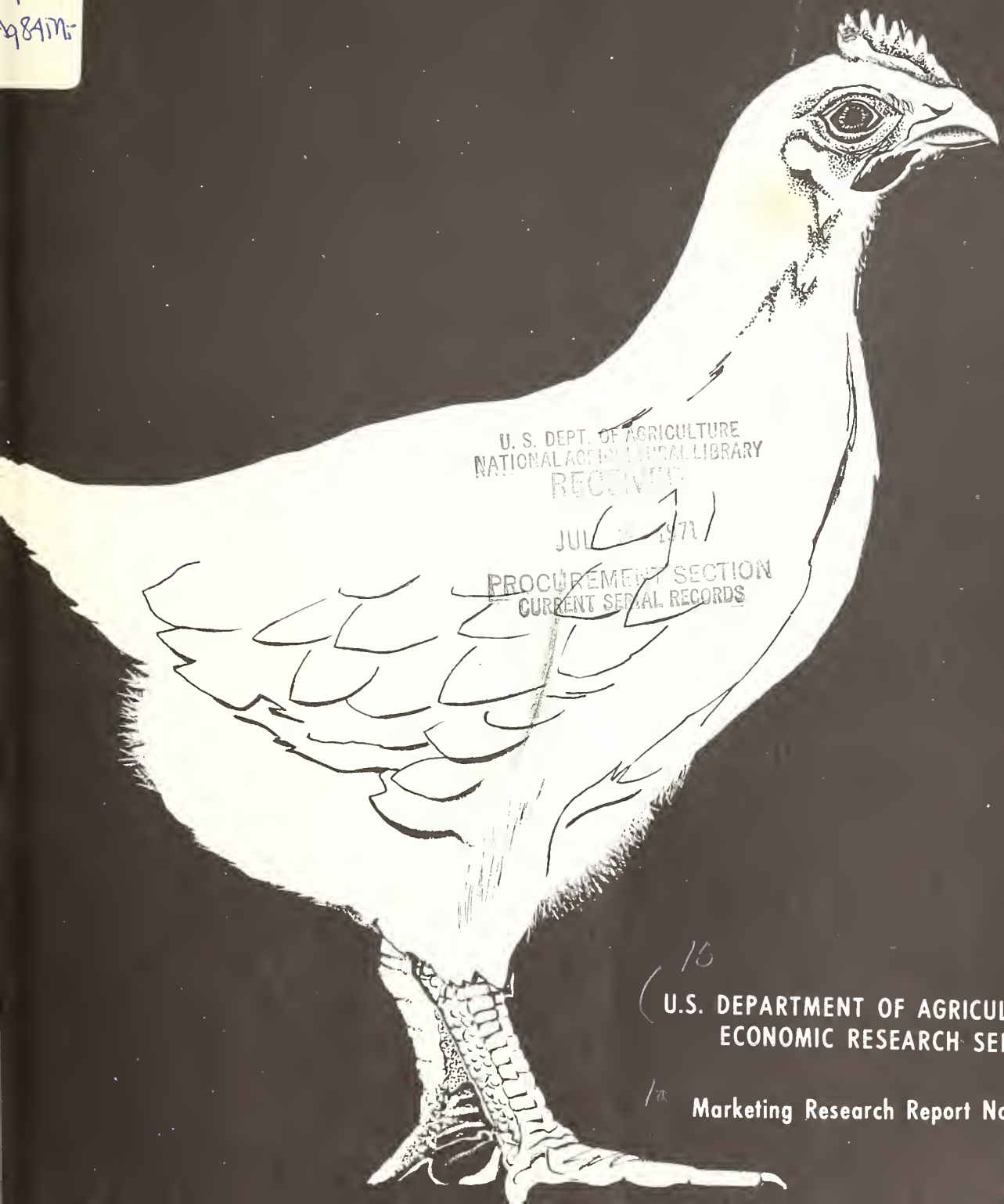
THE CHICKEN BROILER INDUSTRY:
STRUCTURE, PRACTICES, AND COSTS



U.S. DEPARTMENT OF AGRICULTURE
ECONOMIC RESEARCH SERVICE

Marketing Research Report No. 930

ABSTRACT

As detailed in this report, extensive changes took place in production, processing, and marketing in the chicken broiler industry during 1950-70. The industry has changed dramatically from being one of small, widely scattered chicken farms to one that is large, concentrated, and efficient. More than 95 percent of broilers produced are grown under contract and by integrated firms which vary in size of operation and complexity. About 84 percent of all production is concentrated in 10 States. Some of the other factors discussed that contributed to these changes are: costs, prices, processing, marketing, and demand.

Keywords: Broilers, marketing, processing, consumption, demand.

Washington, D.C. 20250 May 1971

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402

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HIGHLIGHTS

Per capita broiler consumption is expected to continue its steady rise, possibly approaching 41.4 pounds by 1985. It was 35 pounds in 1969, up from 0.5 pound in 1934. Per capita consumption of red meats advanced from 144 pounds to 182 pounds over the period.

In 1969, the $1,531 million gross farm income from broilers was 2.8 percent of the total realized gross farm income. This compares with $19 million in 1934, when the broiler share was only 0.2 percent.

Concentration and efficiency of the U.S. chicken broiler industry have also grown steadily since the mid-1930's, when broilers first emerged as an important source of farm income. Vertical coordination, or the linking together of successive stages of production and marketing through ownership or contracting, has spread rapidly. More than 95 percent of all commercial broilers are grown under contract or by integrated firms themselves.

Georgia, Arkansas, Alabama, and North Carolina ranked highest, in that order, in 1969 production of broilers. Forty-three percent of all broilers were produced on farms raising 100,000 or more birds a year, according to the 1964 Census of Agriculture. California, Mississippi, Maryland, Delaware, and Texas were the leading States in percentage of 1964 output from farms producing this many birds. Twenty-three percent of broilers are produced on farms raising 60,000 to 99,999 birds a year, and 23 percent on farms raising 30,000 to 59,999.

The 1963-69 farm value of broilers varied from 18.2 to 21.0 cents per pound, while retail price varied from 39.4 to 42.4 cents per pound in major cities. Over 50 percent of the farm-to-retail price spread involved retailing; 23.1 percent, processing; 16.9 percent, wholesaling and storage; 5.6 percent, transportation; and 3.1 percent, assembling the live birds. Over 50 percent of the farm-to-retail price spread was for wages and salaries.

Prices to retailers are higher in New York, Baltimore, and Washington, D.C., than in Atlanta, and prices in markets on the west coast are several cents higher than in the East or Midwest. The variance generally reflects added cost for transporting and handling as distance from surplus-production areas increases.

The number of processing plants under Federal inspection slaughtering all types of poultry dropped from 288 in 1962 to 231 in 1969. However, during this period, the volume of young chickens slaughtered increased from 6 billion to 9 billion pounds live weight. The average slaughter of young chickens per plant increased from 2.6 million pounds in 1962 to 39.0 million pounds in 1969. All major regions showed gains in volume of slaughter during

1962-69. Average monthly slaughter varied from 82 to 117 percent of the annual monthly average. The high months were May through October and the low months were November through April.

The cost of processing broilers is determined largely by the size of the plant and utilization of the plant capacity. Longrun average costs of broiler processing decrease from 3.8 cents per pound live weight at 4.15 million pounds output per year to 2.6 cents per pound at 69.16 million pounds output per year. In the past, average costs of processing accounted for 52 percent of total processing plant cost, and transportation and selling costs accounted for 48 percent.

Since the 1930's, commercial exports and shipments have ranked second to domestic civilian use of broilers. The peak of exports and shipments was 262 million pounds in 1962. In 1969, this figure was 176 million pounds. The third largest share of the total broiler-fryer supply went to the military and the fourth largest outlet was U.S. Department of Agriculture donations.

THE CHICKEN BROILER INDUSTRY: STRUCTURE, PRACTICES, AND COSTS

By

Fred L. Faber, Agricultural Economist, and
Ruth J. Irvin, Economic Assistant
Marketing Economics Division

INTRODUCTION

Broilers are young chickens 8 to 10 weeks old, of either sex, which have tender meat; soft, pliable, smooth-textured skin; and flexible breastbone cartilage. In some data series, broilers may also be called fryers or frying chickens. In others, they are reported as "young chickens."

In 1934, realized gross farm income from all sources was $8,568 million. Gross farm income from broilers was $19 million, 0.2 percent of the total. By 1969, realized gross farm income from all sources was $54,598 million and that from broilers was $1,531 million, 2.8 percent of the total.

Per capita consumption of broilers was 0.5 pound in 1934, compared with 144 pounds of red meats. By 1969, per capita consumption of broilers had risen to 35 pounds, while that of red meats had risen to 182 pounds.

Total domestic supply of chicken meat has been between 6 and 8 billion pounds (ready-to-cook basis) in recent years. Since the early 1950's, imports have been insignificant. Exports of chicken meat reached a peak of 262 million pounds in 1962, 4 percent of the total supply. Since then, exports and shipments to U.S. territories have declined, dropping to 176 million pounds in 1969. In recent years, broilers have accounted for nearly 90 percent of the total chicken supply and over 80 percent of exports.

The industry has changed dramatically in the past 20 years. Broilers were once grown in small flocks widely scattered throughout the United States. They are now grown mainly in concentrated clusters of counties within certain States (34) 1/. The major production areas are in northern Georgia and Alabama; central Mississippi; the northwestern corner of Arkansas; east Texas; southern Maine; the Delmarva Peninsula of Maryland, Delaware, and Virginia; central North Carolina; and California (fig. 1).

Another major development has been the spread of vertical coordination, or the linking together of successive stages of production and marketing through ownership or contracting. The high degree of coordination has resulted in a very efficient industry, one that has been quick to utilize new technology. The typical integrated broiler firm often has its own

1/ Underscored numbers in parenthesis refer to items in Selected References at the end of this report.

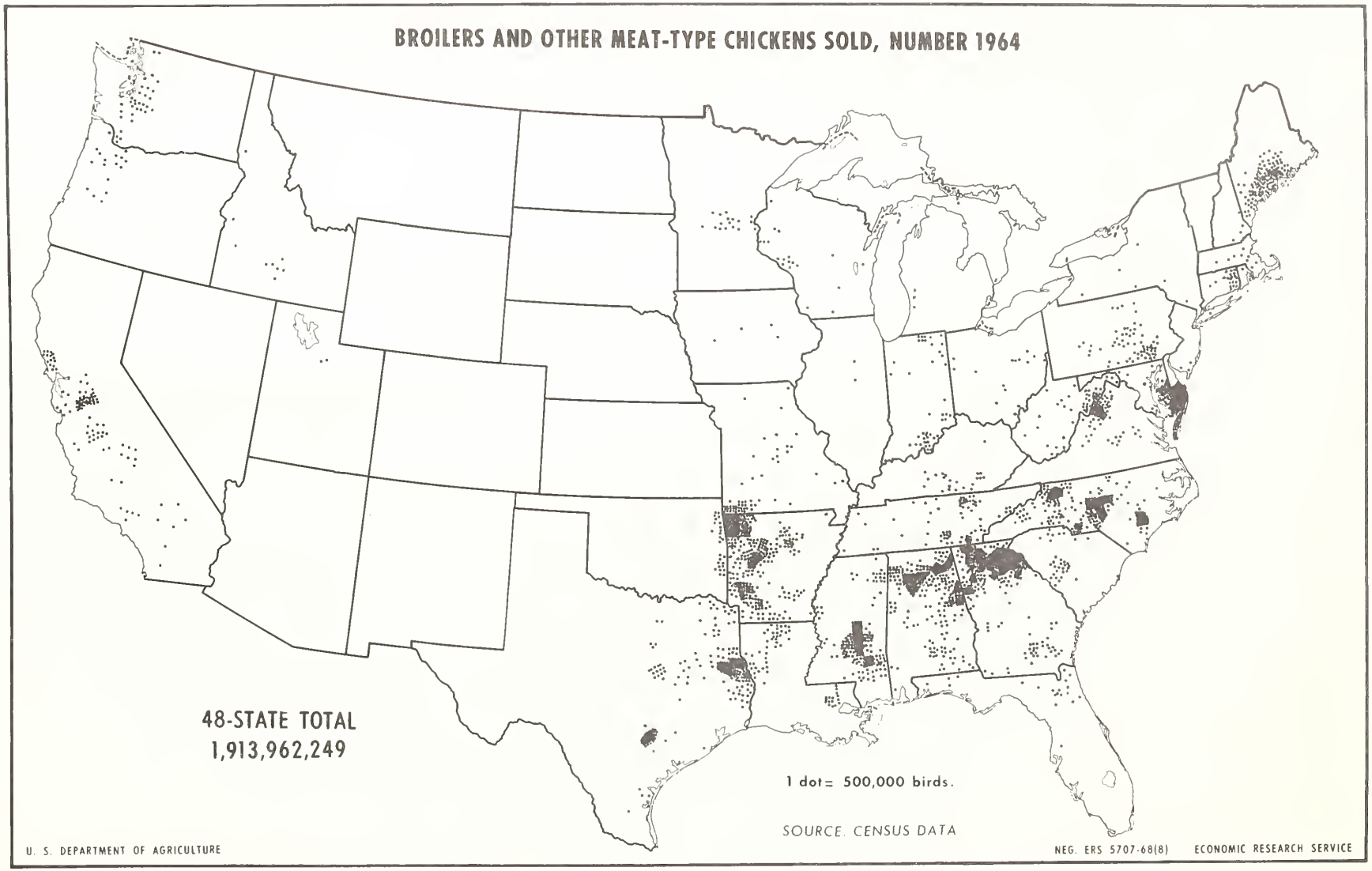

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Figure 1

hatchery, feed mill, and processing plant, and depends almost entirely on contract production (fig. 2). Not all firms are as fully integrated as the illustration suggests, but virtually all firms combine two or more major functions. The firm may be local, a subsidiary of a national feed company or meatpacker, or part of a large conglomerate corporation. Some firms are integrated horizontally because they include more than one processing plant, feed mill, or hatchery.

More than 95 percent of all commercial broilers produced in the United States are grown under contract or by integrated firms themselves. Contracting firms vary greatly in size and complexity. A recent study (51) of 30 firms in Alabama, Georgia, and Arkansas showed these firms received no birds directly from independent growers (producing without contracts). These firms alone accounted for 30 percent of the broilers slaughtered under Federal inspection.

PRODUCTION

Output

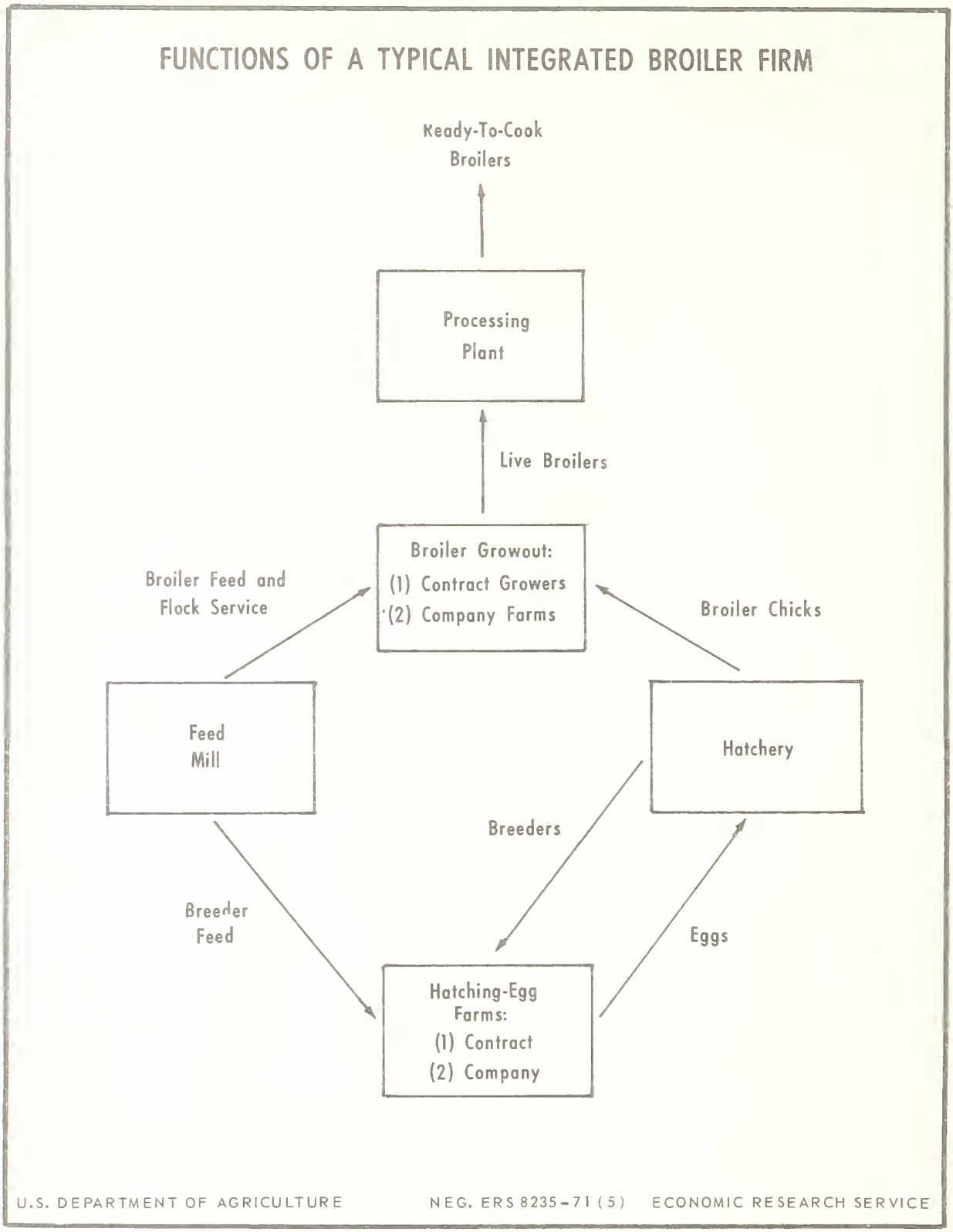
In 1934, 34 million broilers were raised. By 1954, production had jumped to 1 billion birds and by 1969, to 2.8 billion birds (table 1). A rapid rate of growth occurred during the late 1940's and the 1950's. In recent years, the absolute numbers of birds produced have increased, but the rate of growth has declined. However, per capita consumption is increasing more rapidly than production.

Importance of 10 Leading Producing States

The 10 States leading in production are Georgia, Arkansas, Alabama, North Carolina, Mississippi, Maryland, Texas, Delaware, California, and Maine. Broilers sold off-farms in these States have accounted for about 84 percent of the U.S. total in recent years. The largest increases in production occurred in Arkansas, Alabama, Mississippi, North Carolina, and Georgia, but all 10 States chalked up increases during the past 5 years (table 2).

Output Per Farm

According to the 1964 Census of Agriculture, the number of U.S. farms producing broilers and other meat-type chickens dropped from 42,000 in 1959 to 35,000 in 1964, while output increased from 1.4 billion to 1.9 billion birds. Thus, average output per farm increased from 33,600 birds in 1959 to 54,500 in 1964 (table 3).


FUNCTIONS OF A TYPICAL INTEGRATED BROILER FIRM
Ready-To-Cook Broilers
Processing Plant
Live Broilers
Broiler Growout:
(1) Contract Growers
(2) Company Farms
Broiler Feed and Flock Service
Broiler Chicks
Feed Mill
Hatchery
Breeders
Breeder Feed
Eggs
Hatching-Egg Farms:
(1) Contract
(2) Company
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NEG. ERS 8235-71 (5)
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Figure 2

Table 1.--Broiler production, live weight, price per pound, value, and civilian per capita consumption, 1934-69[1/]

	Production					
	Number	Live weight	Pounds produced as percentage of preceding year	Average price received by producers per pound	Value of production	Civilian per capita consumption
	Millions	Million pounds	Percent	Cents	Million dollars	Pounds
1934.....	34	97	---	19.3	19	0.5
1935.....	43	123	126.8	20.0	25	.7
1936.....	53	152	123.6	20.6	31	.8
1937.....	68	196	128.9	21.4	42	1.1
1938.....	82	239	121.9	19.0	46	1.3
1939.....	106	306	128.0	17.0	52	1.6
1940.....	143	413	135.0	17.3	72	2.0
1941.....	192	559	135.4	18.4	103	2.8
1942.....	228	674	120.6	22.9	155	3.2
1943.....	285	833	123.6	28.6	238	4.1
1944.....	274	818	98.2	28.8	235	3.9
1945.....	366	1,107	135.3	29.5	327	5.0
1946.....	293	884	79.9	32.7	289	4.1
1947.....	310	936	105.9	32.3	302	4.3
1948.....	371	1,127	120.4	36.0	405	5.5
1949.....	513	1,570	139.3	28.2	443	7.1
1950.....	631	1,945	123.9	27.4	533	8.7
1951.....	789	2,415	124.2	28.5	689	10.4
1952.....	861	2,624	108.7	28.8	756	11.7
1953.....	947	2,904	110.7	27.1	786	12.3
1954.....	1,048	3,236	111.4	23.1	747	13.7
1955.....	1,092	3,350	103.5	25.2	844	13.8
1956.....	1,344	4,270	127.5	19.6	838	17.3
1957.....	1,448	4,683	109.7	18.9	886	19.1
1958.....	1,660	5,431	116.0	18.5	1,002	22.0
1959.....	1,737	5,763	106.1	16.1	925	22.8
1960.....	1,795	6,017	104.4	16.9	1,014	23.4
1961.....	1,991	6,832	113.5	13.9	947	25.9
1962.....	2,023	6,907	101.1	15.2	1,049	25.6
1963.....	2,102	7,276	105.3	14.6	1,063	27.0
1964.....	2,161	7,521	103.4	14.2	1,070	27.5
1965.....	2,334	8,115	107.9	15.0	1,218	29.4
1966.....	2,572	8,993	110.8	15.3	1,372	32.2
1967.....	2,593	9,186	102.1	13.3	1,223	32.7
1968.....	2,621	9,332	101.6	14.2	1,326	32.8
1969.....	2,788	10,046	107.7	15.2	1,531	35.3

1/ Includes Alaska and Hawaii beginning in 1961.
2/ Includes consumption in households of producers which is less than 1 percent of total production.

Source: Annual issues of Chicken and Eggs, Production, Disposition, Cash Receipts, and Gross Income, U.S. Dept. Agr., Stat. Rpt. Serv., and Poultry and Egg Situation, Econ. Res. Serv.

Table 2.--10 States leading in broiler production, 1965-69, by rank in 1969

State	1965	1966	1967	1968	1969	1965-69 average
	Mil. birds					
Georgia	403	456	447	437	442	437
Arkansas	320	362	365	391	415	371
Alabama	285	324	325	329	353	323
North Carolina	234	260	263	263	281	260
Mississippi	168	184	197	203	221	195
Maryland	145	159	151	158	174	157
Texas	142	153	161	162	171	158
Delaware	109	122	127	115	134	121
California	60	67	69	68	77	68
Maine	68	72	74	72	73	72
10-State total	1,935	2,160	2,180	2,197	2,339	2,162
United States	2,334	2,572	2,591	2,690	2,787	2,595
	Percent					
10 States as percentage of United States	83	84	84	82	84	83

Source: Annual issues of Chickens and Eggs, Production, Disposition, Cash Receipts, and Gross Income, U.S. Dept. Agr., Stat. Rpt. Serv.

Table 3.--Number of farms producing broilers and other meat-type chickens, total birds sold, average sold per farm, 1959 and 1964, and percentage distribution of flocks by size, United States and selected States, 1964[1/]

Item	Unit	Me.	Md.	Del.	Calif.	N.C.	Ga.	Ala.	Miss.	Ark.	Tex.	10-State average	U.S.
Farms in --													
1959.....	Thous.	1.1	1.7	1.5	0.9	3.3	8.3	3.9	1.5	4.0	2.2	2.8	42.2
1964.....	do.	0.9	1.5	1.4	0.4	3.3	7.4	4.5	1.7	4.1	1.9	2.7	35.1
Chickens sold in--													
1959.....	Mil.	49	79	72	45	104	225	141	89	150	80	103	1419
1964.....	do.	59	116	108	53	173	307	211	151	268	124	157	1915
Chickens per farm in --													
1959.....	Thous.	44	47	48	48	31	27	37	59	37	37	42	34
1964.....	do.	65	77	76	134	53	42	47	90	66	65	72	55
Distribution of 1964 flocks by birds (thous.)		Percent											
1-1.9.....		2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/
2-3.9.....		0.1	2/	2/	0.1	0.1	0.1	0.1	2/	2/	0.1	0.1	0.1
4-7.9.....		0.3	0.2	0.2	0.3	0.4	0.8	0.3	0.2	0.2	0.4	0.5	0.5
8-15.9.....		1.2	1.3	1.4	4.6	2.4	4.7	2.3	0.8	1.5	2.1	2.2	2.7
16-29.9.....		4.3	4.8	5.7	1.9	8.6	12.5	10.8	2.6	4.9	7.1	7.4	7.9
30-59.9.....		17.9	14.7	16.5	7.7	24.6	31.9	34.3	12.6	22.1	17.8	23.1	22.6
60-99.9.....		30.3	21.9	19.4	7.9	26.4	24.8	27.9	21.6	25.8	20.4	23.9	22.9
100 or more...		45.9	57.1	56.8	77.5	37.5	25.2	24.3	62.2	45.5	52.1	42.8	43.3
Total.....		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1/ Source: 1964 Census of Agriculture. vol. II, ch. 2. Data for 1959 are estimates based on reports for a sample of farms.

2/ Less than one-tenth of 1 percent.

Increases in value of production since 1949 have been achieved by substantial increases in pounds produced, since average prices received by producers have trended downward beginning in 1949. From 1948 to 1969, the average price received by producers declined more than 50 percent, while live weight production increased about 890 percent (table 1).

Production Costs

Through the years, production costs probably have paralleled the average equivalent price at the farm level. As shown in table 1, prices declined from 36.0 cents per pound in 1948 to 15.2 cents per pound in 1969. Because production is part of a total firm operation, costs are not known with precision for the past 20 years. However, production costs have probably averaged below prices received by producers.

The greater-than-50-percent reduction in price and cost from 1949 to 1969 was possible because of substantial increases in production efficiency. Primary breeders have improved broiler strains sufficiently to reduce the time needed to produce a 3.5-pound live bird from 12-14 weeks 20 years ago to 8-9 weeks now. Poultry nutritionists have developed improved feed formulations which have helped reduce the amount of feed needed to produce 1 pound of live broiler from 4 pounds in 1940 to 2.2 pounds today. Mortality rates of 10 to 20 percent were common 20 years ago, while a rate of more than 6 percent is considered high today. Man-hours per 1,000 broilers produced declined from 250 in 1940 to 15 in 1969 as a result of increased mechanization, more efficient farm layouts, and larger flock sizes. Recent improvements in modern poultry housing have stressed complete environmental control; that is, control of light, temperature, humidity, and air movement. Although further gains in efficiency are possible, it is difficult to see how they can be of the magnitude of those in the past 20 years.

Production costs in the highly integrated broiler industry include the values of inputs furnished by both the contracting firm and the contract grower. Actual costs per pound of broiler produced vary among flocks and geographic areas, and seasonally. A recent study gave the following typical percentage distribution of production costs (25):

	Percent
Feed	62.4
Chicks	19.2
Grower payment	12.0
Fuel	2.0
Medications	1.6
Vaccination	1.2
Litter	.8
Miscellaneous	.8

The census also showed that 43 percent of the output came from farms producing 100,000 birds or more, 23 percent from farms producing 60,000 to 99,999, and 23 percent from farms producing 30,000 to 59,999. Another source (43) showed that, on the average, 3.8 lots of birds were raised in 1964 in Delmarva Peninsula, 3.9 lots in Georgia, and 4.1 lots in Maine. Thus, numbers for output per farm should be divided by about 4 to arrive at number of birds raised per lot.

Substantial increases in average output per farm were registered in all leading broiler areas from 1959 to 1964. The largest outputs per farm in 1964 were in California, Mississippi, Maryland, and Delaware. The smallest outputs per farm that year were in Georgia and Alabama. In California, Mississippi, Maryland, Delaware, and Texas, more than half the output came from farms producing 100,000 or more broilers. California was considerably ahead of other States in percentage of production from larger units. Relatively high percentages of output from farms producing fewer than 30,000 birds were registered in Georgia, Alabama, and North Carolina.

Seasonality

Broilers are grown in all seasons of the year, although production costs and volume vary seasonally. Seasonal variation in numbers and size of birds produced is related to seasonal variation in demand. Seasonal variation in production is best measured from data on slaughter of live birds by processing plants and is discussed more thoroughly in the section of this report on processing. (The weekly report on broiler chicks placed on farms in 22 States is a good indicator of the number of broilers that will be available 8-9 weeks later.)

Value of Production

The average price received by producers for broilers fluctuated around 20 cents per pound in the 1930's and early 1940's. Prices received by producers then began to increase, reaching a peak of 36 cents in 1948. In 1949, the price dropped 7.8 cents and since then has been declining irregularly, reaching the 14- to 15-cent level in the mid-1960's (table 1). In 1967, it dropped to a record low of 13.3 cents per pound, but has since increased.

With broiler production almost entirely under contract, farm prices, based on actual sales of live birds, have been gradually losing significance, although live-equivalent prices continue to be used in many measurements of value of farm output and in statistical analyses.

The farm-equivalent value of broilers produced in 1934 was $19 million. Through the years, this amount increased and was $1 billion in 1958. By 1969, the value of production stood at $1.5 billion. Since 1950, reported

prices for broiler feed have remained about the same, but prices for chicks have declined about one-third.

Grower payment is the amount paid to a contract grower by a contracting firm. The payment is primarily for labor, equipment, and housing, although contract growers in Southern areas usually pay for fuel and litter. Costs of other items are borne by the contractor.

Payment plans for most contracts now in use have minimum guaranteed payments and bonus clauses based on feed conversion rates or on a ranking of a grower's prime production costs with those of other growers associated with the same contractor. Feed conversion rate is the amount of feed required to produce a pound of broiler and is a common measure of efficiency. Prime costs refer to costs paid by growers for inputs furnished by contractors. Southern contractors usually pay growers on a per pound basis, while Maine and Delmarva Peninsula growers are paid on a per bird basis. Several types of contracts have been described in detail in two recent studies (51, 12).

In 1964, average payments per 1,000 broilers produced were $102 in Maine, $77 in the Delmarva Peninsula, and $61 in Georgia (19). In 1966, the latest comparable figures were $88 in Maine, $81 in the Delmarva Peninsula, and $74.50 in Georgia. These payments represent the gross income that contract growers receive for their labor, housing, equipment, and other items they furnish.

PROCESSING

Changes in Concentration

There has been a longrun trend toward greater concentration of broiler processing into fewer plants, with processing by fewer firms. However, this trend tended to level off from 1964 to 1968 (9). During this period -- following the long period of high activity in mergers and acquisitions during the 1950's and early 1960's -- broiler firms reorganized and improved the efficiency of plants rather than acquiring new ones. Acquisitions and mergers made in 1969 suggest that concentration in broiler processing may speed up again in the next few years.

The four and eight largest broiler firms processed virtually the same share of federally inspected slaughter in 1968 as in 1964. The 20 largest firms processed about 3 percent more of the total in 1968 than in 1964. The number of plants owned by the four and eight largest broiler firms decreased from 1964 to 1968, but the number owned by the 20 largest firms increased by four (table 4).

Table 4.--Share of federally inspected young chickens slaughtered by the by the 4, 8, and 20 largest firms, and number of plants operated by these firms, 1960, 1964, and 1968 1/

Year	Share of total federally inspected slaughter		
	Four largest firms	Eight largest firms	20 largest firms
	Percent		
1960	12	18	32
1964	18	28	44
1968	18	29	47
	Plants operated		
	Number		
1960	21	31	52
1964	36	51	80
1968	31	48	84

1/ Production from plants processing at least 1,000 head annually.

Source: Data for 1960 and 1964 from Tech. Study no. 2, Natl. Commiss. on Food Mktg., June 1966. Data for 1968 comp. by the Econ. Res. Serv. from unpubl. data of U.S. Dept. Agr., Consumer and Mktg. Serv.

Numbers of firms processing broilers decreased from 286 in 1960 to 153 in 1968. In 1960, 94 firms, or 33 percent of the total, processed 70 percent of the volume. By 1968, 48 firms, or 31 percent of the total, handled 70 percent of the volume (table 5). Of the total number of broilers leaving farms and moving to market in 1969, 89 percent were slaughtered in processing plants under Federal inspection. The remaining 11 percent were slaughtered on farms or in processing plants not under Federal inspection.

Table 5.--Number of federally inspected firms processing young chickens and accounting for specified proportions of output, 1960, 1964, and 1968 1/

Percentage of output	Year		
	1960	1964	1968
	Number		
30	19	9	8
50	47	26	22
70	94	55	48
80	125	77	66
90	175	107	90
95	228	131	108
100	286	201	153

1/ Production from plants processing at least 1,000 head annually; at least two-thirds of all poultry processed in such plants are young chickens.

Source: Data for 1960 and 1964 from Tech. Study no. 2, Natl. Commiss. on Food Mktg., June 1966. Data for 1968 comp. by the Econ. Res. Serv. from unpubl. data of U.S. Dept. Agr., Consumer and Mktg. Serv.

Product Form

Historically, broilers have been marketed in four forms: live, New York-dressed, ready-to-cook, and as part of further-processed products. Currently, the birds marketed live go almost entirely to the kosher trade and account for a very small percentage of the total. The New York-dressed method, with only blood and feathers removed, was a popular way of marketing before World War II. At present, it is used in a very limited way on intracompany interplant transfers and in some plants not under Federal inspection. It accounts for a very small percentage of the total.

The largest share of broiler output is processed as ready-to-cook birds. In 1960, 3.7 billion pounds of ready-to-cook young chickens were certified by

Federal inspectors. By 1969, this had increased to 6.5 billion pounds. Nearly 90 percent of these young chickens were packed as fresh-dressed ice packed or chilled birds. Frozen birds accounted for only 9 to 10 percent of the total poundage certified between 1960 and 1969 (table 6).

Young chickens inspected for cut-up in 1969 accounted for 1,628 million pounds, or 25 percent of the total certified. This is more than double the 662 million pounds inspected for cut-up in 1962, the first year such data were published. These chickens accounted for 15 percent of the total certified in 1962.

Most of the remaining volume sold by processing plants is in the form of whole birds. In 1969, whole birds accounted for 4,584 million pounds, or 71 percent, of the 6,484 million pounds certified. In 1962, the plants sold 83 percent of their birds as whole birds. Subsequent handlers, including retailers, cut up the young chickens and may have accounted for about as much of or more than the volume cut up at the processing-plant level.

Young chickens inspected for canning and further processing in 1969 accounted for 272 million pounds, or 4 percent of the 6,484 million pounds certified (ready-to-cook weights). These figures are almost double those for 1964 (table 7).

Table 6.--Young chickens certified under Federal inspection, ready-to-cook weights, by method of preservation, 1960-69

Year	Chilled	Frozen	Total
	Mil. lb.		
1960	3,382	317	3,699
1961	3,487	439	4,287
1962	3,865	496	4,361
1963	4,077	531	4,607
1964	4,244	566	4,810
1965	4,624	570	5,194
1966	4,976	628	5,604
1967	5,251	625	5,876
1968	5,326	613	5,939
1969	5,829	655	6,484

Source: Various issues of Poultry Slaughtered Under Federal Inspection and Poultry Used in Further Processing, U.S. Dept. Agr., Stat. Rpt. Serv.

Table 7.--Young chickens certified under Federal inspection, ready-to-cook weights, by end use at the plant, 1960-69

Year	Whole birds 1/	Cut-up birds 2/	Further processing	Total
	Mil. lbs.			
1960.....	N.A.	N.A.	102	3,699
1961.....	N.A.	N.A.	78	4,287
1962.....	3,612	662	87	4,361
1963.....	3,750	753	104	4,607
1964.....	3,839	847	124	4,810
1965.....	4,054	1,001	139	5,194
1966.....	4,317	1,109	178	5,604
1967.....	4,367	1,289	220	5,876
1968.....	4,295	1,390	254	5,939
1969.....	4,584	1,628	272	6,484

1/ Calculated as a residual.
2/ Cut-up birds included in "further processing" totals in 1960-61.
Note: N.A. means not available.

Source: Various issues of Poultry Slaughtered Under Federal Inspection and Poultry Used in Further Processing, U.S. Dept. Agr., Stat. Rpt. Serv.

Number, Size, and Location of Processing Plants

Poultry-processing plants under Federal inspection slaughter young chickens, mature chickens, turkeys, and other poultry. A few plants specialize in slaughtering only one of the market classes of poultry, but most of the plants slaughter two or more market classes. For this study, the plants were classified according to the predominant market class that was slaughtered.

According to this definition, in 1962, 288 plants slaughtered nearly 6 billion pounds (live weight) of young chickens. They also slaughtered 252 million pounds of mature chickens and other poultry and 147 million pounds of turkeys. In 1969, the number of plants had dropped to 231 and volume of young chickens slaughtered had increased to 9.0 billion pounds (table 8). In 1969, these plants also slaughtered 149 million pounds of mature chickens and other poultry and 95 million pounds of turkeys. Thus, the average plant slaughtered 20.8 million pounds of young chickens in 1962 and 39.0 million pounds in 1969.

All regions showed gains in slaughter from 1962 to 1969 except the East North Central and West. The largest gains were in the South Atlantic and South Central regions, each of which increased slaughter by a billion pounds.

Plants in the two smallest size groups (see table 8) dropped both in numbers and volume of slaughter from 1962 to 1969. Conversely, plants in the two largest size groups increased both in numbers and volume of slaughter. Plants slaughtering 1 million or more pounds per week, the largest size group, made the most impressive gains. From 1962 to 1969, plants in that group more than doubled in number and output. In 1969, they accounted for about 26 percent of the poultry-processing plants and nearly 50 percent of the pounds slaughtered.

The locations of the 231 poultry plants under Federal inspection slaughtering predominantly young chickens are shown in figure 3. With very few exceptions, the plants are located in broiler-production areas. Twenty-five years ago, the slaughtering plants were located mainly in the cities and the poultry was hauled to them. Thus, the migration of processing plants from cities to country points is now virtually complete. Also, areas of high plant density are areas of high production density (compare figs. 1 and 3).

Seasonality

Seasonal variation in the processing of broilers can also be measured by the slaughter by federally inspected plants. For 1965-69, average monthly rates of slaughter varied from a low of 82 percent to a high of 117 percent of the annual monthly average (table 9). The low months were November through April and the high months were May through October. This is a relatively low amount of seasonal variation compared with those of some other commodities.

Processing Costs and Income

Recent studies of assembling and processing broilers indicate that substantial economies of scale exist. However, the optimum size of plant in any given situation will be determined by the combined costs of assembling, processing, and distributing.

Table 8.--Number of poultry slaughtering plants under Federal inspection and annual volume of young chickens slaughtered (live weight), by size of plant and region, selected years 1/

Region	Plants in size group annually producing (1,000 lb.)-- Less than 5,200 lb.	5,200 to 15,599 lb.	15,600 to 51,999 lb.	52,000 lb. and over	Total	Annual volume of plants in size group annually producing (1,000 lb.)-- Less than 5,200 lb.	5,200 to 15,599 lb.	15,600 to 51,999 lb.	52,000 lb. and over	Total
	Number					1,000 pounds				
1962:										
North Atlantic	12	12	8	3	35	18,322	137,739	239,151	169,891	565,103
East North Central	17	11	---	---	28	28,399	102,667	---	---	131,066
West North Central	7	8	3	---	18	11,864	82,327	75,438	---	169,629
South Atlantic	8	20	51	13	92	13,380	189,488	1,546,200	810,727	2,559,795
South Central	9	28	2/56	9	2/102	18,515	303,958	2/1,566,319	537,901	2/2,426,693
West	4	9	2/---	---	2/ 13	9,858	77,668	2/ ---	---	2/ 87,626
Total	57	88	118	25	288	100,438	893,847	3,427,108	1,518,519	5,939,912
1967:										
North Atlantic	7	3	10	5	25	10,206	34,361	291,844	306,651	643,062
East North Central	6	3/---	3	---	3/ 9	8,819	3/	60,322	---	3/ 69,141
West North Central	3	3/ 4	4	4/---	3/4/11	8,328	3/52,950	93,565	4/ ---	3/4/154,843
South Atlantic	9	6	43	4/27	4/85	18,720	78,047	1,403,035	2,003,941	3,503,743
South Central	3	11	58	22	94	6,894	92,522	1,896,528	1,636,785	3,632,729
West	---	8	3	---	11	---	84,988	76,200	---	161,188
Total	28	32	121	54	235	52,967	342,868	3,821,494	3,947,377	8,164,706
1968:										
North Atlantic	5	5	8	6	24	5,429	55,383	232,918	354,114	647,844
East North Central	6	2/---	2/5	0	11	8,528	2/---	2/97,210	0	105,738
West North Central	3	2/---	2/8	0	11	8,183	2/---	2/184,642	0	192,825
South Atlantic	3	8	40	28	79	7,224	86,769	1,363,125	2,005,257	3,462,375
South Central	3/3	7	60	22	92	3/6,846	68,446	2,009,456	1,621,763	3,706,513
West	3/---	5	4	0	9	2/ ---	55,323	88,127	0	143,450
Total	20	25	125	56	226	36,212	265,921	3,975,478	3,981,134	8,258,745
1969:										
North Atlantic	5	2/---	2/12	5	22	10,078	2/---	2/331,436	311,239	652,753
East North Central	6	2/---	2/ 5	0	11	9,152	2/---	2/107,614	0	116,766
West North Central	3	2/---	2/ 9	0	12	8,070	2/---	2/210,460	0	218,530
South Atlantic	5	6	43	28	82	13,980	55,068	1,554,004	2,220,339	3,843,391
South Central	3/6	5	3/60	3/26	97	3/20,086	53,889	3/2,044,607	3/1,962,047	4,080,629
West	3/---	7	3/---	3/---	7	3/ ---	85,586	3/---	3/---	85,586
Total	25	18	129	59	231	61,366	194,543	4,248,121	4,493,625	8,997,655

1/ Slaughtering predominantly young chickens.
2/ Plants and volume for South Central and Western regions have been combined to avoid disclosure of individual plant data.
3/ Plants and volume for East North Central and West North Central regions have been combined to avoid disclosure of individual plant data.
4/ Plants and volume for West North Central and South Atlantic regions have been combined to avoid disclosure of individual plant data.

Source: Comp. from unpubl. data, U.S. Dept. Agr., Consumer and Mktg. Serv., Poultry Div.

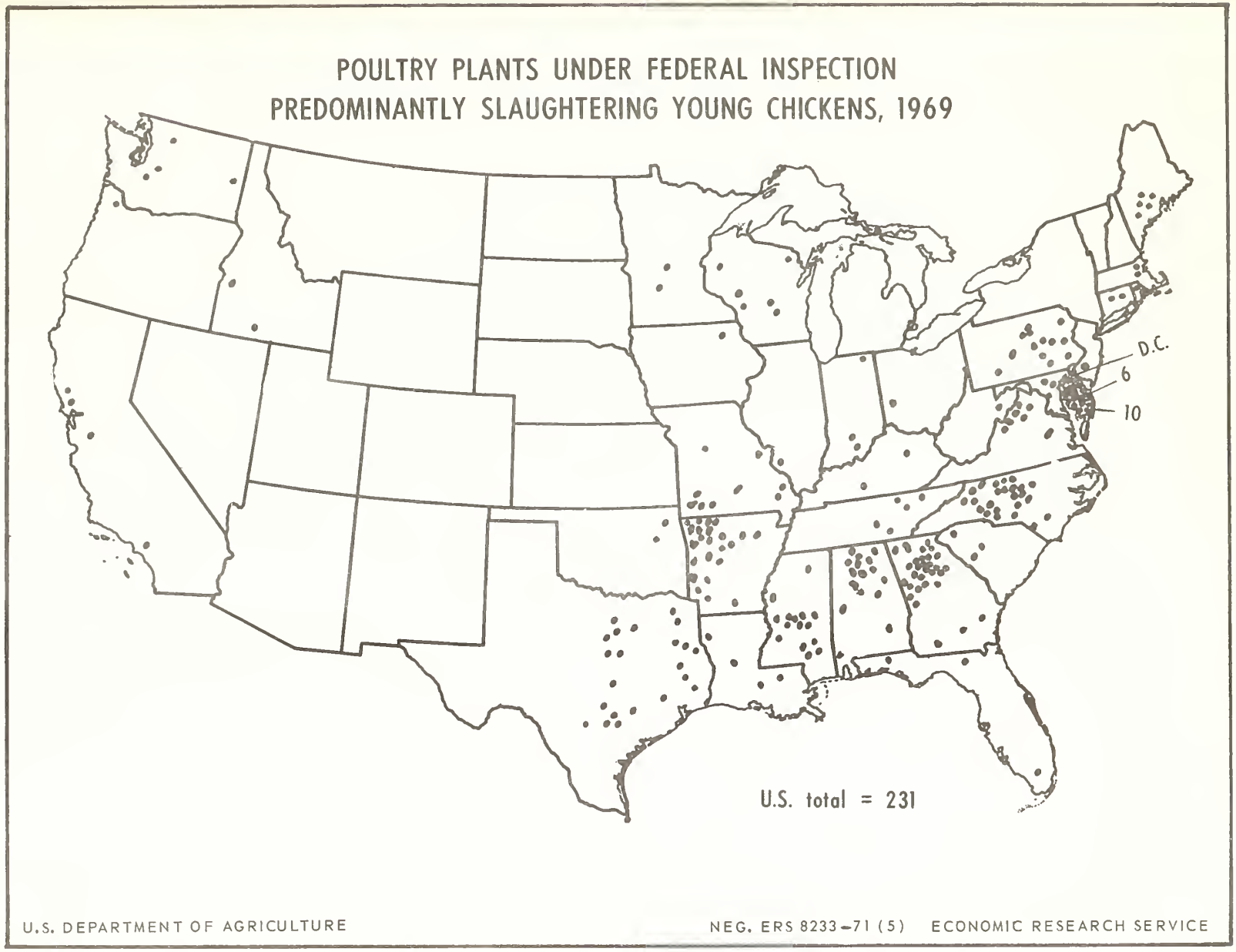
POULTRY PLANTS UNDER FEDERAL INSPECTION
PREDOMINANTLY SLAUGHTERING YOUNG CHICKENS, 1969
D.C.
6
10
U.S. total = 231
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 8233-71 (5) ECONOMIC RESEARCH SERVICE

Figure 3

Table 9.--Index of seasonality of slaughter, young chickens, 1963-67

Month	Monthly slaughter (1,000 lbs.)1/					1965-69	Percentage of annual monthly average					1965-69
	1965	1966	1967	1968	1969	average	1965	1966	1967	1968	1969	average
January	396	407	475	484	541	460	91	87	97	98	100	95
February	353	398	404	429	446	406	82	85	82	87	83	84
March	408	439	472	449	483	450	94	94	96	91	89	93
April	420	450	456	485	533	469	97	96	93	98	99	97
May	433	470	552	532	563	510	100	101	113	107	104	105
June	487	514	548	497	574	524	112	110	112	100	106	108
July	467	465	488	551	568	508	108	100	100	111	105	105
August	483	540	573	548	574	544	112	116	117	111	106	112
September	470	515	504	503	578	514	109	110	103	102	107	106
October	457	497	526	572	611	533	106	106	107	116	113	110
November	398	435	449	426	461	434	92	93	92	86	85	89
December	421	473	430	464	553	468	97	101	88	94	102	96
Total	5,193	5,603	5,877	5,940	6,484	5,819						
Annual monthly average	433	467	490	495	540	485						

1/ Certified ready-to-cook weights.

Source: Comp. from unpubl. data of U.S. Dept. Agr., Consumer and Mktg. Serv., Poultry Div.

One study, published in 1959, indicated that longrun average costs of broiler processing decreased from 3.8 cents per pound (live weight basis) at an output of 4.15 million pounds per year to 2.6 cents per pound at an output of 69.16 million pounds per year (36). On the other hand, costs per pound for assembling live broilers tend to increase with total volume at any given level of production density. According to a 1964 study of marketing New England poultry, with production density at 1,000 pounds per square mile per year, combined assembly and processing costs reached a minimum at about 25 million pounds per year. At density levels of 5,000 and 25,000 pounds per square mile per year, combined per unit costs continued decreasing at 70 million pounds per year (14).

Utilization of plant capacity also affects costs. For example, a given annual volume of broilers could be handled by one large slaughtering plant operated at less than 100 percent capacity or by two smaller plants operated at capacity. A plant capable of slaughtering and eviscerating 3,600 broilers per hour, but operating at 50 percent capacity, might process a given volume for 4.0 cents per pound live weight. But a plant with a capacity of only 1,800 birds per hour,operated at 100 percent capacity, could process the same total volume for 3.3 cents per pound.

A breakdown of average costs of processing, transporting, and selling broilers to retail outlets shows that, in 1963, processing costs accounted for 52 percent of total costs, and transportation and selling costs for 48 percent (table 10). The largest cost items in processing plants were wages and supplies.

Annual earning rates for selected chicken-processing firms from 1959 through 1964 are given in table 11. Over the 6-year period, net income after taxes averaged 0.65 percent of sales, 3.6 percent of assets, and 7.7 percent of net worth (22).

Losses

Condemnation Loss in Processing Plants

When young chickens are brought to the processing plants, they are inspected twice. Inspection of live birds is known as ante mortem inspection. Examination of carcasses and body contents after slaughter is known as post mortem inspection.

In 1969, 9,065 million pounds of live young chickens were inspected at processing plants under Federal inspection and 34 million pounds, or 0.4 percent, were condemned (52). From 1960 through 1965, the ante mortem condemnation rate was 0.2 percent. It rose to 0.3 percent in 1966 and stayed at that rate until 1969 (table 12).

Table 10.--Average costs per pound live weight for slaughtering and eviscerating, transporting, and selling broilers, medium-capacity plants, 1963

Item	Costs per pound	As percentage of total costs
	Cents	Percent
Processing:		
Plant wages	1.4	24.1
Supplies	.8	13.8
Management	.3	5.2
Utilities	.2	3.4
Capital ownership	.3	5.2
Total processing	3.0	51.7
Transporting and selling:		
Live hauling	.6	10.4
Transporting to market	.9	15.5
Selling cost	.2	3.4
Miscellaneous 1/	1.1	19.0
Total transporting and selling	2.8	48.3
Total cost	5.8	100.0

1/ Includes intracity transportation, profits, and storage.

Source: Rogers, G.B., and Conley, F.M., Marketing Poultry and Eggs, U.S. Dept. Agr., ERS-324, Oct. 1966.

Table 11.--Earning rates for 17 chicken-processing firms, 1959-64[1/]

Year	Net income after taxes as a percentage of --		
	Sales	Assets	Net worth
1959	0.41	2.3	4.8
1960	.60	2.2	7.5
1961	.69	3.9	8.1
1962	.80	5.3	10.2
1963	.73	4.1	8.3
1964	.66	3.7	7.6
6-year average	0.65	3.6	7.7

1/ All meatpacking firms and firms with less than 50 percent of 1964 sales from meat and poultry were excluded. Firms were classified based on 1964 operations. Excluded were firms processing more than one product; that is, both chickens and turkeys. Many firms were vertically integrated; however, fiscal years were not all on a calendar year basis, although most of these years corresponded approximately.

Source: Organization and Competition in the Poultry and Egg Industries, Natl. Commis. on Food Mktg. Tech. Study no. 2, June 1966.

Table 12.--Condemnations and yields of young chickens slaughtered under Federal inspection, 1960-69

Year	Ante mortem	Post mortem	Yield[1/]
	Percent		
1960.....	0.2	2.5	72.18
1961.....	0.2	1.9	72.52
1962.....	0.2	2.2	72.50
1963.....	0.2	2.4	72.59
1964.....	0.2	2.5	72.55
1965.....	0.2	2.7	72.55
1966.....	0.3	3.7	71.83
1967.....	0.3	4.0	71.62
1968.....	0.3	3.6	71.47
1969.....	0.4	3.5	71.53

1/ Total pounds of certified ready-to-cook weight as a percentage of live weight hung on the lines.

Source: Comp. from unpubl. data of U.S. Dept. Agr., Consumer and Mktg. Serv., Poultry Div.

Subtracting the 34 million pounds of live-bird condemnations from the 9,065 million pounds of live young chickens leaves 9,031 million pounds that were hung on the processing lines in 1969. When these birds are slaughtered and blood and feathers removed, the result is equivalent to 8,128 million pounds of New York-dressed young chickens (90-percent yield). At this stage, the birds are opened and their body contents examined by Federal inspectors, leading to the post mortem condemnations.

In 1969, Federal inspectors condemned 288 million pounds (New York-dressed weight) of young chickens, 3.5 percent of the young chickens slaughtered. From 1960 through 1965, post mortem condemnations varied from 1.9 to 2.7 percent of the New York-dressed weight inspected. In 1966, the percentage increased to 3.7 and in 1967 to 4.0.

Causes of these losses are mainly diseases or infections such as leukosis, septicemia, air saculitis, synovitis, and tumors. Other causes are bruises, cadavers (death), contamination, and overscald. A recent study analyzed the importance and causes of broiler condemnations and trends in condemnation in the United States for 1959-66 (29).

Spoilage Loss During Storage

No specific information is available on spoilage loss during storage for broilers. However, it must be insignificant because: (1) only 655 million pounds (ready-to-cook weight), or 10 percent of the young chickens certified in 1969 were frozen; and (2) peak cold-storage holdings of broilers in 1969 were 23 million pounds, less than 4 percent of the birds that were frozen. Thus, the peak amount stored was less than 0.4 percent of the amount certified. Losses among cold-storage items are usually relatively small; thus, storage losses for broilers must be very small indeed.

Processor's Selling Prices

Through the years, there has been no consistent national price series for broilers sold by poultry processors. However, processor's selling prices have trended downward for two reasons: (1) farm price for live birds has shown a downward trend since 1948 (table 1); and (2) as processors have become larger and more efficient, costs have decreased and their margin has narrowed.

Pricing methods widely used by processors in the 1950's and 1960's were summarized in a study by the National Commission on Food Marketing (22, p. 55). The general practice through most of this period was to tie the ready-to-cook broiler price to the live price by a formula. The typical formula was the live price divided by 73 percent (the approximate yield of ready-to-cook broiler from live weight) plus 5 to 7 cents to cover processing costs. The live price used was that reported by the U.S. Department of Agriculture (USDA) Market News Service for one of the important southern

broiler-producing States. Ready-to-cook price determined was used in beginning negotiations with buyers. The price-basing point typically used at that time was Atlanta; and incremental amounts were added to the price to cover transportation to various locations.2/ As more and more broilers were produced under contract, there were fewer and fewer actual sales of live broilers to quote. Thus, the USDA Market News Service changed the name of the quotation to "live at-farm base valuation" and based this value on information gathered from processors. Finally, on October 1, 1965, the USDA Market News Service discontinued the report entirely and began expanding its coverage of ready-to-cook market prices in large metropolitan areas. The change left the broiler processor without the live-price quotation he needed for his traditional pricing formula. At the request of the broiler industries in some States, State departments of agriculture began live-price reporting services to take the place of the discontinued USDA report. Greater emphasis was also given to experimenting with formulas tied to ready-to-cook prices reported by USDA in major cities (22).

More recently, the USDA Market News Service has developed a nine-city weighted average price for ready-to-cook icepacked broilers, delivered to consuming markets for trucklot sales. The price is published on Monday for deliveries to be made in the current week. The trading level used is "delivered to first receivers" at terminal markets. The nine cities are: Chicago, Cleveland, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, and San Francisco. The nine-city average is now widely used throughout the industry as a measure of the price lead.

Another recent development by the USDA Market News Service in cooperation with the broiler industry has been the processors' f.o.b. dock-equivalent price for ready-to-cook broilers. The birds--plant grade A and U.S. grade A--are icepacked, in trucklots, for delivery to major markets. Daily reports reflect number of loads of whole birds sold at each price level since the last report for deliveries to terminal markets during the current week and for the next week. Also, the cumulative number of loads at each price for delivery in the next week are shown. Processors' f.o.b. dock-equivalent prices are reported for Georgia, Alabama, and Mississippi.

MARKETING

Geographical Movements

One way to suggest the movements between producing and consuming areas is to develop a surplus-deficit table. This is done by assuming that U.S. average consumption per person applies equally in all parts of the country.

2/ Table 13 shows typical transportation costs from north Georgia to selected markets as of Mar. 1968.

Table 13.--Transportation costs for truckload lots of ready-to-cook broilers, from North Georgia plants to various destinations, March 1968 1/

City	Costs per pound
	Cents
New York City	2/1.50-1.75
Philadelphia	1.50
Baltimore	1.25
Washington, D.C.	No shipments
Tampa	.75-.90
Miami	1.00
Cincinnati	1.00
Cleveland	1.25-1.50
Detroit	1.50
Chicago	3/1.25
Milwaukee	1.25
Minneapolis	1.50
Kansas City	1.25
Des Moines	1.50
St. Louis	1.00
Denver	1.75 (No shipments)
Salt Lake City	2.75 (Occasional shipments)
Los Angeles	2.25 (Occasional shipments)
San Francisco	2.50 (Occasional shipments)
Seattle	3.00 (Occasional shipments)

1/ Truckload lots are customarily 400 boxes weighing 24,000 pounds or more without the ice.

2/ The rate of 1.50 cents per pound was stable for several years. In April-May 1967, it was increased to 1.75 cents per pound. By mid-July 1967, both rates were being used, but mostly 1.75.

3/ This rate is sometimes dropped 0.10 cent per pound on a full-load basis.

Source: U.S. Dept. Agr., Consumer and Mktg. Serv., Poultry Div., Mkt. News Br.

An estimate of requirements for each State can be obtained by multiplying the number of people in the State by the U.S. average per capita consumption figure. This estimate can then be compared with the pounds of broilers produced State by State. The difference between estimated consumption and production is the surplus or shortage.

The States with the largest shortages in 1969 were New York, 637 million pounds; California, 474 million pounds; Illinois, 387 million pounds; Ohio, 349 million pounds; Michigan, 304 million pounds; Pennsylvania, 274 million pounds; and New Jersey, 248 million pounds. For all these States, the shortages of broilers were greater in 1969 than in 1960 or 1950 (table 14).

The States with the largest surpluses in 1969 were Georgia, 951 million pounds; Arkansas, 945 million pounds; Alabama, 765 million pounds; North Carolina, 565 million pounds; Mississippi, 474 million pounds; Maryland, 357 million pounds; Delaware, 356 million pounds; and Maine, 181 million pounds. For all these States, the surpluses of broilers were greater in 1969 than in 1960 or 1950. California, one of the 10 leading States in production, is deficit when its needs are considered.

Table 14.--Broiler surpluses and shortages by State and region, selected years1/

State and region	1950	1960	1967	1968	1969
	Million pounds				
Maine	43	129	181	182	181
New Hampshire	6	1	-16	-19	-24
Vermont	-2	-8	-14	-14	-15
Massachusetts	-8	-96	-162	-163	-182
Rhode Island	-5	-16	-28	-28	-31
Connecticut	20	-6	-71	-74	-87
New England	54	4	-110	-117	-158
New York	-110	-368	-584	-586	-637
New Jersey	-23	-125	-225	-229	-248
Pennsylvania	-56	-168	-256	-254	-274
Mid-Atlantic	-190	-660	-1,065	-1,069	-1,159
Ohio	-56	-195	-313	-320	-349
Indiana	27	-22	-119	-122	-143

Note: See footnote at end of table

Continued--

Table 14.--Broiler surpluses and shortages by State and region, selected years--Continued[1/]

State and region	1950	1960	1967	1968	1969
	Million pounds				
Illinois	-57	-226	-357	-360	-387
Michigan	-51	-174	-279	-285	-304
Wisconsin	-18	-42	-95	-96	-104
East North Central	-155	-659	-1,164	-1,183	-1,287
Minnesota	-22	-64	-92	-89	-97
Iowa	-12	-54	-80	-79	-84
Missouri	-7	-29	-98	-100	-109
North Dakota	-5	-15	-21	-21	-22
South Dakota	-6	-16	-22	-22	-23
Nebraska	-5	-28	-44	-44	-48
Kansas	-13	-47	-73	-74	-80
West North Central	-70	-254	-431	-428	-462
Delaware	164	233	331	297	356
Maryland	92	200	292	309	357
Washington, D.C.	-7	-18	-27	-27	-28
Virginia	57	27	-30	-16	-4
West Virginia	16	15	-18	-17	-22
North Carolina	19	264	515	532	565
South Carolina	-5	-15	-38	-38	-34
Georgia	91	667	979	951	951
Florida	-7	-95	-138	-113	-126
South Atlantic	419	1,278	1,868	1,879	1,105
Kentucky	-23	-33	-80	-83	-95
Tennessee	-22	-5	-15	-27	-21
Alabama	-3	329	702	711	765
Mississippi	14	215	405	421	474
East South Central	-33	506	1,012	1,022	1,123
Arkansas	78	360	803	812	945
Louisiana	-20	-31	-16	-11	-11
Oklahoma	-14	-40	-48	-49	-50
Texas	-6	14	39	48	36
West South Central	38	304	777	798	921
Montana	-5	-16	-23	-23	-24
Idaho	-4	-7	-8	-7	-9
Wyoming	-3	-8	-10	-10	-11
Colorado	-8	-39	-66	-67	-74
New Mexico	-6	-23	-33	-33	-35
Arizona	-5	-30	-53	-54	-59
Utah	-5	-17	-28	-29	-33
Nevada	-1	-7	-14	-15	-16
Mountain	-37	-146	-236	-238	-261
Washington	-11	-30	-45	-49	-59
Oregon	-4	-13	-31	-30	-32
California	-1	-237	-430	-449	-474
Pacific	-16	-280	-506	-528	-565

1/ Minus figures indicate shortages.

Source: Farmer Coop. Serv., U.S. Dept. Agr.

Origins of receipts at a sample of 13 cities also help to identify broiler movements. The origins of receipts to these major cities are listed in order of importance. However, competition among the producing areas for markets is also apparent. The following tabulation for 1969 is based on information obtained by the Poultry Market News Branch, Poultry Division, Consumer and Marketing Service, USDA, Market News field offices:

City	Principal origins
Boston	Delmarva Peninsula; New England area including Maine; and Virginia
New York	Delmarva Peninsula; North Carolina; New England area including Maine; and Georgia
Baltimore	North Carolina, Delmarva Peninsula; and Georgia
Washington, D.C.	North Carolina, Delmarva Peninsula; and Georgia
Cleveland	Georgia, Missouri, Arkansas, and Ohio-Indiana
Chicago	Alabama, Georgia, Mississippi, Arkansas, and Ohio-Indiana
Minneapolis-St. Paul	Missouri-Arkansas, Minnesota, Georgia, Mississippi, and Alabama
St. Louis	Missouri-Arkansas, Alabama, Mississippi, and Georgia
Atlanta	Georgia and Alabama
Denver	Arkansas, Texas, Missouri, and Alabama
Los Angeles	Arkansas, Texas, California, Alabama, Louisiana, and Mississippi
San Francisco	California, Texas, Mississippi, Arkansas, and Alabama
Seattle	Washington, Arkansas, and California

Seasonality

The seasonal variation in slaughter of broilers was discussed in the earlier section, Processing. Consumption also varies seasonally. Domestic consumption is highest during the second and third quarters of the year and lowest during the first and fourth quarters (table 15). The two major outlets other than domestic use are further processing and exports. Seasonal variations for these seem to follow the seasonal variation in broiler slaughter.

The monthly patterns for farm and retail prices are inversely related to the seasonal variations in slaughter. When slaughter is highest, the price per pound is lowest. But farm-to-retail price spreads are narrowest in December and January and widest in early spring.

Table 15.--Per capita consumption of broilers, by quarters

Period	Quarter				Annual
	First	Second	Third	Fourth	
	Pounds				
1960-62	5.3	6.9	6.9	5.8	24.9
1963-65	6.4	7.4	7.6	6.6	28.0
1966-68	7.5	8.5	8.8	7.9	32.7
1969	8.0	9.0	9.3	8.8	35.1

Source: Poultry and Egg Situation, U.S. Dept. Agr., Econ. Res. Serv., June 1970.

Marketing Channels

A growing greater volume of broilers moved direct from processing plants to final outlets during the 1960's. Thus, wholesale distributors have been increasingly bypassed as marketing channels have become shorter and more direct. In the early 1960's, volumes moving direct to retail and institutional outlets and volumes moving through wholesale distributors to such outlets were approximately equal (35). By 1969, about two-thirds of this volume moved direct and only one-third went through wholesale distributors (fig. 4).

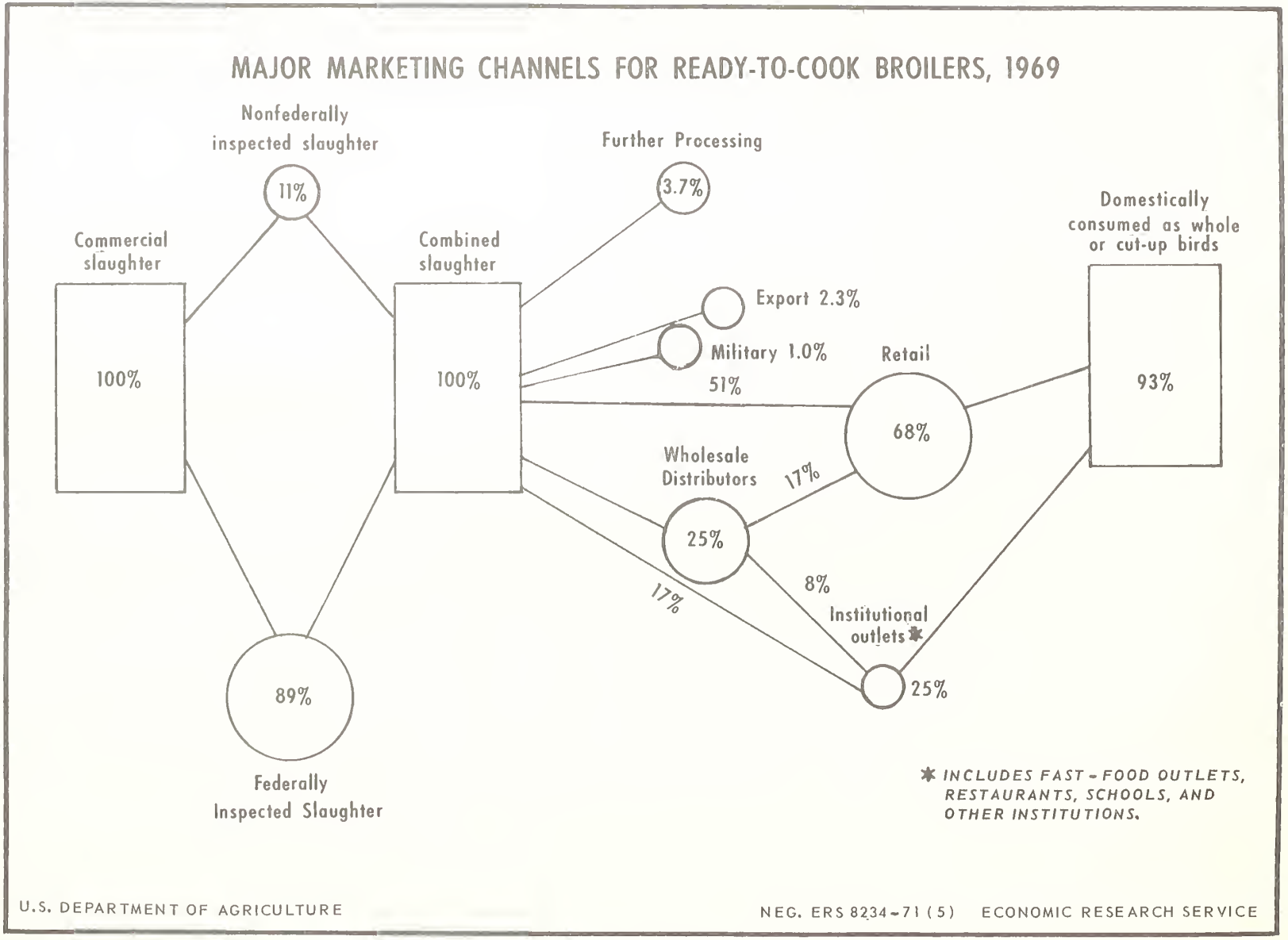
MAJOR MARKETING CHANNELS FOR READY-TO-COOK BROILERS, 1969
Nonfederally inspected slaughter
11%
Commercial slaughter
100%
89%
Federally Inspected Slaughter
Combined slaughter
100%
Further Processing
3.7%
Export 2.3%
Military 1.0%
51%
Retail
68%
Wholesale Distributors
17%
25%
8%
17%
Institutional outlets*
25%
Domestically consumed as whole or cut-up birds
93%
* INCLUDES FAST-FOOD OUTLETS, RESTAURANTS, SCHOOLS, AND OTHER INSTITUTIONS.
U.S. DEPARTMENT OF AGRICULTURE
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Figure 4

In the early 1960's, institutional outlets accounted for 12 percent of the volume of broilers sold other than for further processing, export, and military requirements (35). By 1969, institutional outlets accounted for about 25 percent of this volume. The major factor responsible for the relative growth in institutional use has been the development of fast-food outlets.

A 1969 survey underlined the present extent of the institutional market for broilers, based on estimates of how processing plants packed poultry and of places where it was to be sold. This analysis indicated that 66 percent of the plants' output was packed for retail outlets, 30 percent for institutional outlets, and the remaining 4 percent for export and military outlets. Of the share packed for retail outlets, 51 percent were fresh-ice or CO_2 packs; 9 percent, fresh deep-chill (blast) packs; 3 percent, frozen raw; and 3 percent, frozen cooked. Of the share packed for institutional outlets, 15 percent was fresh for fast-food outlets; 9 percent fresh for restaurants, schools, and so on; 3 percent, frozen raw; and 3 percent, frozen cooked (7).

Further processing, export, and military requirements combined accounted for about 6 percent of commercial broiler output in the early 1960's (52) and 7 percent in 1969. The percentage of volume used in further processing more than doubled during 1964-69, while the percentages exported and used for military needs declined more than a third. Actual quantities used in further processing about tripled, while exports declined moderately and military requirements changed little.

Supermarkets have a larger share of the volume of broilers sold through retail foodstores than they do of the total volume of all food products. They handle about three-fourths of the broilers sold through retail foodstores.

Marketing Margins and Costs

For 1963-69, farm value of frying chickens varied from 18.2 to 21.0 cents per pound, while retail price varied from 39.4 to 43.6 cents per pound.3/ The margins between these price levels also exhibited considerable stability. The farm-to-retailer margin varied from 9.0 to 11.7 cents per pound, while the retailer-to-consumer margin varied from 10.5 to 11.4 cents (table 16). The farmer's share of the consumer's dollar was 50.0 percent in 1963, compared to 47.8 percent in 1969.

An earlier study (36) divided the marketing margin for frying chickens into price spreads by agencies, function, and cost items (fig. 5). Profit was not shown separately.

Prices to retailers for frying chickens generally reflect added costs of transportation and handling as distance from major surplus areas increases.

3/ Farm value is payment received by farmers for a quantity of live poultry equivalent to a pound of ready-to-cook poultry.

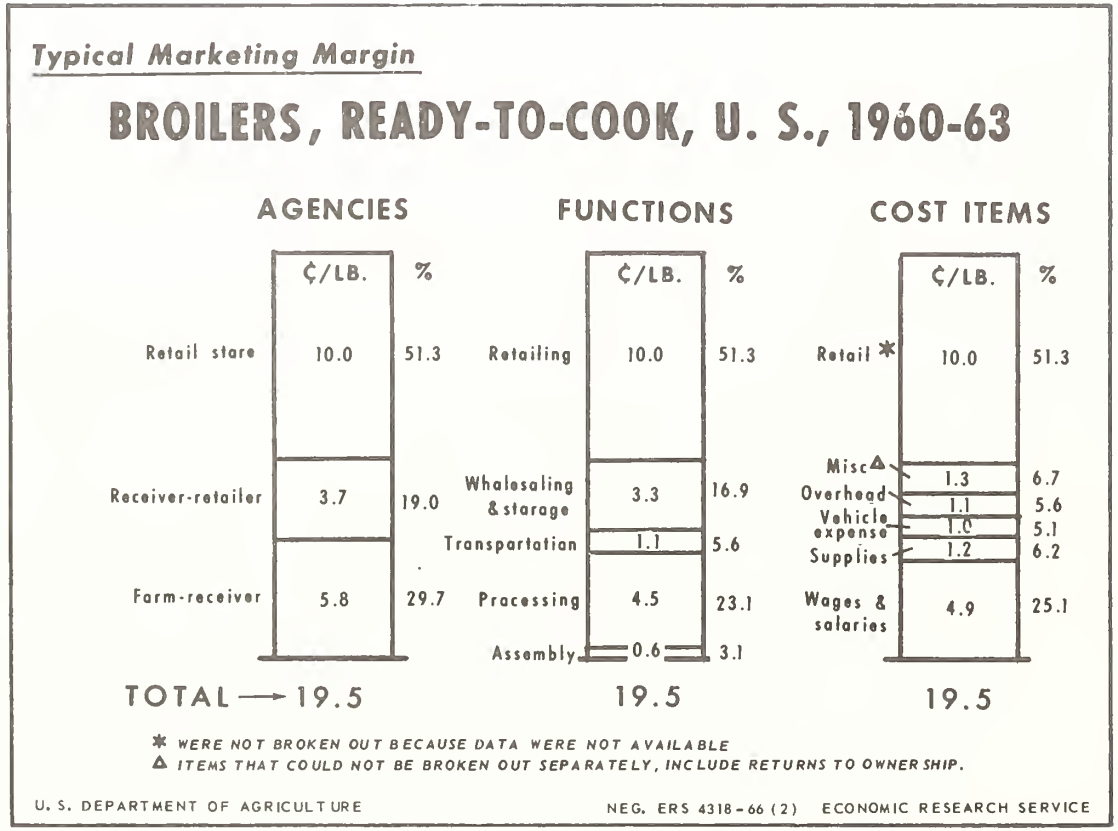
Typical Marketing Margin
BROILERS, READY-TO-COOK, U. S., 1960-63
AGENCIES
FUNCTIONS
COST ITEMS
¢/LB.
%
Retail store
10.0
51.3
Receiver-retailer
3.7
19.0
Farm-receiver
5.8
29.7
TOTAL → 19.5
Retailing
Whalesaling & storage
3.3
16.9
Transportation
1.1
5.6
Processing
4.5
23.1
Assembly
0.6
3.1
19.5
Retail *
Misc△
1.3
6.7
Overhead
1.1
5.6
Vehicle expense
1.0
5.1
Supplies
1.2
6.2
Wages & salaries
4.9
25.1
19.5
* WERE NOT BROKEN OUT BECAUSE DATA WERE NOT AVAILABLE
△ ITEMS THAT COULD NOT BE BROKEN OUT SEPARATELY, INCLUDE RETURNS TO OWNERSHIP.
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Figure 5

Table 16.--Prices and price spreads for ready-to-cook frying chickens in 12 cities, 1963-69

Items	1963 1/	1964	1965	1966	1967	1968	1969	1963-69 average
	Cents							
Farm value	20.4	19.5	20.4	21.0	18.2	19.4	20.8	20.0
Price to retailers	29.4	28.6	29.5	31.1	28.9	30.6	32.5	30.1
Retail prices	40.8	2/39.4	40.2	42.4	39.4	41.1	43.6	41.0
Spreads:								
Farm-retail	20.4	2/19.9	19.8	21.4	21.1	21.7	22.8	21.0
Farm-retailer	9.0	9.1	9.1	10.1	10.7	11.2	11.7	10.1
Retailer-consumer	11.4	2/10.8	10.7	11.3	10.5	10.5	11.0	10.9
	Percent							
Farm share of retail prices	50.0	2/49.5	50.7	49.5	46.3	47.3	47.8	48.7

1/ 11-city average: Boston, New York, Baltimore, Washington, Atlanta, Cleveland, Chicago, St. Louis, Los Angeles, San Francisco, and Seattle.
2/ Estimated from data for less than 12 months.

Source: U.S. Dept. Agr., Econ. Res. Serv.. Mktg. Econ. Div.

While prices to retailers in New York, Baltimore, and Washington are higher than those in Atlanta, prices in Boston (because of averaging of prices in Maine and other areas) are slightly lower. Prices in markets on the West Coast are several cents higher than in the East or Midwest.

Retail prices may also vary between cities because of the varying extent of "specialing" in different cities. It is a common practice to use frying chickens as price specials along with other meats. Either retailers or suppliers may initiate action leading to specials. In one sense, specialing may disrupt orderly producing and marketing arrangements. In another sense, it may increase total annual sales, since several times as many pounds are sold in "special" weeks as in "nonspecial" weeks.

Spoilage Loss During Marketing

According to the National Commission on Food Marketing, three leading retail chains purchased an estimated 1.032 pounds of frying chicken for every pound sold at retail (22). This extra 3.2 percent was needed to make up for (1) cutting loss; (2) weepage of both moisture from the cooling process and fluids from the meat, which reduces weights; (3) waste due to mishandling; and (4) spoilage. These losses also vary with the length of time fresh birds are in marketing channels.

The cutting-up operation is being done increasingly in the processing plant, but shrinkages may be similar in plants or retail stores. Cutting shrink and weepage in retail stores was measured in three research projects. According to a Maine agricultural station report (37), cutting shrink was 1.72 percent; an unpublished Delaware thesis (40) showed 1.77 percent; and a North Carolina report (41) showed 1.83 percent.

Subtracting the maximum cutting shrink of 1.8 percent from the 3.2 percent of extra pounds that the retailers must purchase would suggest a loss of 1.4 percent due to spoilage, if all of the birds were cut up at the retail level. However, it was established earlier that 15-25 percent of the ready-to-cook birds were cut up at the processing-plant level. Moreover, consumers buy many birds in whole-carcass form. Thus, the loss due to spoilage at the retail level must be higher than 1.4 percent. A conservative estimate of the maximum loss due to spoilage would be 2.5 percent. If the average of the low and the high estimates is used, an average spoilage rate of 2 percent is indicated.

Assuming 6.2 billion pounds of ready-to-cook broilers moving to retail outlets, including institutions, a 2-percent spoilage loss would equal 124 million pounds. A value for the estimated spoilage loss can be obtained by using wholesale prices for broilers. The nine-city weighted average delivered price for trucklot sales of ready-to-cook icepacked broilers averaged 27.1 cents per pound for 1965-69. Multiplying the estimated spoilage loss of 124 million pounds by the average wholesale price of 26.6 cents per pound (assuming unitary elasticity) results in an estimated value of the annual spoilage loss of $33.0 million.

Time Lapse in Marketing

To illustrate the time lapse in marketing, a shipment of icepacked broilers will be traced from a north Georgia processing plant to a homemaker in Chicago. Live birds are hung on the processing line directly from trucks beginning on Monday morning. By Monday afternoon or evening, the birds have been processed ready-to-cook, chilled, icepacked, and loaded into a large truck carrying a net weight of at least 24,000 pounds. With one driver on the truck, the load arrives at a chainstore warehouse or wholesale distributor's warehouse in Chicago on Wednesday morning. The birds are distributed to retail stores and other outlets on Wednesday and Thursday. The last lots distributed may be re-iced. Some birds are then cut-up, packaged, price marked, and date coded in a back room of the retail store. Other birds are packaged and sold whole. They are displayed in refrigerated retail counters on Friday and Saturday. The homemaker buys them on Friday or Saturday and cooks the birds on Sunday. Any birds that have not been sold after their third morning in the retail store are checked for odor and are also rewrapped if, for example, the package has been torn. In the example given, the total lapsed time was 7 days from slaughter to consumption. This can be shortened or lengthened depending on marketing conditions.

Tighter scheduling all through the processing and marketing system can reduce the time lapse substantially. For instance, orders received by the processor in midweek may be filled from stocks on hand in the cooler. Also, transit time can be sharply reduced by using two drivers instead of one (table 17).

Table 17.--Transit time from north Georgia plants to various destinations for truckload lots of ready-to-cook broilers, 1968

Destination	Transit time	
	One driver	Two drivers
	Hours	
New York City	40	18
Tampa	18	N.A.
Miami	24	12
Cincinnati	18	N.A.
Cleveland	36	18
Detroit	40	20
Chicago	36	18
Milwaukee	36	18
Minneapolis	40	20
Des Moines	36	18
St. Louis	18	N.A.

Note: N.A. means not available.

Source: U.S. Dept. Agr., Econ. Res. Serv., Consumer and Mktg. Serv., Mark. News Br.

Quality Preservation

Temperature control, both at the processing plant and during marketing and distribution, is important to quality preservation. Immediately after processing, the internal body temperature of the birds must be brought to 40 degrees F. or below (52). This can be achieved through ice and water chilling, air chilling, or freezing.

The most widely used method is a slurry of ice and water in which the birds are tumbled or agitated. Birds under 4 pounds must be chilled to less than 40 degrees in 4 hours or less. Under current technology, this is done in less than 1 hour. The ice water slurry brings the internal body temperature to just below 40 degrees F. Water absorption of 10-12 percent results depending on: (1) how long the birds are kept in the ice and water and (2) how they are tumbled or agitated. According to USDA regulations, moisture absorption for icepacked birds cannot exceed 12 percent at time of packing (52). Before packaging, the birds are hung on a drip line and some of the water is lost. Additional amounts are lost during transportation and handling through the distributor's warehouse.

Chlorine can be used in the ice slurry used to chill broilers that will be ice- or chill- packed. The effect of this is described in (29): "With an initial nominal concentration of available chlorine of 200 p.p.m., shelf-life at 1 degree C. was extended by about 20 percent. Panels of observers detected no significant effect on appearance, taste, or odor and the results of a small scale consumer trial supported these findings. Initial concentrations of available chlorine of 500 p.p.m. and more resulted in tainted carcasses."

A 20-percent extension of shelf life for icepacked broilers would be about 1 day. Apparently, the chlorine in high concentration (200 p.p.m.) removes salmonellae from the skin surface, but it does not combat salmonellae imbedded in the skin or hair follicles.

Freezing preserves broilers for long periods; other forms of preservation can be used for shorter periods. Freezing accounted for only 10 percent of the pounds of broilers certified as wholesome in 1969. Although frozen poultry can be kept for a year or longer, broilers are usually moved into and out of the warehouses on a 3-month rotation. Broilers can be cut-up, packaged, and frozen at the processing plant for regular accounts, institutions, and other outlets that want a frozen product. Very few, if any, of the frozen broilers are put into storage because of low prices or slack demand.

In 1969, 90 percent of the broiler poundage certified in plants under Federal inspection was marketed as icepacked and CO_2 packed or as chill packed. Icepacked and CO_2 packed combined are more important. Probably less than 10 percent is chill packed.

Icepacked broilers are usually packed 24 to the box and then covered with 20 pounds of ice. Some buyers specify that 20 birds be packed to the box during the summer months so that more ice can be put into the box. Some buyers specify a 60-pound net weight of the birds in the box to facilitate easier billing from the warehouse to the stores. Usually, the entire truckload is top iced also, between the top layer of poultry boxes and the roof of the truck. Internal body temperature of the birds will be at 34-35 degrees F. as long as a good covering of ice is maintained in the boxes. A recent study concluded in part: "Shipping boxes with good insulation properties protect the product from rapid spoilage in two ways: First, by retaining ice for a longer period during extended low temperature unfrozen storage; and second, by minimizing the effect of any accidental exposure to high temperatures during shipping and handling" (44). Among the various kinds of boxes used to pack poultry, polystyrene boxes provide the best insulation. However, these are not in use commercially except on a test basis.

In one type of pack, liquid carbon dioxide is drawn from a 12-ton tank. The liquid goes through insulated copper tubing to a dispenser hood which fits over a corrugated box. An automatically timed shot of 1 pound of the liquid emerges as a gas and supercools the box, then falls to the bottom as snow ice. A wet-strength pad is placed on top of the snow ice and the box is ready to receive poultry (6). After the poultry is put into the box, it may be top iced with carbon dioxide. Except for the use of carbon dioxide as a coolant, the broilers are handled the same as the icepacked birds.

The advantages claimed for this patented system are: (1) a payload 25 percent greater than that from icepacking, (2) no short-weight problems, (3) a more sanitary package, and (4) at least 20-percent less storage space needed by receiver for dry cartons.

Birds being chill packed are first chilled in an ice water slurry but are not agitated, thus minimizing water absorption. Only 5 percent water is picked up, compared with 12 percent in the conventional chillers. Next, the birds are hung on a conveyor line that moves through a 34-degree F. cooler for 45 minutes, a longer draining time than that for icepacked birds. The birds are then put through a blast freezer where the temperature is minus 40 degrees F. They are kept in the freezer 45 minutes--long enough to pull the internal body temperature down to 28 degrees F. (Meat freezes at 26 degrees F.) The birds are then kept in a holding room where the temperature is 28 degrees F. Cutting, wrapping, weighing, pricing, and date coding can all be done at the processing-plant level. Plants that have successfully used the patented chill-pack system have done so by (1) using a very high degree of sanitation in the processing plant to minimize initial bacterial populations, especially the spoilage types; and (2) bringing the body temperature down to 28-32 degrees F. and keeping it there during distribution and retailing (4). Chill packs also provide greater payloads than icepacks and less storage space is needed for dry cartons.

Retailers have been paying about 3 cents more per pound for chill-packed than for icepacked whole broilers (4). This differential is partially offset by savings in labor, cutting shrink, packaging, rewrapping, and spoilage at the retail store. There are also some intangible benefits: dry products are handled instead of wet products, the problem of box disposal is reduced, and butchers have more time to keep the red-meat counters stocked.

Disadvantages of the chill-pack system are high initial investment in equipment and increased inventory, rigid requirements of temperature control during distribution and marketing, and current lack of middlemen who can meet the processor's distribution requirements.

Shelf Life of Broilers

"Shelf life" is a concept that involves time and means different things to various groups of people. Apparently, retailers think of shelf life as the length of time from arrival of the food product in their store to the point when it is no longer sound, heathful, clean, and otherwise fit for human consumption. Wholesalers and processors consider shelf life as the length of time from slaughter of the bird to the time when it is unfit for human consumption. This amount of time varies depending on several factors, but the most important appear to be (1) initial bacterial populations as measured by bacteria counts, (2) proportions of the initial bacteria that are spoilage types, and (3) storage temperatures (56, 39). Short shelf life is associated with relatively high initial bacterial counts, especially spoilage types; variable temperatures; and poor handling and sanitary practices during marketing. Conversely, longer shelf life is associated with low initial bacterial counts, strict temperature control, and good handling and sanitary practices during marketing. The lower the temperature the better, and the more consistent the low temperature the better. Shelf life may also be affected by the type of pack used.

In some experiments, icepacked broilers were stored for as long as 13 days. However, a shelf life of about 7 days is used in commercial practice and represents the maximum time allowable between killing the birds at the processing plant and purchase by the consumer in the retail store.

Shelf life for CO_2-packed broilers is about equivalent to that for wet icepacked birds. The manager of one firm reported his customers (retailers) want a 5- to 7-day shelf life (Presumably in the retail stores) (5). This would compare with 2 to 3 days in the retail stores for icepacked birds. An experimental shipment in 1963 showed a much longer shelf life -- from the time the birds were slaughtered in a plant in Mississippi until they were sold to homemakers in Hawaii. Although the birds arrived at retail stores in Hawaii in 14 days, they were still salable after 21 days (3).

Irradiation Preservation

Preservation of broilers by ionizing irradiation with gamma rays is still in the experimental stage, but it may be feasible in the future. It offers the advantage of control of salmonellae and other micro-organisms and longer shelf life. In this process, the fresh-dressed whole or packaged poultry is placed in containers which are hung on an overhead conveyor, which could be a part of a processing plant. The containers are moved into a heavily shielded area where they are exposed to the radiation source--Cobalt 60. Two levels of dosage have been used. At the high level of 4.5 megarads, the meat is sterilized.4/ In one experiment, the chickens were kept up to 21 months at 70 degrees F. and compared favorably with frozen chickens kept the same length of time (48). At the low level of 0.1 to 0.5 megarads, poultry meat is pasteurized and can be kept 18-25 days, when stored at 34-40 degrees F. (48, 20). Thus, the longer shelf life compared with that of icepacked poultry can be viewed as a definite advantage.

Another advantage is that both the high and low levels of irradiation control salmonellae. There are many kinds of salmonellae and some are more dangerous than others. One barrier to producing salmonellae-free foods is the difficulty of preventing recontamination. Apparently, this can be prevented if the food is in its final form and package and then is irradiated. A further advantage might be the ability to reach domestic and foreign markets not possible to reach now (55). The technical advantages and disadvantages of irradiation are summarized by Mountney (21).

There are three disadvantages to irradiating broilers. First, processing the birds through the irradiator produces some off-odors and off-flavors that some people find objectionable. This is truer for high-level dosage than for low-level dosage. Depending on how the birds are cooked finally, off-odors and off-flavors may not be readily detectable. Second, irradiation may also kill micro-organisms which indicate spoilage or off-condition. Third, a large amount of capital is required initially. For example, one study (47) estimated capital requirements at $1 million for a gamma radiation facility with a throughput of 5,000 pounds per hour on a continuous basis. At this level of operation, costs were estimated at 0.89 cent per pound. A facility of this kind could irradiate all of the poultry of a processing plant with a throughput of 15,000 pounds per hour, working one 8-hour shift. Another study (55) estimated capital requirements from $730,000 to $990,000, depending on efficiency in radiation processing. For facilities irradiating a throughput of 5,000 pounds per hour, operating costs are estimated at 0.77 to 1.0 cent per pound. When the level of 100,000 pounds per hour of throughput is reached, operating costs drop to 0.28-0.45 cent per hour.

4/ A megarad is 1 million rads. A rad is the quantity of ionizing radiation which results in the absorption of 100 ergs per gram of irradiated material.

Ionizing irradiation of broilers as a commercial practice is not an immediate possibility for two reasons. First, approval of the Food and Drug Administration (FDA) must be obtained before it can be used as a process. After this, USDA approval must be obtained because the process is subject to the Poultry Products Inspection Act. Second, commercialization of the process will come slowly because it is new, initial costs are high, and consumers and others generally lack knowledge of the benefits of ionizing irradiation. One study (46) in which a survey was conducted among consumers and food handlers of fruits and fish revealed that consumer knowledge of radiation and what it can do was low. Only 6 percent of the consumers surveyed knew what the process can do and an additional 18 percent had heard the term. FDA approval, when granted, would reassure most consumers and gain their acceptance, it was disclosed. Among the food handlers, 90 percent were receptive to irradiated foods provided the foods had FDA approval.

CONSUMPTION AND DEMAND

Broiler Consumption

Total consumption of chicken consists of broilers and "other" chickens. In the 1930's and 1940's, other chickens accounted for the bulk of total consumption.[5/] Such chickens then consisted of surplus cockerels and pullets raised for marketing as young birds, plus fowl sold from egg-producing flocks. Most of these chickens were sold frozen because production was highly seasonal. With the development of commercial broiler production, consumers were offered more fresh-killed birds and generally preferred them.

Production of other young chickens for market also gradually declined because lighter market-egg strains were developed and many day-old cockerel chicks were separated out by sexing and then destroyed. Other chickens marketed now consist mainly of fowl. By the early 1950's, consumption of broilers equaled and then surpassed that of other chickens. Consumption of other chickens became relatively stable by 1960, but consumption of broilers continued to increase. Consequently, broiler consumption accounted for almost 90 percent of total chicken consumption by 1969 (table 18).[6/]

The rapid increase in broiler consumption obviously reflects consumer satisfaction with the high-quality, young, fresh-killed birds from modern broiler enterprises. But the increase has been accompanied by a downward trend in both relative and actual price levels for broilers.

5/ These were usually called "farm chickens."

6/ App. table 1 shows details of supply area utilization of broilers, 1947-69.

Table 18.--Per capita consumption of broilers and other chicken, selected years, 1934-69

Year	Broilers	Other chicken	Total chicken	Broilers as share of total chicken
	Pounds			Percent
1934	0.5	13.1	13.5	3.7
1940	2.0	12.1	14.1	14.2
1945	5.0	16.6	21.6	23.1
1950	8.7	11.9	20.6	42.2
1955	13.8	7.5	21.3	64.8
1960	23.3	4.7	28.0	83.2
1965	29.4	3.9	33.3	88.3
1969	35.1	4.1	39.2	89.5

Source: U.S. Dept. Agr., Econ. Res. Serv.

Demand for Broilers

Various studies have discussed price elasticity, cross elasticity, and income elasticity of demand for broilers.7/ Detailed results of selected studies of demand are given in appendix table 2. Because of the former predominance of "farm chickens" in the chicken meat supply, many earlier studies evaluated the demand for all chickens, in contrast to later studies which confined demand to broilers. Coefficients from various studies vary over wide ranges because of the years included, the data sources, and the scope and methodology of the studies.

7/ Coefficients of elasticity can be simply expressed as percentages. Price elasticities for broilers are generally negative, since quantities and prices are inversely related, while cross- and income-elasticity coefficients for broilers are generally positive. Price elasticity of demand at the farm, wholesale, or retail levels refers to the percentage change in the quantity of broilers used for every 1-percent change in broiler price. Cross elasticities usually deal with the percentage change in broiler quantity for a 1-percent change in the price of a competing meat. Income elasticity usually relates broiler quantity to change in family income.

Fox reported price elasticity of demand for chickens at the farm level as -1.61 for 1922-41 (11). More recent studies all show decidedly lower values. Brandow reported -0.74 for chickens during 1955-57 (2). Farris and Darley reported values for the price elasticity of demand for broilers at the farm level of -0.84 to -1.37 for various months of the year during 1953-63. Values for the months of July through November (all at -0.98 or below) were lower than for other months (10). For more recent years, monthly coefficients of -0.7 to -1.3 seem appropriate.

Coefficients of price elasticity of demand for broilers at the retail level would be expected to be higher than those at the farm level. Studies summarized in appendix table 2 show a range of -1.17 to -3.80. Using data from retail store experiments, Jasper reported a coefficient of -3.80 for the early 1950's (17), and Hilver and Smith, a range of -2.67 to -3.71 for the late 1950's and early 1960's (16). Time series analyses yielded lower estimates. (In appendix table 2, these mostly fell into two ranges, -1.2 to -2.0 and -2.0 to -2.7.) Using Atlanta consumer panel data for 1958-62, Purcell, Elrod, and Raunikar classified chicken in the food group with a nonresponsive demand at the retail price level. Their price elasticity of demand for chicken was -0.89 (26).

A recent study by O'Mara compared wholesale broiler price with broiler quantity, making adjustments for income and population. The derived price elasticity of demand was -1.053 (24).

Purcell noted a strong elasticity of demand for poultry with respect to the price of hogs at the farm level (27). A recent USDA "Broiler Marketing Guide" observed that an increase of 1 percent in per capita consumption of pork has usually been associated with a decline of about 0.5 percent in wholesale broiler prices (53). O'Mara observed the following percentage changes in wholesale broiler prices for each 1-percent change in quantity of other meats: pork, 0.20; beef, 0.17; turkey, 0.06; and nonbroiler chicken, 0.09 (24).

Considerably more information is available on the cross elasticity of demand for broilers at the retail level. Martin (18), using 1951-58 data, data showed very low cross elasticities of demand for fryers with respect to the price of beef. They ranged from 0.08 to 0.40 in four models (app. table 2). Cross elasticities with respect to the price of pork were also very low ranging from 0.02 to -0.34. Martin showed high cross elasticities of demand for fryers with respect to "other meats." These ranged from 1.71 to 2.87.

Waugh (57), using per capita consumption and deflated retail prices for 1948-62, concluded that beef prices are not affected significantly by changes in supplies of pork or chickens. On the other hand, pork and chicken prices are both affected by changes in supplies of other meats.

Income elasticity of demand for poultry has received considerable attention, because poultry is one of the major food items included in

household consumption studies, consumer panel studies, controlled experiments in stores, and other studies and experiments. Gerra (13), in analyzing the 1948 study "Food Consumption of Urban Families in the United States " (8), noted that based on consumption per person, eggs, poultry, meat, other meat, and fish used showed little increase with a given rise in income. When data for money value were examined for relationships with income, eggs and poultry meat increased very little as income increased.

Rockwell (33) reported low coefficients of income elasticity of demand for chicken based on analysis of the 1955 Household Food Consumption Survey. For nonfarm households, the coefficients ranged from 0.09 to 0.17 for low-income, 0.45 to 0.56 for medium-income, and 0.07 to 0.10 for high-income households. The coefficients for farm households were also low.

Martin (18) showed high income elasticity coefficients for fryers. Based on four distributed lag models using consumer panel data for 1951-58, his estimates ranged from 0.46 to 1.19 for four shortrun estimates. Long-run estimates ranged from 0.63 to 1.32. These relatively high coefficients stand out as being different from those developed in other studies.

Egbert (54) showed an income elasticity of demand for chicken of only 0.03.

Purcell and Raunikar (28) included poultry in the list of foods that exhibited nearly constant elasticities over the range of income between $3,000 and $10,000 per year per household. Poultry was next to the lowest item on the list, with an income elasticity of 0.13.

Hiemstra (15) noted that expenditures per person for poultry do not increase, or may decline, with higher incomes. Families in higher income brackets spend proportionately more for beef and fish but less for poultry.

O'Mara recently estimated the income elasticity for chicken (including broilers) as 0.37 (24).

Projections, 1975-85

During 1969, per capita broiler consumption was 35.1 pounds, ready-to-cook weight. If that level of consumption were to be projected for 1975-85, the result would be a total consumption of 7.3 billion pounds in 1975 and 8.4 billion pounds in 1985. However, per capita consumption of broilers is expected to actually increase in the years ahead. By 1975, it may be 38.9 pounds, ready-to-cook weight, and by 1985, 41.4 pounds. Thus, total annual broiler consumption for 1975 may be 8.5 billion pounds, ready-to-cook weight, and for 1985, 10.5 billion pounds (app. table 3).

Earlier research studies contained estimates of price elasticity of demand for broilers which fell mostly in a range of -1.0 to -2.7. In 1975-85, a shift toward less elastic coefficients may occur. Thus, a range of -0.8 to -1.5 appears likely during 1975-85 for elasticity of demand with respect to price at the retail level for broilers.

Projections for per capita consumption for 1975-85 are up for beef and chicken and down for pork and lamb. This suggests part of the gains for beef and chicken will be at the expense of pork and lamb. If incomes go up, the effect of income on elasticity of demand will go down from levels that are already low.

Broiler production is projected to increase during 1975-85; the leaders will be the South Atlantic and South Central regions (app. table 4).

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Appendix table 1.--Supply and use of chicken, 1947-69

Year	Supply				Ending commercial stocks	Use						
						Exports and shipments			Domestic			
										Civilian		
	Production 1/	Imports and inshipments	Beginning commercial stocks	Total supply		Commercial 2/	USDA 3/	Total	Military 4/	USDA donations	Total	Per capita ready-to-cook
	Mil. lb.											
1947	2,706	12	166	2,884	220	23	-	23	54	-	2,587	18.1
1948	2,563	36	220	2,819	107	12	-	12	40	-	2,660	18.3
1949	2,991	15	107	3,113	161	13	-	13	43	-	2,896	19.6
1950	3,174	5	161	3,340	163	15	-	15	65	-	3,097	20.6
1951	3,432	1	163	3,596	187	29	-	29	106	-	3,274	21.7
1952	3,443	3	187	3,633	123	21	-	21	105	-	3,384	22.1
1953	3,567	-	123	3,690	145	32	-	32	89	-	3,424	21.9
1954	3,743	-	145	3,888	139	34	-	34	86	-	3,629	22.8
1955	3,572	1	139	3,712	125	46	-	46	85	-	3,456	21.3
1956	4,217	-	125	4,342	164	54	4	58	81	-	4,039	24.4
1957	4,404	-	164	4,568	134	58	-	58	80	-	4,296	25.5
1958	5,005	1	134	5,140	179	61	-	61	73	-	4,827	28.2
1959	5,230	1	179	5,410	161	133	9	142	69	-	5,038	28.9
1960	5,208	-	161	5,369	130	181	1	182	74	4	4,983	28.0
1961	5,787	-	130	5,917	160	246	1	247	79	33	5,431	30.0
1962	5,825	-	160	5,985	124	258	4	262	98	42	5,501	29.9
1963	6,048	-	124	6,172	135	217	9	226	84	55	5,727	30.7
1964	6,219	-	135	6,354	138	244	6	250	87	54	5,879	31.0
1965	6,649	-	138	6,787	108	185	6	191	94	34	6,394	33.3
1966	7,309	-	108	7,417	163	172	-	172	97	45	6,985	36.0
1967	7,527	-	163	7,690	169	159	-	159	104	51	7,258	37.1
1968	7,580	1	169	7,750	97	165	-	165	100	74	7,388	37.4
1969	8,059	1	97	8,157	110	176	-	176	88	60	7,783	39.0

1/ Includes chickens, other than commercial broilers, sold from and consumed on farms where produced, plus nonfarm production of these chickens estimated at 10 percent of farm output in 1950-54. Beginning in 1955, this percentage adjustment was reduced 1 point annually, reaching zero in 1964. The factor for converting from live weight to ready-to-cook weight was increased gradually from 68.84 percent in 1950 to the current level of 72 percent in 1958.

2/ Includes exports of turkey through 1957, dressed weight or ready-to-cook equivalents.

3/ Beginning in 1955, exports under P.L. 480 and USDA donations to U.S. territories.

4/ Includes USDA donations to military and military feeding of civilians in occupied territories.

Source: U.S. Food Consumption, U.S. Dept. Agr., Stat. Bul. 364, 1965, and selected issues of Poultry and Egg Situation.

Appendix table 2.--Estimates of the coefficient of demand elasticity by various authors

Item	Period	Type of dollar	Quantity measure	Dependent variable	Chicken: Elasticity at-- Retail level: Price	Retail level: Income	Retail level: Cross	Farm level: Price	Farm level: Income	Farm level: Cross
Egbert (54)	Not reported	Current	Consumption	Price		0.03				
Brandow (2)	1955-57							-0.74		
Rockwell (33):										
Ordinary least squares	Spring, 1955	do.	Quantity consumed per person	Quantity						
Nonfarm households;										
Low income--										
using product	do.	do.	do.	do.		.09				
all households	do.	do.	do.	do.		.17				
Medium income--										
using product	do.	do.	do.	do.		.56				
all households	do.	do.	do.	do.		.45				
High income--										
using product	do.	do.	do.	do.		.07				
all households	do.	do.	do.	do.		.10				
Farm households;										
Low income--										
using product	do.	do.	do.	do.		.03				
all households	do.	do.	do.	do.		.05				
Medium income--										
using product	do.	do.	do.	do.		.29				
all households	do.	do.	do.	do.		-.03				
High income--										
using product	do.	do.	do.	do.		.23				
all households	do.	do.	do.	do.		.40				

Note: See footnotes at end of table.

Continued--

Appendix table 2.--Estimates of the coefficient of demand elasticity by various authors--Continued

Item	Broilers								
	Period	Type of dollar	Quantity measure	Dependent variable	Elasticity at--				
					Retail level			Farm level		
					Price	Income	Cross	Price	Income	Cross
Farris and Darley (10):										
Single equation, least squares in logs:	1953-63	Current	Supply per capita	Price						
Jan.								-1.39		
Feb.								-1.43		
Mar.								-1.37		
Apr.								-1.25		
May								-1.17		
June								-1.15		
July								-1.03		
Aug.								-1.03		
Sept.								- .98		
Oct.								-1.00		
Nov.								-1.11		
Dec.								-1.54		
Actual data:	do.	do.	do.	do.						
Jan.								-1.37		
Feb.								-1.33		
Mar.								-1.24		
Apr.								-1.12		
May								-1.11		
June								-1.11		
July								- .98		
Aug.								- .92		
Sept.								- .85		
Oct.								- .84		
Nov.								- .95		
Dec.								-1.41		

Note: See footnotes at end of table.

Continued--

Appendix table 2.--Estimates of the coefficient of demand elasticity by various authors--Continued

Item	Broilers									
	Period	Type of dollar	Quantity measure	Dependent variable	Elasticity at--					
					Retail level			Farm level		
					Price	Income	Cross	Price	Income	Cross
Farris and Darley (10):										
Actual data with slope of regression line held constant over different months:	1953-63	Current	Supply per capita	Price						
Jan.								-1.36		
Feb.								-1.31		
Mar.								-1.27		
Apr.								-1.13		
May								-1.04		
June								- .99		
July								- .98		
Aug.								- .97		
Sept.								- .96		
Oct.								- .99		
Nov.								-1.08		
Dec.								-1.11		
Tomek (45):										
Ordinary least squares	1949-56	Current	Consumption	Quantity	-2.68					
	1956-64	do.	do.	do.	-2.33					
Stanton (41):										
Quarterly data, ordinary least squares in logs--										
Winter	1953-59	do.	do.	Price	-1.29 to -1.53					
Summer	do.	do.	do.	do.	-1.19 to -1.32					
Reduced form--										
Winter	do.	do.	do.	do.	-1.26 to -1.79					
Summer	do.	do.	do.	do.	-2.24 to -2.29					

Note: See footnotes at end of table.

Continued--

Appendix table 2.--Estimates of the coefficient of demand elasticity by various authors--Continued

Time	Fryers									
	Period	Type of dollar	Quantity measure	Dependent variable	Elasticity at--					
					Retail level			Farm level		
					Price	Income	Cross	Price	Income	Cross
Nordhauser and Farris (23): Retail store experiment, least squares in logs, with fryer sales related to fryer price and other meat prices	Jan.-June 1958	Current	Weekly sales	Quantity	-1.80					
Riley (31)					1/-1.43					
Jasper (17): Retail store experiment	Fall 1953	do.	Sales per capita	do.	-3.80					
Baker (1)					-1.17 to -1.92					
Martin (18): Distribution lag models with consumer panel data-- Shortrun estimates:										
Model I	1951-58	Constant	Consumption	Quantity	-1.95	1.19	2/ 0.05			
							3/ 0.02			
							4/ 1.71			
Model II	do.	do.	do.	do.	-2.46	0.76	2/ 0.08			
							3/-0.16			
							4/ 2.72			
Model III	do.	do.	do.	do.	-2.49	0.86	2/-0.40			
							3/-0.34			
							4/ 2.87			
Model IV	do.	do.	do.	do.	-2.36	0.46	2/ 0.01			
							3/-0.13			
							4/ 2.12			

Note: See footnotes at end of table.

Continued--

Appendix table 2.--Estimates of the coefficient of demand elasticity by various authors--Continued

Item	Period	Type of dollar	Quantity measure	Dependent variable	Fryers: Elasticity at-- Retail level: Price	Retail level: Income	Retail level: Cross	Farm level: Price	Farm level: Income	Farm level: Cross
Martin (18):										
Longrun estimates:										
Model I	1951-58	Constant	Consumption	Quantity	-1.93	1.17	5/1.68			
Model II	do.	do.	do.	do.	-1.78	1.32	5/1.99			
Model III	do.	do.	do.	do.	-1.83	0.63	5/2.11			
Model IV	do.	do.	do.	do.	-1.86	1.31	5/1.67			

1/ As reported by Farris in (10).
2/ With respect to price of beef.
3/ With respect to price of pork.
4/ With respect to price of "other" meats.
5/ With respect to price of "other" meats

Source: (59).

Appendix table 3.--Projections of total and per capita consumption of broilers, selected years

Year	Population 1/	Per capita consumption 2/	Projected total consumption
	Thous.	Lb.	Mil. lb.
1975	219,336	38.6	8,466
1980	235,212	40.0	9,408
1985	252,871	41.4	10,469

1/ Bureau of the Census, series C population projection used.
2/ Adapted from discussion material prepared by A.C. Egbert for presentation at Northeast Regional Agr. Outlook Conf., Hershey, Pa., Sept. 9-10, 1968. The broiler projection was obtained by multiplying the all-chicken projection by 92 percent.

Appendix table 4.--Estimated regional distribution of broiler production, selected years

Region	1975	1980	1985
	Million pounds		
North Atlantic	381	395	419
East North Central	102	103	105
West North Central	102	103	105
South Atlantic	3,606	3,999	4,397
South Central	3,877	4,328	4,868
Western	398	480	575
United States	8,466	9,408	10,469

Source: U.S. Dept. Agr., Econ. Res. Serv., Mktg. Econ. Div. Poultry Group.