, although expansion is usually quicker than contraction. In general, the industry has experienced continual demand growth which puts upward pressure on broiler prices. This encouraging demand situation and the resulting attractive prices bolster firm confidence to increase production which, when combined with cost reducing technology, expands supply and lowers the real price to consumers. Over time this process has repeated itself many times resulting in the relationship traced out in

Figure 1. However, the process is much more volatile than Figure 1 suggests.

Like most agricultural industries with a perishable commodity, the industry is somewhat cyclical, some analysts see a three-year chicken cycle. Firms within the industry respond to changes in supply and demand conditions which can vary greatly. Given broilers short production cycle, firms can change their output levels in three to nine months based on their reading of the market forces. The most significant demand changes emerge with changes in the supply and pricing of substitutes, with changes in export markets, and general economic conditions. On the supply side the changes are usually even more dramatic and unexpected. Weather and disease are the chief supply uncertainties since the weather affects both the cost of feed and the success of the grow-out stage of production which is affected by disease outbreaks. When favorable cost conditions prevail, usually low feed costs, the industry is usually profitable. Although economists delight in markets that adjust to the interplay of supply and demand, the resulting price can swing erratically. Even a forecasted snowstorm to hit major cities will move prices upward temporarily as buyers increase order sizes in preparation of consumers stocking up.

Broiler price volatility is a problem for management planning. All else equal, stable prices are preferred to volatile prices in a market by both business managers and consumers. Volatile prices, however, are often a signal of a competitive market which most economists prefer to price stability that is the outcome of supply management by firms with market power. In times of slack demand, such firms idle resources (e.g., lay off workers at a plant), reducing supply and offsetting the downward pressure on prices. No firms in the broiler industry possess such market power and, thus, prices fall as well as rise based on the unimpeded interaction of supply and demand.

Vertical integration improved the vertical coordination of broiler production but did not affect horizontal coordination. Firms take individual actions rather than collective actions. The usual outcome is that the sum total of each firm's production increase exceeds the industry expansion consistent with stable prices; thus, price falls and most in the industry suffer poor returns until demand catches up and prices recover. The industry trade associations often appeal to their members to hold the line on expansionary decisions warning that the collective outcome will hurt all, but there is a sufficiently large number of broiler firms that mistrust of others and self-interest prevent the advice from the association from being heeded. Consumers are the beneficiaries.

5.2 Technical Efficiency

Under competitive pressure, firms must adopt low cost technologies to remain in business and invest in finding still better methods. The broiler industry has done an enviable job. The public sector, mainly the USDA, the departments of poultry science at the land-grant universities around the country and the Cooperative Extension Service, has assisted in providing the industry research-based information and improved scientific methods. But it has been the private firms in the industry that made rapid use of such improvements and invested their own resources in further research and development.

The broiler industry has a remarkable record in reducing the real costs of producing a pound of broiler meat through the discovery, implementation and diffusion of improved technology and management. Advances in genetics, health care, nutrition, housing, processing and distribution have combined to give the U.S. processor the lowest production costs in the world.⁴⁷ Only Thailand and Australia compete with such low costs. The vertically integrated firms allow management to coordinate the stages of production and to respond more quickly to needed changes.

The industry's feed conversion rate, a measure of productivity, has declined from over 3 pounds of feed to produce a pound of liveweight in the 1940s to slightly under 2 pounds today. The number of days required for a bird to reach market weight has declined from over 70 days in 1955 to under 50 days today, and the average market weight of a broiler has increased from 3.1 pounds to 4.4 pounds in the process. The marketing efficiency of the broiler industry is also impressive. The selling expenses are low, especially for broilers, but even in the more value-enhanced, further processed products the selling expenses are less than the average among food industries.

The overall summary of allocative and technical efficiency is that prices should reflect costs. One measure of market performance uses the theoretical result that market price should equal marginal cost in a competitive market after all market adjustments have played themselves out. The relationship between price (P) and marginal cost (C) is captured in the price-cost margin (PCM), known as the Lerner index: $(P - C)/P$. The PCM is positive when price exceeds marginal cost and should trigger expansionary corrective action in the market until the ratio is zero. Although this is a theoretical index, it has an empirical proxy calculated from Census data as follows:

$$(VS - PR - CM) / VS,$$

where VS is value-of-shipments, PR is total payroll, and CM is the cost of materials. The Census PCM ignores several costs including taxes,

corporate overhead, advertising and marketing, research, and interest. Unlike the theoretical index, this PCM will not equal zero in competitive equilibrium but it does provide a useful benchmark to check how prices compare to costs and to compare industries.

Broiler processing has one of the lowest PCMs in the food system. In 1987, the latest year data are available, it was 11.7 percent for broilers. The weighted average for the 150 food and tobacco product classes where data were available was 28.5 percent. In the more concentrated, differentiated food industries it was much higher—65.4 percent for breakfast cereals, 56.7 percent for chewing gum and 43.7 percent for beer, for example.

5.3 Product Variety

The broiler industry has shown remarkable technical efficiency in finding and adopting cost-reducing technology. In addition, the industry has continually increased product variety as it responds to consumer demand for convenient food products and seeks profitable new outlets for broilers. The ways a consumer can buy chicken today is overwhelming—seldom do we buy the whole bird anymore but we select our favorite parts, perhaps even precooked. The demand for parts allows processors to charge more for the high value cuts and less for the other parts not in high demand. These preferences are related to consumer income and those consumers willing and able to pay premiums for breasts help reduce the price of leg quarters.

The demand for convenience foods also benefits processors by allowing them to move more production into the value-enhanced products that are less influenced by price fluctuations and have provided better profits. This change should continue and holds both good and bad news for consumers. As the product form becomes more value-enhanced, product differentiation becomes more pronounced and market performance could suffer in the future. At present, the consumer is willing to pay for the added benefits of convenience and the excitement of new products. To date, the industry has been very responsive to both the retail buyers' needs and to consumer demand.

5.4 Product Quality

Marketing a perishable food product is not easy, especially fresh meat products. A fresh broiler's shelf life is 10 to 15 days from the time it leaves the processor's plant until it reaches the consumer's plate. Most chicken in the grocers' meat cases is USDA Grade A which helps to standardize quality. Lower grade chickens are wholesome but are usually further processed into pot pies, soups and similar products.

Companies have emphasized brands more than the USDA Grade A, as they attempt to create product differentiation.

Consumers have difficulty evaluating food quality and taste can be a highly subjective process. In many households today no one is trained in food selection, handling, and preparation and thus consumers often rely on informal cues that may or may not have any merit. The color of the broiler's skin is not a useful guide to product quality yet many consumers continue to base preferences on the chicken's skin color.

Most of the taste-test studies done on fresh broilers conducted by trained experts conclude that quality differences are minor and exist even within the same brand. *Consumer Reports* concluded their article on fresh chicken by noting that all of the sampled chickens were reasonably tender and the differences in flavor were small.⁴⁸ Brand names did no better in terms of taste or consistency. They suggested consumers should check for product freshness by examining the sell-by date and then shop by price, choosing the plumpest pieces for a given price.

Blind taste-tests often produce humorous results. A *Wall Street Journal* reporter found four of six dinner guests preferred ordinary chicken to the pricey "Rocky the Range Chicken" with one guest claiming the one she mistakenly thought was Rocky tasted "... like a bird that flies around. It tastes happier."⁴⁹ Even the well-known chef of Los Angeles' Spago restaurant, Wolfgang Puck, who serves grilled Rocky at premium prices, preferred ordinary chicken over Rocky in a blind taste-test done in his restaurant. His response to the taste-test was, "I definitely think we should find out why they charge so much money."⁵⁰

5.5 Food Wholesomeness and Safety

The red meat industry has had continuous, mandatory Federal inspection since 1907, when Congress passed the Meat Inspection Act after consumer uproar following the publishing of Upton Sinclair's novel, *The Jungle*, depicting the horrors of Chicago's meat packing plants. Poultry was excluded from the Act because it was a minor industry then. In the 1920s voluntary poultry inspections began, largely triggered by a poultry plague that swept through New York City, poultry's leading distribution center at the time. In 1957, the Poultry Products Inspection Act brought similar mandatory inspection to the poultry industry for products to be sold interstate. The 1968 Wholesome Poultry Products Act expanded inspection to products marketed within a state's borders. Today there are over 7,000 Federal

inspectors monitoring the wholesomeness of our meat supply and the service is paid for by the U.S. Government.

The original meat inspection system was designed to detect diseases and infections since acute infections, often traced to animal products, were the leading cause of human death.⁵¹ The resulting system relied on sight, touch and smell checks performed by trained Federal inspectors on every bird. Under the system, the inspector checks for abnormalities (e.g., broken bones, inflammations, tears, feces, tumors and off-color) as he or she examines the outside, inside and organs of each bird, all in two or three seconds. When abnormalities are found, the inspector can direct an employee to trim or wash the problem areas or can condemn the entire bird. Condemned parts and birds are not approved for human consumption and are sent to rendering plants.

The system has proved successful but calls for its reform began in the late 1970s and continued in the 1980s. Processors sought faster line speeds than were allowed with the continuous, every bird inspection system, and in 1985 the National Academy of Sciences issued a report stating that the inspection system was outdated and unscientific.⁵² The original infectious disease problems that the system was designed to detect were replaced by newer problems of microbial and chemical contamination that go unnoticed by the old inspection methods. Detection of these problems, like salmonella and campylobacter, require laboratory analysis. The report called for statistical sampling and hazard control analysis to replace continuous bird-by-bird inspection.

Salmonella and other foodborne illnesses present the industry a troublesome problem. A 1985 USDA study concluded that 35 percent of chicken carcasses were contaminated with salmonella.⁵³ Salmonella is a widespread natural pathogenic bacterium that causes flu-like symptoms in most people but can be fatal, especially with the old and the very young. Most people never know what made them ill and few ever report it to medical professionals or health officials. The foodborne bacteria multiply in the body for up to a week before symptoms arise and, hence, it is nearly impossible to trace the source of the contamination. This inability for the consumer to know the source reduces the firm's incentive to control the problem since it will pay the cost yet will not necessarily receive the benefits. Cooking kills the bacteria, thus proper handling and preparation methods would eliminate the problem. However, one must be quite careful and the decreased knowledge of food preparation by consumers contributes to the problem. Contamination can occur when a used knife, cutting board, or even a drop of water from the chicken touches other surfaces or food items.

The late 1970s and the 1980s were a time of deregulation and the political climate supported efforts to shift more of the inspection tasks from Government to industry. Economic incentives exist for processors to improve quality control to reduce costs and improve product quality, as long as the buyer can identify and attribute the higher quality to the processor. Brands can serve this function by identifying the seller to the buyer. The poultry industry as a whole has an interest in protecting its reputation and retaining the public's trust and confidence in the wholesomeness of its products. The industry experienced what a negative effect a major story can have when in 1987 television's "Sixty Minutes" aired a special on the salmonella problem that depressed poultry sales for awhile.

The new inspection approaches tried in the 1980s transferred some of the quality control functions to the plant's management. Faster line speeds, up to 91 birds per minute, were allowed if the plant adopted a USDA quality control plan.⁵⁴ These changes along with pilot tests at some plants have not resulted in any new legislation on meat inspection but have caused a storm of controversy. Congressional hearings have been held and Congress has appropriated millions of dollars for research to improve the system. Consumer advocates charge that USDA is not improving the inspection system but dismantling it. Unionized inspectors fear it is an attempt to reduce the number of inspectors. Some firms fear that the public trust in a safe poultry supply is being eroded.

Perhaps new technologies can solve the problems and allow factory-farming without any threat to food safety. Irradiation of poultry has shown that it can reduce, or eliminate, salmonella and other foodborne pathogens.⁵⁵ It has been approved for use with poultry products and can extend the shelf life of raw chicken to 60 days. However, the industry is reluctant to use it because of its costs and how negatively consumers react to the idea of radiation. Estimates suggest that irradiation could add 1 to 5 cents per pound to the price of chicken, but the bigger unknown is when will consumers become comfortable buying products that have been treated with low level doses of radiation.

5.6 Equity

Of the four major groups that share in the success of the broiler industry, consumers are the clear winners. They have benefited from a competitive industry that has lowered the real cost of its products and has responded to their demands. Next, the owners and managers of the integrated broiler companies have been rewarded for their abilities and risk taking consistent with a competitive industry. When a good year

brings above normal profits, current firms prosper but since market power is not a problem, the industry self-corrects with an expansion that reduces future profits as called for by a properly functioning market. That is not to say that the top CEOs of the leading firms are not handsomely rewarded. Don Tyson, CEO of Tyson Foods, made 3.5 million dollars in 1989 and Charles Harper, CEO of ConAgra, made 4.3 million dollars; both were substantially above the median compensation of nearly 1.5 million dollars from a survey of the country's largest companies.⁵⁶ Whereas all consumers have benefited, not all growers and laborers have shared in the industry's success. Whether the variability in success is attributable to skill level and job performance or to an unequitable sharing of the rewards is unclear, but the economic setting suggests these groups are in the weaker position.

5.6.1 Growers

Over time broiler farm size has dramatically increased while the number of broiler farms has fallen substantially—by almost 50 percent since 1959 if small farms of under 2,000 birds are not considered. In 1959 there were 42,185 broiler farms with only 2,254 farms raising 100,000 or more birds per year and accounting for 28.5 percent of broiler sales.⁵⁷ By 1987 over 14,000 farms were raising 100,000 or more birds and accounted for 93 percent of broiler sales.⁵⁸ In less than 30 years, the largest share of broiler sales had shifted from farms raising 16,000 to 60,000 birds per year—nearly 20,000 farms with a 43 percent share of 1959 total broiler sales—to farms raising 200,000 to 500,000 birds per year—nearly 7,000 farms with a 47 percent share of 1987 broiler sales.

These growers perform the grow-out function for the vertically integrated processors. Over 90 percent of the broilers are raised under contracts with independent growers with the rest raised on company owned farms. The grow-out stage represents about 50 percent of the total capital costs of a vertically integrated broiler firm. The main advantage of having independent growers raise the chicks to market weight under contract is to reduce the capital needs of the integrator while still maintaining control of the total operation. Integrators do not wish to tie up half of their assets in the grow-out function when better profit opportunities exist elsewhere, yet they want control of this important stage of the vertical system. Farmers who raise chicks to market weight have always been financially vulnerable. Originally, it was the market's price volatility that caused financial stress and growers sought arrangements with feed companies to reduce the risk of raising broilers. Contracts were embraced by the financially weak growers.

Even with contracts, growers remain vulnerable. The growers provide the land, buildings, equipment, labor and management functions for the grow-out stage. The integrator provides the chicks, feed, medicines, and supervisory assistance. A major risk the grower faces is the sunk cost of the land, buildings, and equipment since it has no good alternative uses. These sunk costs create a barrier to exit. The integrator decides how many batches of chicks the growers will get each year which has a substantial effect on the grower's income. In addition, the integrator can demand modernization programs and changes in cultural practices or threaten to cut off a grower. Integrators have spread themselves out regionally from other integrators and, hence, growers face either a local monopsonist or at best a tight oligopsony. The areas chosen for broiler production are often those with few, if any, economic alternatives. The areas are often characterized as "rural poor." The land is not usually productive in an agricultural sense. The growers are not organized into collectives or bargaining units and allegations have been leveled at integrators for cutting off growers who try to organize growers. Such an economic setting suggests that the contract growers are in a weak position, even though the processor has no desire to raise all the broilers under company ownership. Unfortunately, no publicly available data allow researching grower returns to determine if a problem exists, and if so if it is widespread or limited to marginal growers.

5.6.2 Labor

The employees of the processing plants have not become prosperous from the industry but have gained added job opportunities from processors locating in their rural areas. The processing plants are located close to the production areas and thus share the economically depressed conditions of these regions. The processing plant is likely to be one of the few employers in the area. Working conditions are often poor and worker safety violations are not uncommon. Even in the better plants, the work is unpleasant, hard and repetitive motion trauma is common. Most of the line workers are minority women whereas most managers are white males. Union representation is low, estimated to be 25 percent of poultry workers, and union organizers are unwelcome by the integrators. Of the 53 food and tobacco industries, poultry workers earned the lowest hourly wage rate in 1987, an average of \$6.16 per hour for all production workers.³⁹ Its nearest rival for the bottom hourly wage was the fresh and frozen fish packing industry which shares many commonalities with poultry processing. This compared to the average for all food and tobacco industries of \$10.41 per hour and to the \$20.76 per hour earned in the beer industry, which

is both highly concentrated and unionized—two major factors related to high wages. Should wage rates rise in the poultry industry, however, processors will further automate their plants as well as explore relocating again, even in Mexico especially if free-trade agreements survive the political process.

6. Summary

Overall, the broiler industry is one of the most competitive in the food system. Its market structure is characterized by low concentration, low product differentiation, vertically integrated well-managed firms, and low barriers to entry that have resulted in lowering the real cost of broilers over time. Its firms compete on a price and quality basis. Objectively superior quality receives a premium consistent with the cost of the improved quality. Firms have responded to consumers' demands for convenient, tasty, and healthful products. To date that new demand has benefited firms as well since they have been able to market value-added products that reduce their sensitivity to commodity price swings.

The industry is at a crossroads, however. Recent years have seen a marked increase in concentration. The level of concentration has reached, for the first time, the level that some economists use to mark the beginning of noncompetitive industries. The beef industry became a concentrated industry in less than ten years. ConAgra, the second leading broiler company, was a major player in the concentration of the beef industry and has an active merger history. Further mergers may have to be challenged to prevent the broiler industry from following the beef industry into a more concentrated structure. The shift toward more value-enhanced products, although clearly driven by consumer demand, does allow for greater product differentiation and a lessening of price competition. Hence, the increased concentration and more emphasis on processed products makes the industry one to watch in the 1990s.

Endnotes

1. Sawyer, Gordon. *Agribusiness Poultry Industry*. Jericho, New York: Exposition Press, Inc., 1971, pp. 15-16.
2. Sawyer, Gordon. *Agribusiness Poultry Industry*. Jericho, New York: Exposition Press, Inc., 1971, p. 76.

3. U.S. Department of Agriculture, Economic Research Service. *The U.S. Broiler Industry* by Floyd Lasley and others. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, 1988, pp. 77-81.
4. Putler, Daniel and Elizabeth Frazao. "Diet/Health Concerns About Fat Intake." *Food Review*, U. S. Department of Agriculture, Economic Research Service, January-March 1991.
5. Robbins, William. One Man with Purpose Takes on Heart Disease. *The New York Times*, July 22, 1990.
6. National Broiler Council 1989 Industry Survey.
7. Livestock and Poultry Situation and Outlook Report, USDA, February 1992, p. 18.
8. Connor, John M., Rogers, Richard T., Marion, Bruce W., and Mueller, Willard F. *The Food Manufacturing Industries*. Lexington, Massachusetts: D.C. Heath and Company, 1985, p. 73.
9. Connor, John M., Rogers, Richard T., Marion, Bruce W., and Mueller, Willard F. *The Food Manufacturing Industries*. Lexington, Massachusetts: D.C. Heath and Company, 1985, p. 148.
10. Marion, Bruce and Donghwan Kim. "Concentration Change in the Selected Food Manufacturing Industries: The Influence Of Mergers versus Internal Growth." *Agribusiness*, 7, 5 (1991):415-431.
11. Tyson Foods, Inc. Annual Report, 1990.
12. Mueller, Willard. "Public Policy Implications of Recent Changes in the Livestock Industry." Working Paper 94. Madison, Wisconsin: University of Wisconsin-Madison, October 1990.
13. *Broiler Industry*, December 1989 and earlier years.
14. "Value of Shipments Data by Product Class for the 1,000 Largest Manufacturing Companies of 1950," Staff Report to the Federal Trade Commission, U.S. Government Printing Office, Washington, D.C., January 1972.
15. *Food Institute Report*. 23 March 1991.
16. "Organization and Competition in the Poultry and Egg Industries. National Commission on Food Marketing," Technical Study No. 2. Washington, D.C.: U.S. Government Printing Office, 1966.
17. Marion, Bruce, and Arthur, H. B. "Dynamic Factors in Vertical Commodity Systems." Ohio Agricultural Research & Development Center, Research Bulletin #1065, November 1973.
18. "Top 100 Food Companies," *Food Processing: The Magazine of the Food Industry*. Putnam Publishing Company, Chicago, Illinois, December 1990.
19. "Top 100 Food Companies," "Food Processing: The Magazine of the Food Industry." Putnam Publishing Company, Chicago, Illinois, December 1991.
20. *Broiler Industry*. December 1990, p. 32.
21. Marion, Bruce, and Arthur, H. B. "Dynamic Factors in Vertical Commodity Systems." Ohio Agricultural Research & Development Center, Research Bulletin #1065, November 1973.

22. Whiteside, Thomas. "Annals of Business." *The New Yorker*, 6 July 1987.
23. Connor, John M., Rogers, Richard T., Marion, Bruce W., and Mueller, Willard F. *The Food Manufacturing Industries*. Lexington, Massachusetts: D.C. Heath and Company, 1985, p. 73.
24. Amey, David. "Nation's Top Broiler Companies." *Broiler Industry*, December 1989.
25. Schewe, Charles D. and Reuben M. Smith. *Marketing Concepts and Applications*, Second Edition. McGraw-Hill Book Company, p. 10.
26. Connor, John M., Rogers, Richard T., Marion, Bruce W., and Mueller, Willard F. *The Food Manufacturing Industries*. Lexington, Massachusetts: D.C. Heath and Company, 1985, p. 91.
27. Burbee, Clark R. and Edwin T. Bardwell. "Marketing New England Poultry. 6: Economies of Scale in Hatching and Cost of Distributing Broiler Chicks." Bulletin 483, Agricultural Experiment Station, University of New Hampshire, Durham, May 1964.
28. Marion, Bruce, and Arthur, H. B. "Dynamic Factors in Vertical Commodity Systems." Ohio Agricultural Research & Development Center, Research Bulletin #1065, November 1973.
29. U.S. Department of Agriculture, Economic Research Service. *The U.S. Broiler Industry* by Floyd Lasley and others. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, 1988, pp. 65-69.
30. Connor, John M., Rogers, Richard T., Marion, Bruce W., and Mueller, Willard F. *The Food Manufacturing Industries*. Lexington, Massachusetts: D.C. Heath and Company, 1985, p. 93-94.
31. Connor, John M., Rogers, Richard T., Marion, Bruce W., and Mueller, Willard F. *The Food Manufacturing Industries*. Lexington, Massachusetts: D.C. Heath and Company, 1985, p. 93.
32. *Broiler Industry*, December 1990.
33. Spence, Michael. "Competition, Entry, and Antitrust Policy, in *Strategy, Predation, and Antitrust Analysis*, edited by Steven Salop. Washington, D.C.: Federal Trade Commission, 1981, p. 75.
34. Porter, Michael E. "Strategic Interaction: Some Lessons from Industry Histories for Theory and Antitrust Policy," in *Strategy, Predation, and Antitrust Analysis*, edited by Steven Salop. Washington, D.C.: Federal Trade Commission, 1981, pp. 455-456.
35. Hughes, Kathleen. "If Fitness Matters, Shouldn't a Chicken Do a Workout Too?" *Wall Street Journal*, 16 July 1986, 1.
36. Hughes, Kathleen. "If Fitness Matters, Shouldn't a Chicken Do a Workout Too?" *Wall Street Journal*, 16 July 1986, 1.
37. Koonce, J.M., and Joe G. Thomas. "Differentiating a Commodity: Lessons from Tyson Foods." *Planning Review*, 17 (September-October 1989):24-29.
38. "ConAgra in a Good Mood." *Food Business*, 25 March 1991, 12.
39. Marion, Bruce and Donghwan Kim. "Concentration Change in the Selected Food Manufacturing Industries: The Influence Of Mergers versus Internal Growth." *Agribusiness*, 7, 5 (1991):415-431.

40. ConAgra, Inc. *Annual Report*, 1990.
41. "ConAgra in a Good Mood." *Food Business*, 25 March 1991, 12.
42. Marion, Bruce and Donghwan Kim. "Concentration Change in the Selected Food Manufacturing Industries: The Influence Of Mergers versus Internal Growth." *Agribusiness*, 7, 5 (1991):415-431.
43. Tyson Foods, Inc. *Annual Report*, 1990.
44. Whiteside, Thomas. "Annals of Business." *The New Yorker*, 6 July 1987.
45. Schewe, Charles D. and Reuben M. Smith. *Marketing Concepts and Applications*, Second Edition. McGraw-Hill Book Company, p. 11.
46. Whiteside, Thomas. "Annals of Business." *The New Yorker*, 6 July 1987.
47. U.S. Department of Agriculture, Economic Research Service. *The World Poultry Market—Government Intervention and Multilateral Policy*, by Robert V. Bishop and others. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, 1990, p. 10.
48. "Fresh Chicken" *Consumer Reports*, February 1989, 75-77.
49. Hughes, Kathleen. "If Fitness Matters, Shouldn't a Chicken Do a Workout Too?" *Wall Street Journal*, 16 July 1986, 1.
50. Hughes, Kathleen. "If Fitness Matters, Shouldn't a Chicken Do a Workout Too?" *Wall Street Journal*, 16 July 1986, 1.
51. Becker, Geoffrey S. "Federal Poultry Inspection: A Briefing," Hearings before the Subcommittee on Livestock, Dairy and Poultry of the Committee on Agriculture, House of Representatives, 87-432 ENR, May 8, 1987.
52. Becker, Geoffrey S. "Federal Poultry Inspection: A Briefing," Hearings before the Subcommittee on Livestock, Dairy and Poultry of the Committee on Agriculture, House of Representatives, 87-432 ENR, May 8, 1987.
53. Bruce, Gene. "Dirty Chicken," in *Atlantic Monthly*, November 1990, p. 32.
54. Becker, Geoffrey S. "Federal Poultry Inspection: A Briefing," Hearings before the Subcommittee on Livestock, Dairy and Poultry of the Committee on Agriculture, House of Representatives, 87-432 ENR, May 8, 1987.
55. *Poultry Egg and Marketing*, November-December 1990, p. 17.
56. *Wall Street Journal*, April 18, 1990, p. R18.
57. U.S. Department of Agriculture, Economic Research Service. *The U.S. Broiler Industry* by Floyd Lasley and others. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, 1988, p. 13.
58. U.S. Department of Commerce, Census of Agriculture, 1987.
59. U.S. Department of Commerce. *1987 Census of Manufactures—Industry Series*. Washington, D.C.: U.S. Department of Commerce, 1990.

References

- Amey, David. 1989. Nation's Top Broiler Companies. *Broiler Industry*. December.
- Becker, Geoffrey S. 1987. Federal Poultry Inspection: A Briefing. Hearings before the Subcommittee on Livestock, Dairy and Poultry of the Committee on Agriculture, House of Representatives, 87-432 ENR, May 8.
- Bishop, Robert. V. 1990. U.S. Department of Agriculture, Economic Research Service. *The World Poultry Market—Government Intervention and Multilateral Policy*. Washington: U.S. Department of Agriculture, Economic Research Service.
- Broiler Industry. 1989. 1990.
- Bruce, Gene. 1990. Dirty Chicken. *Atlantic Monthly*. November.
- Burbee, Clark R. and Edwin T. Bardwell. 1964. Marketing New England Poultry. 6: Economics of Scale in Hatching and Cost of Distributing Broiler Chicks. Bulletin 483, Agricultural Experiment Station, University of New Hampshire. May.
- ConAgra in a Good Mood. *Food Business*, March 25, 1991, 12.
- ConAgra, Inc. *Annual Report*. 1990.
- Connor, John M., Rogers, Richard T., Marion, Bruce W., and Mueller, Willard F. *The Food Manufacturing Industries*. Lexington: D.C. Heath and Company.
- Food Institute Report*. March 23, 1991.
- Fresh Chicken. *Consumer Reports*. February 1989, 75-77.
- Hughes, Kathleen. 1986. If Fitness Matters, Shouldn't a Chicken Do a Workout Too? *Wall Street Journal*. July 16.
- Koonce, J.M., and Joe G. Thomas. 1989. Differentiating a Commodity: Lessons from Tyson Foods. *Planning Review*. September-October:24-29.
- Lasley, Floyd, et al. 1988. U.S. Department of Agriculture. Economic Research Service. *The U.S. Broiler Industry*. Washington: U.S. Department of Agriculture, Economic Research Service. 13, 65-81.
- Livestock and Poultry Situation and Outlook Report. USDA. February 1992. p. 18.
- Marion, Bruce and Donghwan Kim. 1991. Concentration Change in the Selected Food Manufacturing Industries: The Influence of Mergers versus Internal Growth. *Agribusiness*. 7(5):415-431.
- Marion, Bruce, and H.B. Arthur. 1973. Dynamic Factors in Vertical Commodity Systems. Ohio Agricultural Research & Development Center. Research Bulletin #1065. November.
- Mueller, Willard. 1990. Public Policy Implications of Recent Changes in the Livestock Industry. Working Paper 94. Madison: University of Wisconsin-Madison. October.
- National Broiler Council 1989 Industry Survey.

- Organization and Competition in the Poultry and Egg Industries. National Commission on Food Marketing. Technical Study No. 2. Washington: U.S. Government Printing Office. 1966.
- Porter, Michael E. 1981. Strategic Interaction: Some Lessons from Industry Histories for Theory and Antitrust Policy. In *Strategy, Predation, and Antitrust Analysis*, ed. Steven Salop. Washington: Federal Trade Commission, 455-456.
- Poultry Egg and Marketing*. November-December 1990, 17.
- Putler, Daniel and Elizabeth Frazao. 1991. Diet/Health Concerns About Fat Intake. *Food Review*, U.S. Department of Agriculture, Economic Research Service, January-March.
- Robbins, William. 1990. One Man with Purpose Takes on Heart Disease. *The New York Times*. July 22.
- Sawyer, Gordon. 1971. *Agribusiness Poultry Industry*. Jericho, New York: Exposition Press, Inc.
- Schewe, Charles D. and Reuben M. Smith. *Marketing Concepts and Applications*, Second Edition. McGraw-Hill Book Company, p. 10-11.
- Spence, Michael. 1981. Competition, Entry, and Antitrust Policy. In *Strategy, Predation, and Antitrust Analysis*, ed. Steven Salop. Washington: Federal Trade Commission.
- Top 100 Food Companies. 1991. *Food Processing: The Magazine of the Food Industry*. Putnam Publishing Company, Chicago, Illinois, December.
- Tyson Foods, Inc. *Annual Report*, 1990.
- U.S. Department of Commerce. *1987 Census of Manufactures—Industry Series*. Washington: U.S. Department of Commerce.
- U.S. Department of Commerce. 1987. Census of Agriculture. *Value of Shipments Data by Product Class for the 1,000 Largest Manufacturing Companies of 1950*. Staff Report to the Federal Trade Commission, U.S. Government Printing Office, Washington, D.C., January 1972.
- Wall Street Journal*, April 18, 1990, p. R18.
- Whiteside, Thomas. 1987. Annals of Business. *The New Yorker*, July.

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