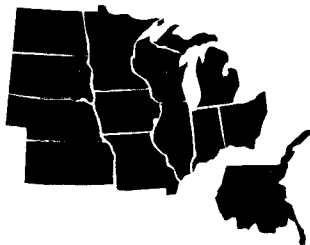
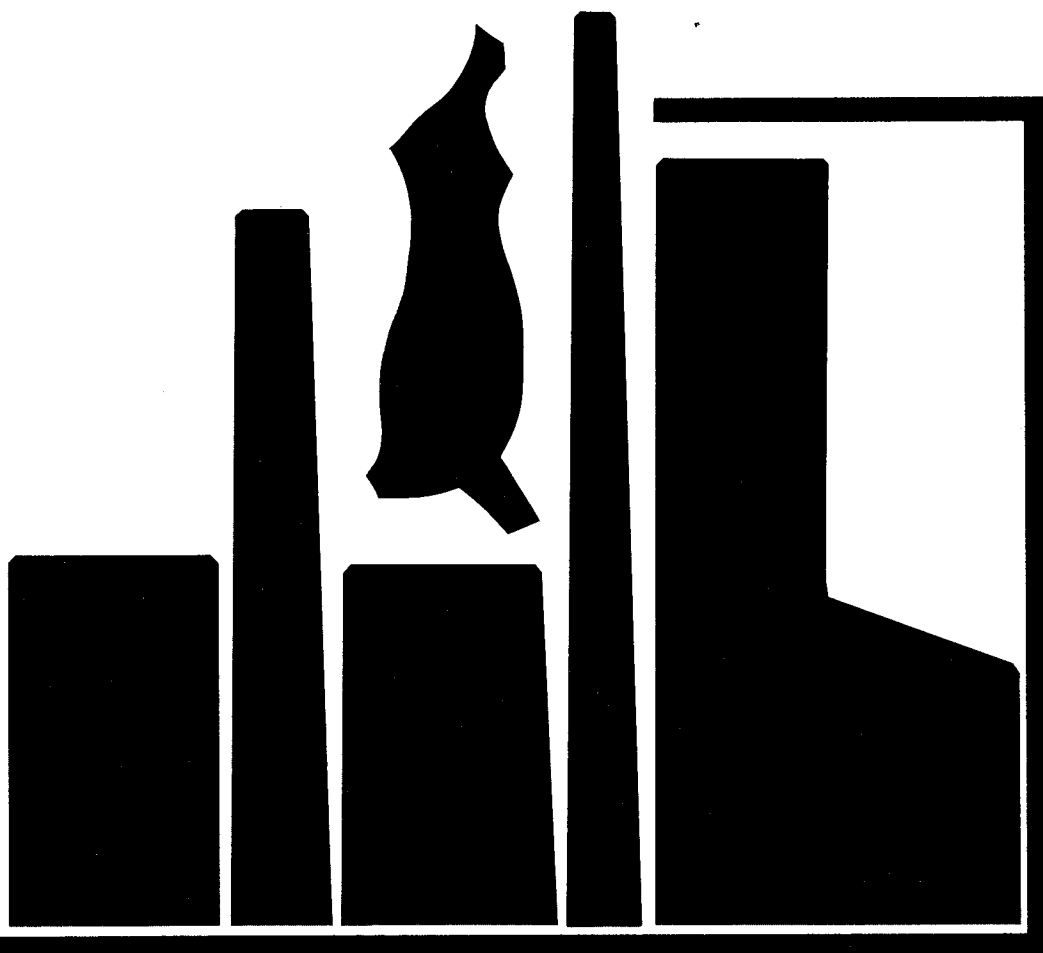


# **PATTERNS OF firm growth IN LIVESTOCK SLAUGHTERING**



Technical Bulletin 261 • March 1969 • Willis E. Anthony



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## SUMMARY

The livestock slaughter industry has experienced substantial change in recent years. Forces of new technology in plant operations, transportation, and management have been reshaping the industry from within, while changing freight rates, meat merchandising, and livestock production patterns have affected it from without. These developments have been particularly apparent after so many years of little change.

Several structural indicators reflect the impact of change. One of the more important manifestations is the changing industry size structure, portraying the degree to which firms are unequal in size. By inference, it also says something of the extent to which they are unequal in market power.

Data for this report are annual slaughter figures of federally inspected (FI) plants during 1950-62. Firm size is measured in number of livestock slaughtered per year. Though it would be desirable to have data spanning more years and particularly recent years, such data were not available. But there is little reason to believe that the trends apparent from these data would be obliterated by any more recent developments.

Between 1950-62, there was a moderate increase in average size of FI slaughter firms. But relative size variation among firms showed virtually no change. However, there were divergent trends among species segments of the industry. While cattle slaughter firms grew more equal in size, calf, sheep, and hog slaughter firms grew less equal.

Growth in average size occurred because: (1) the average size of firms that were in the industry in both 1950 and 1962 increased and (2) entering firms were on the average larger than exiting firms. Variation in size of persisting firms increased, while entering firms were decidedly more equal in size than exiting firms. Again, there were different characteristics among entering, exiting, and persisting firms in each of the species segments.

If the patterns of growth, entry, and exit that existed during 1950-62 continue, a different size structure will emerge in the slaughter industry. By 1998, more than half the FI slaughter firms will be in what is now the largest size class. The projections indicate a less radical change in size structure of FI cattle slaughter firms. By 1998, the majority of firms still will be grouped near the middle size classes. Projected size structures of calf, sheep, and hog slaughter firms are only moderately different from those that existed in 1962. If 1950-62 growth patterns continue in each of these industry segments, there will be a few firms larger than the present average and fewer small firms. But the change will not be great.

Small FI slaughter firms grew much faster than large firms during 1950-62. On the average, firms in the four smallest classes more than tripled in size, while firms in the four largest classes less than doubled. The growth rate among small firms also varied more than among large ones. Species segments also experienced different growth trends, but only in the calf slaughter segment were average growth rates not significantly different among size classes. Patterns of growth also varied among the subperiods within 1950-62, evidencing differences in both mean and variance of growth.

Several factors often are associated with slaughter firm growth. Among them are vertical integration, horizontal integration, distribution of slaughter plants, prior growth of the firm, and initial size. Analysis showed that characteristics related to firm size were most instrumental in shaping growth characteristics. These characteristics included anti-trust policy, patterns of technological change, drive toward scale economies for small firms, possible advantages of small firms in the labor market, and the greater range of investment alternatives available to large firms.

This study was not intended to measure slaughter industry performance, but the results have performance implications. To the extent that growth and survival of small slaughter firms are not impeded, there is a measure of economic equity in the industry.

# Patterns of Firm Growth in Livestock Slaughtering

Willis E. Anthony

Many changes are bearing upon the meatpacking industry. Changing structure and location of livestock production have shifted traditional marketing patterns. A flow of new technology has altered patterns of slaughter plant operation. New transportation routes, equipment, and rates have shifted optimum plant locations and plant size. Urbanization patterns have produced new criteria for plant sites. Different systems of meat merchandising have eroded the former advantages of some types of firm organization. It is not surprising that the size structure of slaughter firms also has changed.

For many years the meatpacking industry changed little. A reasonably accurate profile of the meatpacking industry from World War I into the fifties could be described as follows. Most slaughtering was done in meatpacking centers where railheads formed, and the majority of it was done by a handful of large meatpackers. Slaughtering was done in plants in which livestock entered one end and finished products emerged from the other. A few firms with large single plants rubbed elbows with the "big four" (Swift, Armour, Wilson, and Cudahy) in some meatpacking centers. A few exceptions existed and an occasional firm had a large integrated "interior" plant in an area of concentrated livestock production. But virtually all the remaining slaughtering was done by local butchers or specialty processors who found an unoccupied corner for themselves somewhere in the market. Little new technology appeared. Except for worn parts and management, a plant built in 1910 was almost as efficient in 1950.

To be sure, some ripples had appeared. People discovered that trucks could deliver livestock to any plant near a highway, so plant location at points other than a railhead became feasible, and there were indications that an expanded network of good highways would be developed, which would further alter optimum plant location patterns. Grocers had discovered that they were better off buying directly from packing plants rather than from branch houses, and they had made it apparent that they were not particularly interested in featuring brand name meat. At the same time, labor costs were rising faster than equipment costs. In the fifties, substantial change occurred. The precipitate appears to have been technology that allowed new, relatively small plants to be as efficient as large plants and more efficient than the old integrated ones.

These shifts in the micro-factors of plant organization and operation are associated with, and in large measure have yielded, shifts in the macro-structure of the meatpacking industry. Many of these shifts are associated with the slaughter segment of the industry.

To predict future structural shifts, to enable rational adjustment to changes, and to control undesired change, it is useful to trace the magnitude of change and explore its sources.

The impact of economic force is apparent in several facets of the meatpacking industry. One of the more important ones is size structure. Size structure depicts the relative size and, to some degree, the relative power possessed by some firms over others in the industry. Characteristics of size structure can be depicted in several ways — by concentration ratios, Lorenz curves, measurements on the size distribution, and so on.

Characteristics of slaughter firms do not encompass the entire meatpacking industry. Some meatpackers specialize in meat processing and buy dressed meat from others who slaughter livestock. Other meatpackers both slaughter and process meat. Still others are specialized slaughterers.<sup>1</sup>

This bulletin presents data on industry trends that constitute the demand for livestock. But its scope is limited in several dimensions: in industry coverage, in

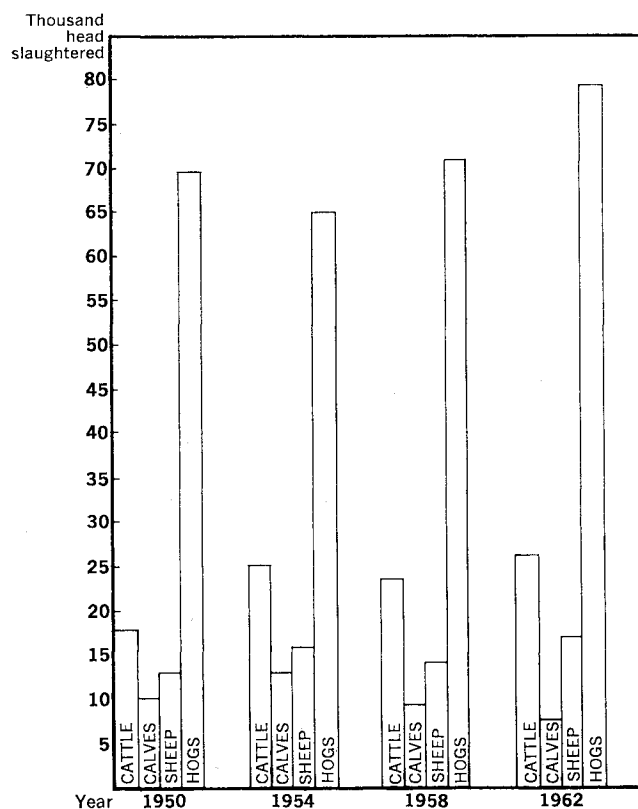


Figure 1. Total U.S. commercial slaughtering by species, 1950, 1954, 1958, and 1962

<sup>1</sup> For more data and information on the degree of such specialization, see references (1) and (2).

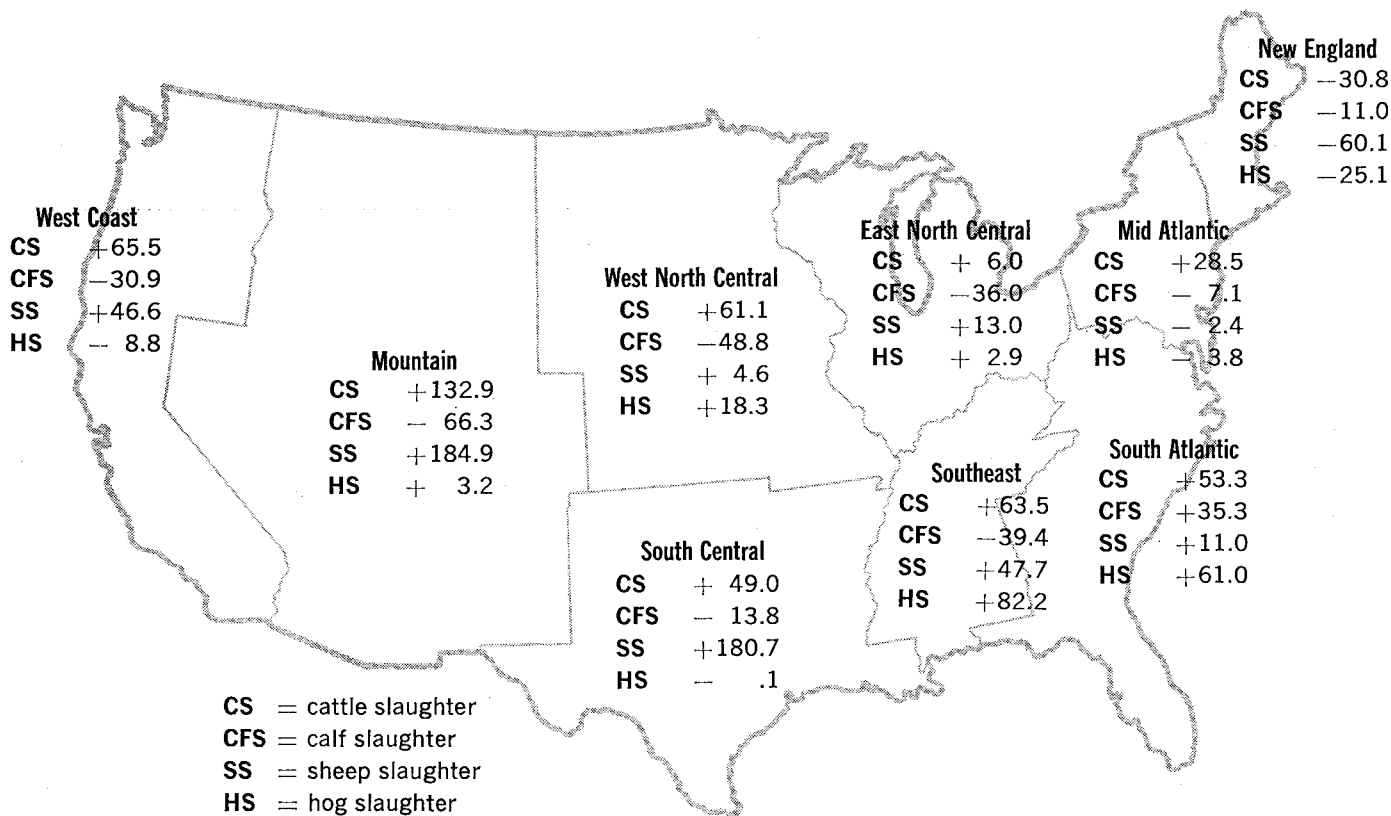


Figure 2. Percentage change in total slaughtering by region of the United States, 1950-62

time covered by the data, in extent of analysis, and in prediction of the future.

All slaughter firms are not represented in this study. Only those firms that slaughter under federal inspection (FI) are included. Such firms include all slaughter firms that can enter interstate trade and thereby participate in the national meat market. These firms do the majority of livestock slaughtering. In 1962, FI slaughtering accounted for more than 83 percent of the total livestock slaughtered (1), and the proportion of slaughtering done under federal inspection has been growing. Though this is a study of exclusively FI firms, there is no reason to believe that the major trends and characteristics reflected by FI firms would be altered if non-FI firms had been included in the data.

If non-FI firms had been included, the industry size distributions probably would have shown a greater number of small firms, a smaller average size, and perhaps somewhat greater variation in size. Growth trends and patterns probably would not have been different, although the smaller firms perhaps would have had a slightly lower average growth rate, since it usually is necessary for a firm to enter interstate trade as it grows larger. This necessity sets a limit to the growth of non-FI firms.

For the most part, data are from the 1950-62 period. The major reason for selecting this period was

that data were readily available. Moreover, since many industry changes became evident soon after 1950, it represented a desirable study period. No claim is made that the period is particularly representative of economic interaction in the slaughter industry.

The primary purpose of this report is to describe paths of change in the size structure of the FI slaughter industry. Projections of future size structure are developed from past changes. It must be noted that change occurred within an environment of increasing livestock production. This is a critical observation, since agricultural commodity processors take the entire supply offered. Price adjusts to clear the market. So expanding livestock production implies an expanding slaughter industry.

Commercial slaughtering increased substantially during 1950-62 (table 1), concurrent with a rapidly expanding demand for meat. Industry growth meant that new firms could enter and old firms could grow without necessarily taking volume from other firms. This fact leads to a major issue: to what extent have small and large firms shared equally in the growth?

Within the total industry, different segments grew at different rates. Cattle slaughter grew faster than hog slaughter (figure 1), sheep slaughter grew very modestly, and calf slaughter declined. There also were substantially different growth rates in different regions (figure 2), and FI slaughter grew at a faster rate than

**Table 1. Percentage change in U.S. federally-inspected and total commercial slaughter by species, 4-year intervals, 1950-62**

	Species							
	Cattle		Calves		Sheep		Hogs	
	Federally inspected	Total commercial	Federally inspected	Total commercial	Federally inspected	Total commercial	Federally inspected	Total commercial
	percent							
1950-54	41.0	39.8	24.3	27.8	18.8	23.8	- 7.1	- 6.8
1954-58	- 4.5	- 5.8	-25.1	-26.9	-12.4	-11.0	12.4	9.5
1958-62	13.4	10.8	-13.4	-19.6	13.8	18.9	13.1	11.8
1950-62	52.6	45.7	-16.0	-24.9	20.2	31.0	18.1	14.1

total commercial slaughter (table 1). Differences among these segments are associated with different patterns of change in size structure. Comparison among the segments furnishes a base from which to draw inferences on causes of change in later analysis.

The measure of firm size used in this report is the annual number of head slaughtered. In instances where the data are combined for different species, pounds of dressed weight of slaughter are used as the measure.

## CHANGING SIZE STRUCTURE OF FI SLAUGHTER FIRMS

### Concentration Of Slaughtering

Perhaps the most readily accepted and undoubtedly the most widely used measurement of size structure is the concentration ratio. It expresses the percentage of total industry volume slaughtered by a few large firms. Concentrations of slaughter in the 8 or 10 largest firms are the usual ratios.

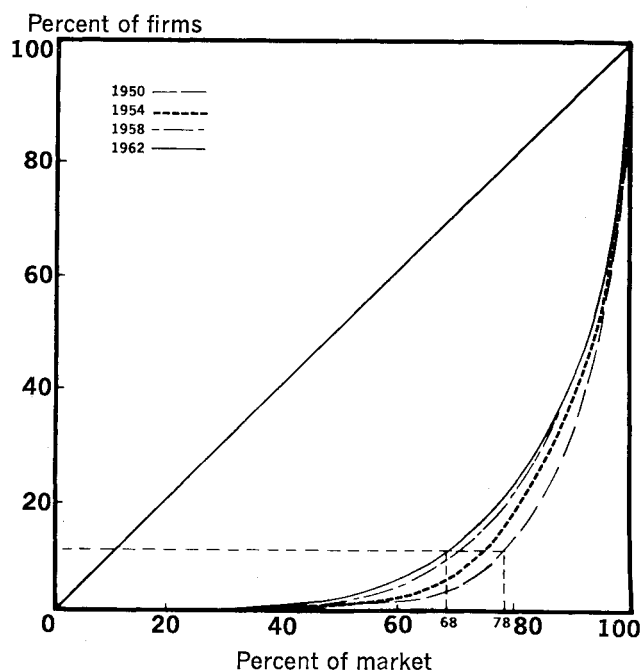
In 1950, the four largest firms accounted for 51 percent of total FI slaughter. By 1962 their share had declined to 35 percent (table 2). The proportion accounted for by the 10 largest firms also declined during this period—from 67 to 49 percent. But while the share by the four largest firms declined, the share

by the 5th through 10th largest firms stayed about the same. It increased very slightly from 1950 to 1954, then declined by nearly 2 percent between 1954 and 1962.

Among industry segments, the greatest concentration was in sheep slaughter. The 10 largest firms accounted for 76 percent of FI sheep slaughter in 1962. Cattle slaughter has shown the greatest decline in concentration and also the lowest concentration. Share of FI cattle slaughter by the four largest firms declined from 52 percent to 30 percent during 1950-62. Signifi-

**Table 2. Percentage of federally inspected slaughter by 1-4, 5-10, and 1-10 largest firms by livestock species, 1950, 1954, 1958, and 1962**

Species	Size rank	Year			
		1950	1954	1958	1962
		percent			
All species	1- 4	50.8	46.6	38.9	35.0
	5-10	15.8	16.1	15.9	14.1
	1-10	66.6	62.7	54.8	49.1
Cattle	1- 4	51.5	45.2	35.7	29.5
	5-10	8.7	10.0	10.5	10.4
	1-10	60.2	55.2	46.2	39.9
Calves	1- 4	58.0	59.3	49.7	39.9
	5-10	12.9	11.7	13.9	16.3
	1-10	70.9	71.0	63.6	56.2
Sheep	1- 4	69.6	68.7	64.4	58.9
	5-10	15.9	16.1	17.2	17.1
	1-10	85.5	84.8	81.6	76.0
Hogs	1- 4	48.5	48.4	41.3	39.0
	5-10	22.1	23.0	23.4	21.5
	1-10	70.6	71.4	64.7	60.5



**Figure 3. Lorenz curve: national FI slaughtering**



cantly, none of the species segments has shown increasing concentration in the 10 largest firms. However, firms ranking 5-10 in size accounted for an increasing share of all species except hogs. This contrast reflects fundamental shifts in slaughter industry size structure that are not portrayed in simple concentration measures.

### Size Distributions Of Slaughter Firms

Data on shares of slaughter by cumulative percentages of firms show something of the size inequality among firms in the industry. If all firms were of equal size, the cumulative percentages of the market would be identical with the cumulative percentages of firms,

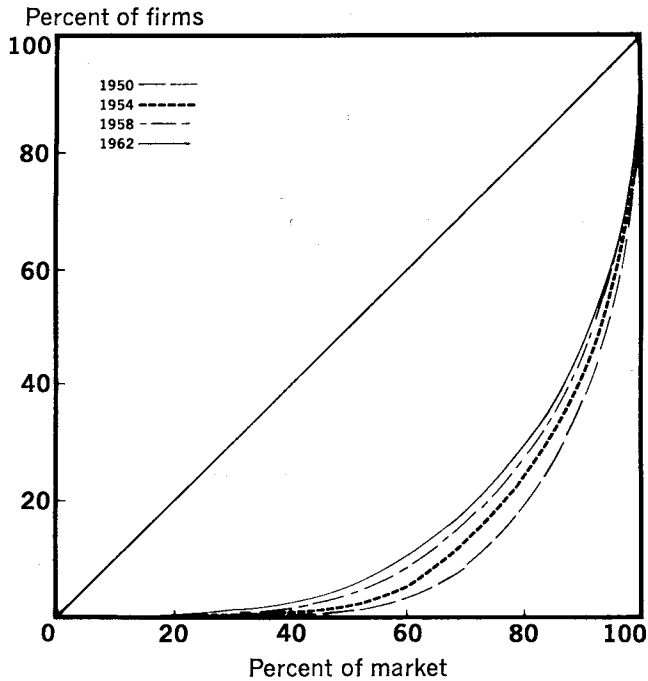


Figure 4. Lorenz curve: national FI cattle slaughtering

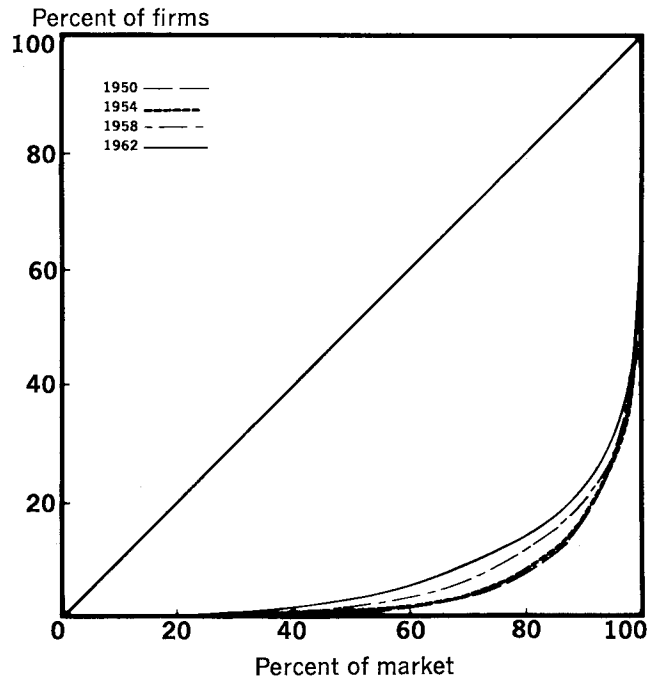


Figure 5. Lorenz curve: national FI calf slaughtering

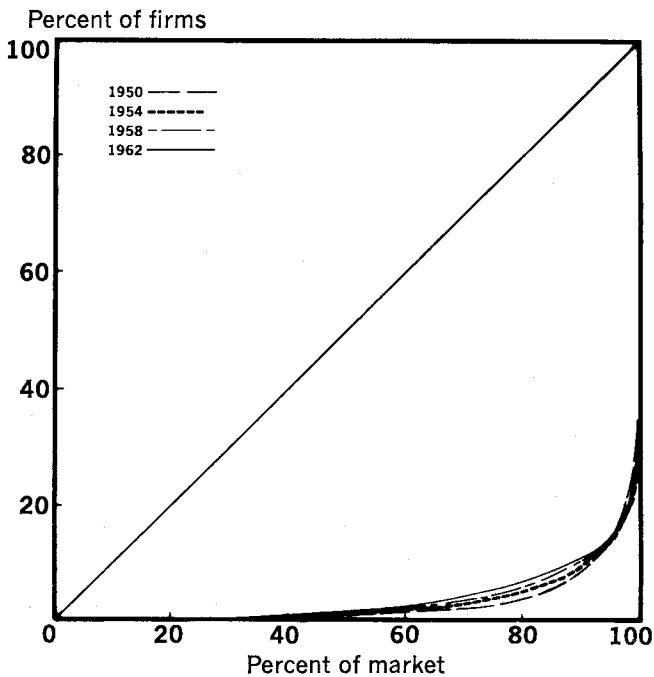


Figure 6. Lorenz curve: national FI sheep slaughtering

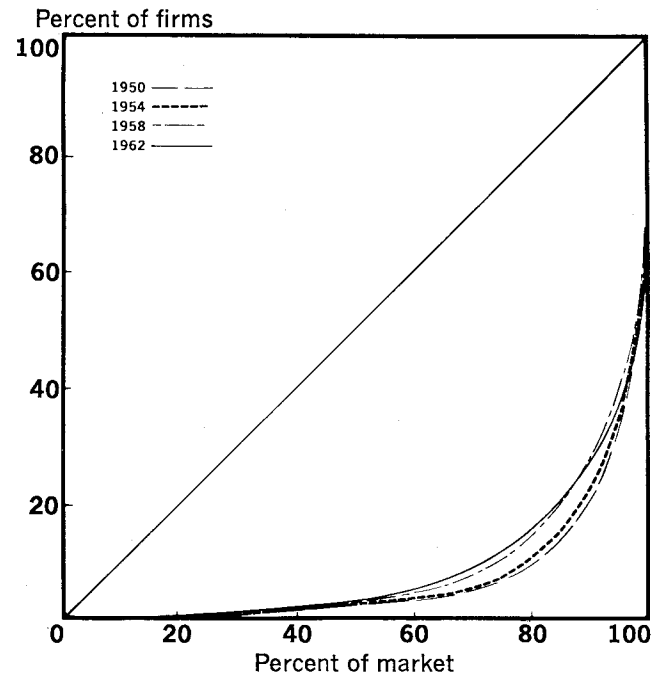


Figure 7. Lorenz curve: national FI hog slaughtering

i.e., 50 percent of the firms would do 50 percent of the slaughtering. In the accompanying charts (figures 3-7), cumulative percentage of firms (ranked largest to smallest) is marked on the vertical axis and cumulative percentage of FI slaughter by the ranked firms is marked on the horizontal axis. The scale on each axis is identical. If all firms had equal volume, a plot of cumulative percentage of firms against their cumulative percentage of slaughter would be a 45° line from the origin of the chart, since a given percentage of firms would have an equivalent percentage of the market. The farther the curve lies from the straight line, the greater is the size inequality of slaughter firms.<sup>2</sup>

Share of FI slaughtering done by the largest 10 percent of the firms declined from 78 percent in 1950 to 68 percent in 1962 (figure 3). The curve moved toward the line of size equality during each of the three periods in 1950-62. The trend was most pronounced among the largest 30 percent of firms. Nevertheless, the largest 80 percent of the firms did 99 percent of the slaughtering throughout the period. For each species except cattle, 40 percent or less of the firms did virtually all the slaughtering.

Least size inequality existed among FI cattle slaughter firms (figure 4). This curve lies closest to the equality line and it shows a greater movement toward equality than in the other species segments. Size of FI calf slaughter firms was unequal, although there was some tendency toward equality during 1954-62 (figure 5). Sheep slaughter firms were most unequal in size. The largest 30 percent did nearly 100 percent of the slaughtering (figure 6). As shown in figure 6, the concentration curve moved away from the equality line in the size groupings of firms constituting less than 20 percent of sheep slaughter, suggesting that small sheep slaughterers became even less significant in the industry. Hog slaughter firms showed a mixed tendency toward size equality (figure 7). Through the 30th percentile, the concentration curve moved toward the equality line. In the successively smaller classes it moved toward it in 1954-58 and away from it during 1958-62, suggesting a shift in the economic forces shaping the size of FI hog slaughter firms.

Charts of firm size distribution (numbers of firms in various classes) show other characteristics of changing size structure.<sup>3</sup> Statistical measurements on characteristics of size distribution help quantify the shifts in size structure. Size distributions consist of the annual slaughter of each firm measured in logs. The data were converted to logs because the conversion made size distributions more nearly normal, which increased the validity of the average size and size variation measurements. Average size of all FI slaughter firms increased during 1950-62 (table 3). Mean size of

Table 3. Change in mean and standard deviation of logarithms of annual slaughter of FI slaughter firms, 1950-62

Firm group	Mean		Standard deviation		Percentage variation*	
	1950	1962	1950	1962	1950	1962
All firms (336 in 1950, 440 in 1962) ...	6.95	7.11	0.73	0.75	11.0	11.0
Persisting firms (206)† ...	7.14	7.36	0.58	0.62	8.12	8.42
Exiting firms (130)‡ ...	6.64	...	1.23	...	18.52	...
Entering firms (234)§ ...	...	6.89	...	0.78	...	11.32

\* Percentage variation =  $\frac{\text{standard deviation}}{\text{mean}} \times 100$ .

† Firms operating in both 1950 and 1962.

‡ Firms operating in 1950 but not in 1962.

§ Firms operating in 1962 but not in 1950.

all firms grew from 6.95 (8.9 million pounds) in 1950 to 7.11 (13 million pounds) in 1962. Meanwhile, there has been very little change in the measure of firm size equality. The standard deviation increased slightly, from .73 to .75. But relative variation remained virtually the same in all years. In both 1950 and 1962, sizes of two-thirds of the firms were within 11 percent of the average size. The most significant feature of size structure change was rather substantial growth in average size, coupled with marked consistency in relative size variation of firms. This implied some pressure toward central tendency in firm sizes. A possible explanation is a U shaped average firm cost curve with a minimum cost point somewhere near the mean firm size.

Size changes differed among the species segments. The mean size of cattle slaughter firms grew from 3.96 (9,000 head) to 4.21 (16,000 head), while relative variance among firm sizes decreased from 20 percent to 18 percent (table 4). Mean size of calf slaughter firms fluctuated (remaining in the 1,400-1,600 head range), while size variation increased from 35 to 42 percent during 1950-62 (table 5). The mean size of sheep slaughter firms declined slightly (remaining under 1,000 head), while size variation increased from 50 to 57 percent (table 6). Finally, mean size of hog slaughter firms, while fluctuating, showed no clear change trend. It increased from 22,000 head in 1950 to 31,000 head in 1958, then decreased to 27,000 head in 1962 (table 7). Variation in hog firm size also remained quite stable, increasing from 27 to 29 percent.

Data on structural shifts within species segments show some changes different from shifts in the structure of the industry as a whole. They reflect differences in structural shifts among firms in the livestock market for different species. Since many firms are

<sup>2</sup> The data from which charts were constructed appear in appendix table A-1.

<sup>3</sup> See the figures in appendix B. Appendix C contains notes on the relation between concentration ratios and size distributions.

**Table 4. Size transitions of all FI slaughter firms, 1950-62**

Class, 1950*	Exits†	Class, 1962*								Firms in 1950	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
number of firms												
I	8	0	1	0	0	1	0	0	0	10	...	...
II	6	0	1	2	1	0	1	0	0	11	...	...
III	12	0	1	4	6	7	1	0	0	31	...	...
IV	57	1	0	2	36	34	4	0	0	134	...	...
V	37	0	1	0	4	51	29	0	0	122	...	...
VI	8	0	0	0	0	0	9	1	0	18	...	...
VII	2	0	0	0	0	0	0	3	1	6	...	...
VIII	0	0	0	0	0	0	0	2	2	4	...	...
Total firms in 1950	...	...	...	...	...	...	...	...	...	336	...	...
Total exits	130	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	1	4	8	47	93	44	6	3	...	...	...
Entries‡	...	9	10	28	77	90	20	0	0	...	234	...
Firms in 1962	...	10	14	36	124	183	64	6	3	...	...	440

\* Class intervals (pounds dressed weight slaughtered per year): I, 1-146,500; II, 146,501-634,900; III, 634,901-2,752,000; IV, 2,752,001-11,930,000; V, 11,930,001-51,580,000; VI, 51,580,001-224,000,000; VII, 224,000,001-970,800,000; VIII, greater than 970,800,000.

† Number of firms operating in 1950 that had quit by 1962.

‡ Number of firms operating in 1962 that had started since 1950.

**Table 5. Size transitions of all FI slaughter firms, 1950-54**

Class, 1950*	Exits†	Class, 1954*								Firms in 1950	Total entries	Total firms in 1954
		I	II	III	IV	V	VI	VII	VIII			
number of firms												
I	6	2	1	0	0	1	0	0	0	10	...	...
II	4	0	4	2	0	1	0	0	0	11	...	...
III	6	1	1	9	10	4	0	0	0	31	...	...
IV	23	0	2	2	69	37	1	0	0	134	...	...
V	8	0	0	0	4	97	13	0	0	122	...	...
VI	3	0	0	0	0	1	13	1	0	18	...	...
VII	1	0	0	0	0	0	0	5	0	6	...	...
VIII	0	0	0	0	0	0	0	1	3	4	...	...
Total firms in 1950	...	...	...	...	...	...	...	...	...	336	...	...
Total exits	51	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	3	8	13	83	141	27	7	3	...	...	...
Entries‡	...	10	7	12	29	16	1	0	0	...	75	...
Firms in 1954	...	13	15	25	112	157	28	7	3	...	...	360

\* See starred footnote, table 4.

† Number of firms operating in 1950 that had quit by 1954.

‡ Number of firms operating in 1954 that had started since 1950.

**Table 6. Size transitions of all FI slaughter firms, 1954-58**

Class, 1954*	Exits†	Class, 1958*								Firms in 1954	Total entries	Total firms in 1958
		I	II	III	IV	V	VI	VII	VIII			
number of firms												
I	12	1	0	0	0	0	0	0	0	13	...	...
II	7	0	3	3	2	0	0	0	0	15	...	...
III	6	0	0	9	8	2	0	0	0	25	...	...
IV	18	1	0	1	68	23	1	0	0	112	...	...
V	22	0	0	0	14	110	11	0	0	157	...	...
VI	1	0	0	0	1	2	24	0	0	28	...	...
VII	0	0	0	0	0	0	0	7	0	7	...	...
VIII	0	0	0	0	0	0	0	1	2	3	...	...
Total firms in 1954	...	...	...	...	...	...	...	...	...	360	...	...
Total exits	66	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	2	3	13	93	137	56	8	2	...	...	...
Entries‡	...	3	2	15	49	23	3	0	0	...	95	...
Firms in 1958	...	5	5	28	142	160	39	8	2	...	...	389

\* See starred footnote, table 4.

† Number of firms operating in 1954 that had quit by 1958.

‡ Number of firms operating in 1958 that had started since 1954.

Table 7. Size transitions of all FI slaughter firms, 1958-62

Class, 1958*	Exits†	Class, 1962*								Firms in 1958	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	4	0	1	0	0	0	0	0	0	5	...	...
II	1	0	4	0	0	0	0	0	0	5	...	...
III	9	1	0	6	7	5	0	0	0	28	...	...
IV	21	2	0	5	78	35	1	0	0	142	...	...
V	20	0	0	0	6	107	27	0	0	160	...	...
VI	8	0	1	0	0	2	28	0	0	39	...	...
VII	1	0	0	0	0	0	0	6	1	8	...	...
VIII	0	0	0	0	0	0	0	0	2	2	...	...
Total firms in 1958	...	...	...	...	...	...	...	...	...	389	...	...
Total exits	64	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	3	6	11	91	149	76	6	3	...	...	...
Entries‡	...	7	8	25	33	34	8	0	0	...	115	...
Firms in 1962	...	10	14	36	124	183	64	6	3	...	...	440

\* See starred footnote, table 4.

† Number of firms operating in 1958 that had quit by 1962.

‡ Number of firms operating in 1962 that had started since 1958.

multiple species slaughterers, it reflects some slaughter adjustments within firms. In part, it also shows the extent to which structural changes in the cattle and hog slaughter segments dominate the entire industry.

### Sources Of Changing Size Structure

#### All FI Slaughter Firms

Over time, size structure of an industry changes in response to three factors: exiting firms, entering firms, and changing size of persisting firms. To analyze changing size structure, it is helpful to sort out changes attributable to each of these factors.

Size structure of the slaughter industry is influenced by exiting firms unless the size characteristics of firms leaving the industry happen to be identical with aggregate industry characteristics. Through time, size structure is influenced by persisting firms as they grow and shrink at various rates. Size structure is further influenced by entering firms, as the group of entrants have different size characteristics from those that exited and persisted. By a straightforward computation, it is possible to isolate the role each of these factors plays in changing size structure.<sup>4</sup>

As has been shown, FI slaughter firms were larger but had the same relative degree of size inequality in 1962 as in 1950 (table 3).

The 206 firms that were in the industry at both the beginning and end of the period contributed to changing structure through both growth and changing size variation. Mean size of persisting firms averaged

7.14 in 1950 but grew to 7.36 in 1962. At the same time, size variation among persisting firms increased slightly (from 8.1 to 8.4 percent), suggesting a somewhat unequal propensity to grow.

The 130 firms that exited from the industry after 1950 had a smaller mean size and greater variation in size than the persisting firms. Hence, their exit produced an industry structure of larger firms with less size variation than was characteristic in 1950. Meanwhile, 234 firms operating in 1962 had entered since 1950. This group of firms had a larger mean size and smaller size variation than those that exited. This, like the structure change attributable to exiting firms, would create an industry of large firms quite equal in size.

Since persisting firms grew and entering firms were larger than exiting firms, average firm size grew. Since the tendency toward size inequality generated by the growing dispersion of persisting firms was approximately offset by the smaller size variation of entering relative to exiting firms, industry size remained approximately the same.

#### Species Segments of the Industry

Slightly different changes took place in size structure in species segments of the industry.<sup>5</sup> While mean size of FI cattle slaughter firms increased, size variation decreased. Persisting firms grew and became substantially less unequal in size. Entering firms were larger than exiting firms and had greater size inequality. Average size of FI calf slaughter firms changed very little, but size variation increased con-

<sup>4</sup> The variance of the total industry size distribution is equal to the summation of the weighted variances of groups within the distribution

$$\sigma^2 = W_e \sigma_e^2 + W_p \sigma_p^2 + W_e W_p (\bar{X}_e - \bar{X}_p)^2$$

where  $\sigma^2$  is a measure of the variance and the weights  $W_e$  and  $W_p$  are the ratios of the number in the group to the total number of firms in the industry. The mean of the distribution — the simple average firm volume — also is a summation of weighted means of groups within the distribution

$$\bar{X} = \frac{\bar{X}_e n_e + \bar{X}_p n_p}{n}$$

where  $\bar{X}_e$  and  $\bar{X}_p$  are the means and  $n_e$  and  $n_p$  are the numbers of firms in the group.

<sup>5</sup> A detailed discussion of this topic appears in appendix D.

siderably. The size structure of persisting firms remained stable. Entering firms were about the same size as exiting firms, but they were far more variable in size. FI sheep slaughter firms decreased in average size, while their size variation increased. Persisting firms grew and became slightly less unequal in size. Entering firms were smaller than exiting firms, and their sizes were more variable. FI hog slaughter firms were larger and less equal in size in 1962 than they were in 1950. Average size and size variation of persisting firms increased. This impact on structure was greater than the impact of the smaller average size and size variation of entering firms relative to exiting firms. Note that the size structure of the industry changed parallel to the structural change of persisting firms in all segments of the industry (except sheep slaughter) as well as in the entire industry. This implies that the growth patterns of persisting firms had a greater impact on industry size structure than the patterns of entry and exit.

### Size Transitions

A more detailed look at changes in size structure is provided by size transition tables.<sup>6</sup> These tables indicate entries and exits and size changes among classes. Thus, they show size transitions of firms in the industry.

#### All FI Slaughter Firms

**Transitions: 1950-62.** Between 1950 and 1962 the size distribution of all slaughter firms skewed to the right. The size category containing the largest number of firms — the peak of the distribution — shifted from class IV to class V. Meanwhile, numbers of firms in classes II and III increased slightly. Table 4 indicates how this came about.

Two facts are immediately apparent from the transition table: (1) there was considerable movement of firms among classes during the 1950-62 period and (2) there was a pronounced growth trend in size of persisting firms. Mobility is evidenced by the numbers of firms in the cells off the principal diagonal of the table. A small portion of firms stayed in their initial size category throughout the period. In addition, there was considerable entry and exit. Out of 336 slaughter firms in 1950, 130 had exited before 1962. Of the 440 slaughter firms in 1962, 234 had entered since 1950. The growth trend of persisting firms is evidenced by the filled cells above and to the right of the diagonal and the preponderance of zeros below and to the left of it.

The greatest number of exits was from the middle classes (IV and V). All entering firms were in classes I-VI, with the greatest entry in classes IV and V. One might expect the entry size pattern to resemble the

exit size pattern, considering that a part of entry/exit consists of turnover in firm ownership. However, the great extent of entry in class V coupled with growth from class IV to class V shifted the peak of the distribution to class V in 1962. The moderate rightward skewing of the size distribution between 1950 and 1962 is thus accounted for by: (1) entry that exceeded exit in all size categories at roughly the same rate and (2) a general growth or transition of persisting firms to larger classes.

**Transitions: 1950-54.** Between 1950 and 1954 a majority of persisting firms remained in the same class, but the peak of the distribution shifted from class IV to class V (table 5). Most of the change that did occur involved class IV, from which 38 firms grew and 4 shrank. Most movement in all categories was a shift (growth or shrinkage) to an adjacent size class. There was very little movement by more than one class. Thus, there was not a great amount of mobility evidenced by persisting firms. There was, however, considerable entry and exit concentrated in the middle and lower classes. In most of these classes entry exceeded exit, which offset the impact on the size distribution of exit and growth from the smaller classes.

**Transitions: 1954-58.** During the 1954-58 period there was not a great deal of size distribution change (table 6). There was a greater amount of entry and exit than there had been during 1950-54, and net increase in numbers continued. But there was about the same amount of size transition on the part of persisting firms. Nearly half the firms remained in their initial size category. However, the pattern of size transition differed from the 1950-54 pattern. There was relatively less total movement on the part of middle-sized firms (classes IV and V), although there was a greater amount of down movement among these firms than during the earlier period. Meanwhile, smaller firms (class II) sustained slightly greater growth. On the whole, the extent of size movement was less in 1954-58 in that there were even fewer firms that grew more than one size than there were in 1950-54. The net result of all the size transitions was fewer firms in the two smallest classes, many more in class IV, and a few more in the remaining categories.

**Transitions: 1958-62.** During the 1958-62 period, firms exited at about the same rate as during 1954-58, but entry substantially exceeded exit (table 7). In fact, rate of entry increased in each of the three periods considered. In each case, entry exceeded exit in the previous period by exactly 20 firms. Size distribution changed somewhat between 1958 and 1962. The height of its peak increased while remaining in class V. Numbers of firms in class VI also increased, while fewer firms appeared in class IV in 1962. Meanwhile, there also was a relatively large increase of

<sup>6</sup> Readers not accustomed to using transition tables should refer to appendix E.

firms in classes I, II, and III. The smaller classes experienced a relatively high degree of total entry. This, coupled with a rather small amount of growth from those classes, resulted in a net increase of small firms. Class IV also experienced much entry, but there was considerable movement from class IV in terms of growth, shrinkage, and exit. It therefore suffered a net decrease in number of firms. While class V received about the same amount of entry, it suffered smaller exit and growth, and hence there was a large increase in class V firms. Generally, size of persisting firms did not change greatly. Although more firms moved to a different class than in the two earlier periods, most of the movement was due to growth from categories IV and V. Very few firms grew more than one class.

#### Species Segments Of The Industry<sup>7</sup>

Size transitions of FI cattle slaughter firms were not substantially different from the movement denoted for the industry as a whole, again reflecting the domi-

nant impact of activity in the cattle segment. For all periods, transitions to larger classes exceeded transitions to smaller classes and entry exceeded exit.

Size transitions of FI calf slaughter firms differed from the transitions of all FI slaughterers. Exit exceeded entry. For all periods except 1950-54, when FI calf slaughter increased, the number of firms that shrank to smaller classes was greater than the number that grew into larger classes.

Size transitions of FI sheep slaughter firms evidenced more exit than entry, except during 1954-58 (the only period in which sheep slaughter increased). A greater number of firms also shrank to a smaller class than grew to larger classes during each of the periods.

More FI hog slaughter firms grew to larger classes than shrank during 1950-62, but exit exceeded entry. During 1950-54, more firms shrank to smaller classes than grew. (Total hog slaughter declined in 1950-54). During 1958-62, entry exceeded exit. Total hog slaughter also increased the greatest amount during this period.

## PROJECTED SIZE STRUCTURE OF THE FI SLAUGHTER INDUSTRY

### Projected Size Distributions

Knowing something about future size structure may assist individual firms as they adjust to change. It also may provide some basis for controlling undesirable change.

Projections of size transitions specify the shape of the structure toward which current changes are leading. These projections are made by means of a Markov-Chain technique. They are extrapolations toward future size structure if past transition patterns continue. If certain assumptions are met, the projections may be used as predictions. The projection technique also indicates the fixed size structure toward which current patterns of change are tending and the number of years that would be required to reach it under present growth conditions. This fixed structure is an equilibrium situation in which number of firms entering and growing into classes equals the number exiting and growing out of them.

#### Projections For All FI Slaughter Firms

If 1950-62 growth patterns continue into future years, the number of large firms will increase rather rapidly (table 8). By 1974, most slaughter firms will be larger than class V firms and by 1986 most will be larger than those in class VI. By 1998, more than half will be in what is now the largest size category. Accompanying the growing size will be an increasing total number of firms.

Table 8. Projected size distributions, all FI slaughter firms

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
1974 .....	1	0	6	11	27	119	140	46
1986 .....	1	1	7	9	25	73	71	209
1998 .....	1	0	5	7	20	58	53	298
2010 .....	1	0	4	5	14	42	40	366
2022 .....	0	0	3	4	11	31	29	416
2034 .....	0	0	2	3	8	23	22	453
Equilibrium ...	0	0	0	0	0	0	0	556

The predictive validity of this projection requires that the total growth of the slaughter industry increase as it has during 1950-62, that technological change have the same impact on size, that consequences of management decisions have the same impact, and that all other factors continue to have the same impact on growth. While these assumptions may hold for a few years, they are unlikely to hold for the longest projections.

The most distinguishing characteristic of the projections from 1950 to 1962 is their extreme rightward skewness. This skewness is readily apparent in the projections to 1974 and continues to increase throughout the projection period to equilibrium. Consequently, if 1950-62 growth patterns were to persist into the future, the distribution toward which they tend would be highly skewed, with virtually all firms

<sup>7</sup> A detailed discussion of size transitions by species segments of the FI slaughter industry appears in appendix F.

**Table 9. Projected equilibrium size distributions, all FI slaughter firms**

Base years	Class							
	I	II	III	IV	V	VI	VII	VIII
1950-62	0	0	0	0	0	0	0	556
1950-54	10	12	16	66	184	75	25	0
1954-58	3	1	13	105	130	80	138	0
1958-62	0	0	0	0	0	0	0	622

in what is now the largest class. Of course, determining size distribution within that class is impossible; the distribution of large firms may be skewed or non-skewed. It also is apparent from the projections that entry and exit patterns reinforce the growth characteristics, i.e., they do not contradict size transition to successively larger classes.

The projections do not indicate a rapid approach to equilibrium. Even the projections as far as 2034 depart from equilibrium, which implies that slaughter firm size structure is approaching a "target" structure at a slow rate. On the other hand, the configuration of the projection to 1974 does not closely resemble the 1962 configuration, implying considerable mobility in the 12-year period. These rather substantial period-to-period changes continue throughout the projection period. So the implication is that the size structure of the slaughter industry is quite mobile, but the equilibrium toward which it has tended during 1950-62 is a long way from the present structure.

Projections from subperiods within 1950-62 provide insight into the forces affecting growth. While projections from the subperiods are detailed for a series of successive future years, most of the differences between the 1950-62 and subperiod projections are reflected in the equilibrium projections.<sup>8</sup>

Projections for all FI slaughter firms from 1950-54, 1954-58, and 1958-62 show a decidedly different configuration (table 9). Projections from 1950-54 and 1954-58 show the industry to have been moving toward a size structure of firms concentrated in classes IV-VII. This placement is not too different from the current structure. On the other hand, the equilibrium projection from 1958-62 has all firms in the largest class. Three conclusions are apparent from these comparisons: (1) size transitions in 1958-62 obviously were heavily weighted by the 1950-62 transitions, (2) the size transition pattern changed radically between 1950-58 and 1958-62, and (3) projections based on the entire period may be misleading because of this change. Subsequent growth analysis may provide some insight into the reasons behind the change.

#### Projections For Species Segments<sup>9</sup>

Projected size distributions of firms in each livestock species vary. This variation is not unexpected, since the size transitions differed among species.

The projected structure of FI cattle slaughter firms shows a rather slowly changing future pattern. Numbers of small firms are projected to decline slowly and numbers of large firms to increase somewhat more rapidly. While projections to the near future show only modest change, the equilibrium projection is substantially different from present structure. This fact may imply that the forces of change in cattle slaughter size structure do not have great vigor, but if they prevail they carry the impact of considerable change.

The projected size structure of FI calf slaughter firms implies a different impact of change. If past transition patterns continue, there will be change in structure in a relatively short time. But little additional change appears in the long run. The implication is that change is coming rather rapidly, but that its impact is not a radical shift.

The projected size structure of FI sheep slaughter firms reflects much the same pattern as that for FI calf slaughterers. Rapid change in size structure will occur within a few years, but little additional change is projected over a long period.

Hog slaughter firm size structure is not projected to change a great deal. Projections into the next few years show little difference from the present. Over longer periods some change does appear in the projections, but even in the long run the projected change is modest.

### Assumptions Underlying The Projections

Note that the portrayal of future size structures has been described as a projection, not a prediction. The distinction is semantic only in part. A projection is a forecast of what the future will be, usually with some probability attached. A projection becomes a prediction when it is possible to intelligently say something about the nature of the economic forces affecting the shape of the industry. It is worth repeating: specific assumptions about economic forces in the slaughter industry underly the technique employed to project size structure.

Projections of slaughter firm size structure were made by means of a Markov-Chain technique. In this procedure, the probability of the growth of a firm is a function solely of the class in which it is located. Future size structure is portrayed by projecting into the future the movement of firms among classes as it occurred in the past. The projection assumes that entry and exit ratios also will be the same as in the past. Two critical assumptions enter here. One is that the numbers of entering and exiting firms will be the same as in the past; the other is that the ratio of actual entrants to potential entrants will continue. Since the projected movement is based on ratios of past movement, it is necessary to make assumptions about the

<sup>8</sup> See appendix G for detailed projection tables.

<sup>9</sup> See appendix H for a detailed discussion of projections for the species segments.

number of potential entrants before calculating an entry ratio. In these projections, it was assumed that the sum of potential entrants was the total number of firms that had been in the FI slaughter industry at some time during 1950-62. The assumption is largely arbitrary, but necessary. If the economic forces that shaped entry, exit, and growth in the past continue into the future with the same impact, the projected size structure will indeed resemble that of the future.

Under these assumptions, the Markov model also can be used to project an equilibrium size structure toward which current growth characteristics are tending. If the past growth, entry, and exit patterns continue, the equilibrium distribution is the size structure toward which the patterns are tending and which would result at some time in the future. The equilibrium does not imply a static state, but a state where entry and exit and growth and shrinkage in each class are equal, so the total number of firms in the class remains constant. If the assumptions of the method are not satisfied, both the shape of the equilibrium and the length of time required to attain it will be misstated. In other words, the projected size distributions will be accurate predictions only if future growth is exactly like past growth.

## PATTERNS OF SLAUGHTER FIRM GROWTH

There are several ways of looking at firm growth. One way is to consider size change patterns among classes within the size distribution. Size changes are shown as movement from one class to another, as described in the previous section.

A different way is to look at rates of change in size. In this context, average growth rates within size groups indicate relative propensities to grow. Variation around the average growth rate indicates the degree to which growth of individual firms in the group approaches the propensity for the entire group. In this section, growth is the ratio of size change to initial size.

Firm growth is a subject of interest for more than one reason. A detailed description of growth patterns helps explain the observed changes in slaughter industry size structure. On the other hand, a measure of industry performance is the extent to which firms of all sizes share equally in growing livestock supplies or suffer equally in declining supplies. If, for example, large firms were securing increasing supplies at a greater rate than small firms, not only would concentration be increasing, but there also would be evidence of economic inequality and perhaps of predatory behavior.

If the structure of the livestock meat economy resembled the world of perfect competition, all firms would be expected to change size in proportion to the change in supply of slaughter livestock, net of entry and exit. More specifically, if all firms had

The growth probabilities undoubtedly change from period to period as changes occur in technology, livestock production, meat consumption, and in other aspects of the firms' industrial environment. The Markov process provides only a means of extrapolating or projecting into the future. Even if the process is not a good predictor, the Markov equilibrium is a useful device for specifying the kind of industry size structure toward which current growth patterns are tending. Analysis of this size distribution can indicate the kind of size inequality and industrial concentration that current growth patterns would produce if they continue. Thus, the analysis can, in a sense, magnify the impact of current industry trends. Further, projections can help evaluate the mobility of industry size structure via comparisons of projection configurations with current distributions. In this respect, there are two dimensions to structural mobility: (1) the rapidity with which changes in size structure are taking place and (2) the net magnitude of long term structural change inherent in current growth patterns. Consequently, even if the Markov process were not a good predictor, it still would be a useful tool for industry structure analysis.

similar cost structures, had equal access to shifting livestock supplies and to the dressed meat market, and had equal knowledge, then the volume of each firm would be expected to change at the same rate as the available livestock supply changed. The rate of change in available livestock supply is in this sense a norm or standard of comparison for observed rates of size change in persisting firms.

The change in supply of livestock for persisting firms is a function not only of change in slaughter numbers, but also of the increased supply available due to exiting firms less the decreased supply available due to entering firms. Thus, the change in supply available to persisting firms is the total change in slaughter numbers plus the extra from exiting firms minus the supply taken by entering firms. This calculated quantity may be termed the expected growth rate. In table 10, expected growth rate is shown for each period as a gage with which to measure the extent each class of firms shared in the growth of livestock supplies.

### Growth Of All Firms

#### Growth: 1950-62

On the average, the size of all persisting firms in the four smallest classes more than tripled between 1950 and 1962 (table 10). On the average, firms in the four largest classes less than doubled their size. In



**Table 10. Characteristics of growth rates by classes, all FI slaughter firms, 1950-62**

Characteristic	Class							
	I	II	III	IV	V	VI	VII	VIII
	<b>1950-62</b>							
Expected growth .....	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
Mean growth .....	455.41	47.56	12.48	3.04	1.99	1.96	1.38	.73
Standard deviation .....	642.49	98.67	15.77	3.90	1.16	1.55	.26	.29
	<b>1950-54</b>							
Expected growth .....	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
Mean growth .....	243.62	10.60	3.90	1.84	1.30	1.24	1.16	1.00
Standard deviation .....	483.02	21.99	4.48	2.24	.47	.82	.11	.25
	<b>1954-58</b>							
Expected growth .....	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Mean growth .....	63.43	5.02	3.14	1.48	1.19	1.15	1.06	.85
Standard deviation .....	153.65	10.20	6.09	2.57	1.78	1.69	1.64	1.48
	<b>1958-62</b>							
Expected growth .....	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
Mean growth .....	1.20	1.39	7.05	1.72	1.31	1.17	1.05	.98
Standard deviation .....	0	2.32	13.72	3.31	1.92	1.73	1.62	1.97

1962, firms in the largest class averaged only 0.7 times their 1950 size.

On the basis of changes in livestock supplies and entry and exit of firms, persisting firms should have grown by 1.42 times during 1950-62. Only firms in classes VII and VIII failed to average this growth rate.

The variance of growth rates among size classes was as marked as the difference in average growth. The growth of small firms was much more variable than that of large ones. The standard deviation of growth rates decreased from 642 in class I to less than 0.3 in classes VII and VIII. Statistical tests for homogeneity of both mean and variance emphatically rejected the hypothesis that these were characteristics of the same population.

#### Growth: 1950-54

The size change pattern for 1950-54 followed that of 1950-62. Persisting firms initially in the smaller classes grew at a greater rate and had greater variation in growth rates than those in the larger classes (table 10). There is thus an apparent inverse relation between initial size and both mean and variance of growth rates. Only firms in classes VII and VIII failed to grow at the expected rate of 1.17 times.

Tests for homogeneity of mean and variance of growth rates rejected an hypothesis of growth equality among classes. In fact, results of the statistical tests suggested that growth rates were even more unequal during 1950-54 than during the entire 1950-62 period.

#### Growth: 1954-58

Growth rate characteristics during 1954-58 paralleled those of 1950-54. Both mean and variance of growth rates were greater in the smaller than in the larger classes (table 10). But the difference was rela-

tively less than for the 1950-54 period. Only firms in class VIII failed to average the expected growth rate.

The test for homogeneity of variance rejected an hypothesis of homogeneity. However, it suggested that there was more homogeneity during 1954-58 than during 1950-54. The test for equality of mean growth rates among size classes accepted an hypothesis of homogeneity. Hence, differences in average growth rates among classes during 1954-58 were not greater than would be expected by chance alone. But the variability of growth rates among small classes was significantly greater than among large ones.

#### Growth: 1958-62

Growth patterns for 1958-62 differed from those for the other periods. Mean growth in the two smallest classes was considerably smaller than previously but remained at about the same level in the large classes (table 10). Growth rate variance also was smaller in the two smallest classes but was higher than it previously was in the remaining classes. During 1958-62, firms in classes VI, VII, and VIII all failed to average an expected size change rate.

The test for homogeneity of means indicates that mean growth rates are not significantly different. However, variances of growth rates are not homogeneous.

#### Conclusion

Three conclusions follow: (1) For all periods, growth rate variance was not equal among size categories—the growth variability of small firms was much greater than that of large firms, (2) Mean growth rates were equal for two periods, 1954-58 and 1958-62, but were not equal for 1950-54 nor for 1950-62, (3) The only firms that failed to grow at the expected rate were those in the largest classes; firms in the small classes grew faster than the growth in available sup-

ply and thus were increasing slaughter volume at the cost of volume to the largest firms.

The growth rates of all FI slaughter firms cannot be regarded as equal in any dimension. Two major questions remain: Why do small firms on the average grow faster than large firms and why is there greater variation of growth rates among small firms?

### Growth By Species Slaughtered<sup>10</sup>

On the average, small FI cattle slaughter firms grew faster than large firms during 1950-62. In only one period, 1958-62, were growth rates not significantly different among classes. Growth variation among small cattle firms also was greater than variation among large firms. This pattern of growth variation persisted in all periods between 1950-62.

The growth patterns of FI calf slaughter firms only vaguely resembled those of all FI slaughter firms.

During each period between 1950-62, mean growth rates were not significantly different among classes. Growth rate variation of FI calf slaughterers did differ among classes, but the variation did not decrease uniformly as class increased.

Mean growth rates of FI sheep slaughter firms were significantly different among classes during 1950-62 but not for any of the periods within that time. Growth rate variation among classes was significantly different during all periods between 1950-62, but there apparently was no tendency toward declining variation as class increased.

Mean growth rates of FI hog slaughter firms were significantly different among classes during 1950-62. The difference, however, was not significant in 1954-58 and 1958-62. There apparently was only a slight inverse relation between class and mean growth rate. Growth rate variability was significantly different among classes during 1950-62 and for all three periods within 1950-62.

## FACTORS INVOLVED IN SLAUGHTER FIRM GROWTH

### Factors Related To Growth

#### Initial Size

Clearly, large FI slaughter firms grew at a much slower rate than small firms. This was true for 1950-62 as well as for each subperiod within that time. A simple correlation between growth and initial size verifies this fact (table 11). This growth rate also was true for slaughter in each of the livestock species. But it is reasonable to question whether growth was inversely related to size as such or to other organizational characteristics of large firms. With the available data, it was possible to evaluate the growth impact of three other organizational characteristics: vertical integration in meat processing, horizontal integration in multiple species slaughtering, and spatial distribution of slaughter facilities.

#### Vertical Integration

It was hypothesized that vertical integration would be *inversely* related to slaughter growth. Firms heavily involved in meat processing were expected to grow in slaughter at a slower rate than specialized slaughter firms for several reasons. By virtue of their participation in another industry, they have a greater range of growth alternatives than specialized firms. Presumably, the greater the number of growth alternatives, the smaller is the likelihood of selecting growth in slaughter when the firm chooses to expand. Another potential growth-retarding factor for vertically integrated firms is capital constraint. If it is advantageous (perhaps chiefly because of meat distribution chan-

nels) for the integrated slaughterer-processor to balance growth in both industries, slaughter growth must be accompanied by processing growth. So an investment in meatpacking must be split between slaughtering and processing. Alternatively, a given growth in slaughtering must be accompanied by comparable growth in processing. Growth in slaughtering may, therefore, imply substantially greater total firm growth for an integrated firm than for a specialized one. There also may be more technical problems in plant expansion for a vertically integrated firm. The product flows through a greater number of processes, and, when the firm expands, it must fit these processes together on a larger optimum scale. This necessity not only engenders technical difficulties, but it also implies greater jumps between successively larger optimum plant sizes. These jumps would arise simply because of the larger number of machines and processes, each with different optimum volumes, that must fit together for an optimum plant. All these factors led to an hypothesis of inverse relationship between slaughter growth and vertical integration into processing. The

Table 11. Simple coefficients of correlation between FI slaughter firm growth and selected variables

Period	Initial size	Proportion of slaughter processed	Number of species slaughtered	Number of plants operated	Growth in preceding period
1950-62 ...	-.344	-.010	-.136	-.028	...
1950-54 ...	-.268	-.003	-.107	-.020	...
1954-58 ...	-.100	-.011	+.070	-.014	-.010
1958-62 ...	-.286	-.033	-.043	-.035	-.038

<sup>10</sup> For a more detailed discussion of growth by species, see appendix I.

correlation between growth and vertical integration was small and negative (table 11).

The variable used to represent this form of vertical integration was the ratio of processing to slaughtering in 1961. Slaughtering is measured as the number of dressed weight pounds of livestock slaughtered. Processing is measured as the number of pounds of meat produced in each principal processing category. In some cases there is double counting of output, as an item may pass through more than one principal process before it leaves the plant. However, this method does accurately portray the extent of involvement in meat processing, since it measures the amount of processing rather than the quantity of plant output. It would have been desirable to measure vertical integration at the start of the growth period, but 1961 was the earliest year for which data were available.

### Horizontal Integration

It was hypothesized that horizontal integration also is inversely related to growth. The rationale for this hypothesis followed some of the same reasoning as that behind the vertical integration hypothesis. Slaughter growth in any one species was expected to be less likely for the multi-species firm because of the greater number of growth choices. But this probability obviously need not retard growth in total slaughter. If it is advantageous for the firm to sustain balanced growth, i.e., if the factors leading to initial horizontal integration still hold, the growth process for multi-species firms is more cumbersome than for specialized firms. Like the slaughterer-processor, such a firm must join together a large group of machines and processes as it moves to a larger optimum size. Growth is thereby a difficult process of rather large increments, perhaps requiring greater management resources. Being more difficult, it also may be less likely.

Conceivably, horizontal integration also may be inversely related to growth through the action of an unmeasured factor associated with integration. Most old line meatpacking plants and firms were full line slaughtering operations, and both location and technology have made their expansion difficult. Two dimensions of past location patterns affect plant growth: (1) current regions of rapid livestock production increase are different from former regions and (2) old plant sites now are frequently surrounded by metropolises, making physical expansion difficult. New technology rarely can be associated with the old. New slaughter plant technology implies new concepts in plant layout and design that complicate the expansion of an old plant. Expansion may require the complete rebuilding of an old plant or construction of a new one, both of which demand sizable capital. Consequently, growth among these firms may be slower than among firms that can sustain growth with smaller outlays. These two factors may be associated with multi-species firms. The variable representing horizontal integration is the number of livestock species

slaughtered by the firm at the beginning of the period. The simple correlation between growth and this variable was small and negative (table 11).

### Plant Distribution

The third variable hypothesized to be associated with growth was the spatial distribution of slaughter facilities. It was expected that the broader the pattern of plant distribution, the greater was the likelihood of slaughter growth. In the aggregate, growth occurs in response to increasing livestock supplies. The individual firm can grow only if it succeeds in attracting additional livestock supplies to its plants. It is therefore reasonable to believe that a broad plant distribution may be associated with growth for two reasons: (1) it increases the likelihood that the firm will be established in areas of expanding supplies and (2) it means that any one plant can draw on expanding livestock supplies without retarding the supply to a firm's other plants. A broad plant distribution pattern implies that a firm is actively trying to attract more livestock.

The variable representing this growth factor in the analysis was a simple count of plants associated with the firm. Obviously, the variable does not necessarily do a good job of depicting the spatial distribution of plants. But if one assumes that a firm will not locate a plant in such a manner as to retard supplies to its other plants, then spatial distribution is highly related to plant numbers and the variable is quite satisfactory. However, other considerations (administration and control, for example) also enter into location decisions. Furthermore, some plants are acquired, not built, by the operating firm. So plant location decisions may not be entirely within a firm's control. The variable therefore must be interpreted with these shortcomings in mind. The correlation between growth and number of plants was negative (table 11).

### Growth History

The impact on growth of a fourth variable — prior growth — was evaluated where data were available. The association between current and prior growth was measured for the 1954-58 and 1958-62 periods. Among firm groups in many industries, there are some growth firms — firms that sustain growth at higher rates than their associates. Those who manage such firms may hold growth as a particularly strong objective, or they may be more successful in attaining it. Some of them may be fortunately situated with respect to a growing industry — near an area of rapidly increasing cattle production, for example. Some may readily acquire the plants and equipment of exiting firms. For these and other possible reasons, a positive association between current growth and growth during a preceding period was hypothesized. But, contrary to expectations, the simple correlation between prior growth and current growth was negative for the periods for which it could be calculated (table 11).

## ANALYSIS OF GROWTH-RELATED VARIABLES

The individual roles of these variables in the growth process can be more precisely evaluated by relating each of them to growth in a regression model. For the 1950-62 period, the model, with calculated coefficients, was:<sup>11</sup>

$$G_1 = 190.63 - 41.96S_1 - .43V - 4.92H_1 + .93N_1$$

$$R^2 = .16$$

$$S_y = 60.54$$

$G_1$  = ratio of firm size in 1962 to firm size in 1950.

$S_1$  = firm size in 1950 (log of total pounds slaughtered, dressed weight).

$V$  = ratio of processing to slaughtering in 1961 (vertical integration index).

$H_1$  = number of species slaughtered in 1950 (horizontal integration index).

$N_1$  = number of plants operating in 1950.

Considering the low  $R^2$  (coefficient of multiple correlation), the model obviously does not incorporate a substantial explanation of growth. But the high negative coefficient on initial size and the positive coefficient on number of plants are of interest. It also appears that the index of horizontal integration had a greater association with growth than the index of vertical integration.

For the data from the 1950-54 period, the model was:<sup>12</sup>

$$G_2 = 126.23 - 27.72S_1 - .25V - 3.83H_1 + .64N_1$$

$$R^2 = .09$$

$$S_y = 55.23$$

$G_2$  = ratio of firm size in 1954 to size in 1950.

$S_1$  = firm size in 1950 (log of total pounds slaughtered, dressed weight).

$V$  = ratio of processing to slaughtering in 1961.

$H_1$  = number of species slaughtered in 1950.

$N_1$  = number of plants operating in 1950.

Again, the small value of  $R^2$  indicates that the model has accounted for a small proportion of the variation in growth rates. The coefficients were of a similar relative magnitude as those for 1950-62.

Growth in 1954-58 was associated with the previous variables plus growth in the preceding period. Results for the 1954-58 model were:<sup>13</sup>

$$G_3 = 7.16 - 1.60S_2 - .03V + .55H_2 + .01N_2 - .00001G_2$$

$$R^2 = .02$$

$$S_y = 7.42$$

$G_3$  = ratio of firm size in 1958 to size in 1954.

$S_2$  = firm size in 1954.

$V$  = ratio of processing to slaughtering in 1961.

$H_2$  = number of species slaughtered in 1954.

$N_2$  = number of plants operating in 1954.

$G_2$  = growth during 1950-54.

Obviously, introduction of the growth variable in the preceding period did not increase the value of  $R^2$ . However, the  $S_y$  (standard error of estimate) was much smaller than in previous models. Compared with the two preceding models, the constant factor in the equation and the coefficient on initial size were much smaller and the coefficient on horizontal integration was positive. The coefficient on growth in the preceding period was very small. Again, the coefficient on initial size was the largest.

Firm growth during 1958-62 was associated with variables in a similar fashion as that associated with growth during 1954-58. This association was:<sup>14</sup>

$$G_4 = 9.54 - 1.79S_3 - .03V - .13H_3 + .04N_3 - .01G_3$$

$$R^2 = .11$$

$$S_y = 2.75$$

$G_4$  = ratio of firm size in 1962 to size in 1958.

$S_3$  = firm size in 1958.

$V$  = ratio of processing to slaughtering in 1961.

$H_3$  = number of species slaughtered in 1958.

$N_3$  = number of plants operating in 1958.

$G_3$  = growth during 1954-58.

Again, the value of  $R^2$  was low. The value of  $S_y$  also was low for this model. The order of magnitude of coefficients on the variables was the same as in the previous periods. The coefficient on initial size was the largest. Both the constant factor and the coefficients were about the same size as the coefficients for 1954-58. However, the coefficient on the number of plants operated at the beginning of the period was negative, as it was for 1950-54 and 1950-62. The coefficient on preceding growth was much larger than it was for 1954-58, but it remained extremely small and negative.

There appeared to be intercorrelation among the variables in each of the regression calculations. One might expect, for example, that "number of plants" would be related to size and perhaps also to "number of species" and "ratio of processing to slaughtering". A standard measure of intercorrelation, the Durbin-Watson test, indicated that the relation was present. Simple correlations between the independent variables showed an unexpectedly small relation. Close inspection of the data partially dispelled the intercorrelation image. Several relatively large firms were specialized slaughterers with one or few plants, so the organizational image of the large, integrated, old line meatpacker did not fit all large firms. In short, while there was some intercorrelation among variables, it was not as great as might have been expected from casual observation.

<sup>11</sup> The coefficients in this and the following models are for the population of firms, not a sample. The calculated coefficients are, therefore, population parameters. Since they are not used to make inferences about the population, the usual tests of coefficient significance are not included in the discussion.

<sup>12</sup> See footnote 11.

<sup>13</sup> See footnote 11.

<sup>14</sup> See footnote 11.

Following these four regressions, it appeared that size was inversely correlated with growth, even after separating its association from vertical and horizontal integration, spatial spread of plants, and prior growth. On the basis of this work, it also appeared that some of the hypotheses on growth factors were acceptable conditionally only.

In all periods, there was a negative coefficient on the variable reflecting vertical integration. The coefficient was small, but it persisted. Apparently, then, the more firms were involved in processing, the less they grew in slaughtering.

There also appeared to be an inverse relationship between growth and horizontal integration as represented by number of species slaughtered. But the nature of the relationship was unclear. For the entire 1950-62 period and for 1950-54, there was a rather sizable negative coefficient on the variable, for 1958-62 the negative coefficient was quite small, and for 1954-58 the coefficient became positive. During 1954-58, growth was positively related to number of species slaughtered, which was in direct conflict with the rationale for the hypothesis on horizontal integration.

The relationship between growth and prior growth was almost zero. The sign of the coefficient on prior growth was negative, suggesting that, insofar as there was a relationship, firms that grew more in a prior period grew less in a current period.

The regressions suggested that the hypothesis on a relationship between growth and horizontal integration should be questioned and that the hypothesis on an association between current growth and prior growth should be rejected. While these results were unexpected, they were not without rationale.

It was hypothesized that growth was inversely related to horizontal integration because integration provided a greater range of growth alternatives and because it made the growth process more difficult. A possible reason for the association pattern of growth and number of species slaughtered lies in the pattern of slaughter livestock production. During 1950-54, there was an increase in cattle, calf, and sheep production and a decrease in hog production. During 1954-58, there was a decrease in cattle, calf, and sheep production but an increase in hog production. During 1958-62, cattle, sheep, and hog production increased,

but calf production declined. The period in which growth was positively related to horizontal integration was the only period of decreasing cattle slaughter. It also was a period in which slaughter of three of the species decreased, but the relative slaughter volumes of the species were such that cattle slaughter had the greatest impact. Thus, when cattle slaughter decreased and hog slaughter increased, growth was positively associated with horizontal integration. A study of the data indicates that a relatively large number of specialized slaughter firms were cattle slaughterers. Consequently, such firms probably would find growth difficult in the face of a declining cattle supply. At the same time, there was a relatively small degree of specialization in hog slaughter. Thus, when hog slaughter firms grew, it likely would be reflected in growth of a multi-species firm. Perhaps, then, the positive coefficient on horizontal integration for 1954-58 was not so much a rejection of the hypothesis as a reflection on other data characteristics not accounted for in the growth model.

It was hypothesized that growth in a current period would be positively associated with prior growth. The basis for this hypothesis was that some firms in many industries appear to be "growth" firms, i.e., over a period of time they sustain growth at a higher rate than other firms. Since the measured relationship between current and prior growth was inverse, the hypothesis appeared not to fit. In 1954-58 and in 1958-62, firms that grew the most appeared to be those that had grown the least in the prior period. So the growth firms hypothesis was rejected. The growth pattern, however, leads to another hypothesis about the life cycle of slaughter firms, an hypothesis that has been touched in economic literature. Examination of the data suggests that the most rapidly growing firms are those that have entered the industry recently. So the suggested life cycle of slaughter firms is one in which a small firm enters the industry, stays small for a few years as management gains experience, then either fails or has a period of rapid expansion to optimum plant size. Some time later it may again grow by adding more plants under a different type of expansion than that of the single plant growing to optimum size.

## OTHER GROWTH FACTORS

While the previous analysis was useful in quantifying some growth factors, it by no means unequivocally answered the question of why slaughter firms grow. The most striking characteristic that emerged was the inverse relation between size and growth rates. When growth rates among classes were computed, there was an inverse relation between class and both mean and variance of growth. The strong inverse relation did not appear in all segments of the industry:

It was quite obvious in cattle and calf slaughter but less strong in sheep and hog slaughter.

This study did not make a full investigation into all causes of growth. However, a line of reasoning does appear to fit the growth pattern. Three relevant factors are: (1) intra-firm factors, which are the technical or organizational attributes of the individual firms in the industry, (2) inter-firm factors, which are the commonly considered structural or organizational

attributes of the industry, and (3) institutional factors, which are the constraints public policy places on business firm behavior.

### Intra-Firm Factors

**Scale Economies.** Among the most important of the intra-firm factors that may produce the inverse relation between size and growth is economies with respect to slaughter firm size. The impact of economies to size could run two ways: (1) small, "high-cost" firms may be at a severe disadvantage compared to large firms and thus have a lower growth rate or (2) small firms may have a powerful incentive to attain the same advantages possessed by large firms and thus have a higher growth rate. Since the slaughter industry has higher growth rates among small firms, the question is whether small firms have greater incentive to grow than large firms in order to obtain the advantages. The fact that growth rates become successively smaller implies that if this incentive is present it wears off in a systematic fashion as size increases and that, for this reason, there is not much incentive to grow beyond class III. Further, there is the implication that the incentive is not present or operates to a much lesser degree in the sheep and hog slaughter segments of the industry.

Firm size economies are difficult to evaluate. Analysis from cross-sectional accounting data leaves much to be desired, and, as Freidman has argued, accounting data can logically be expected to show virtually constant costs among all firm sizes (4). However, it is less difficult to attack the question of plant scale economies. Logically, the average **in-plant** cost curve cannot be expected to turn up at any reasonable postulated output. Other studies support this logic. A study of scale economies in specialized beef slaughter plants by Logan and King indicated appreciable economies of size (5). In their synthesis, per head costs decreased from \$9.48 in a plant slaughtering 32,000 head annually to \$7.28 for a plant slaughtering 226,800 head annually. Costs persistently declined throughout the range of plant size considered. A study by Cox and Taylor (3) supported the Logan and King study. They found significant cost reduction in plants between 18,000 and 56,000 head. But they concluded that economies were virtually exhausted in plants exceeding 60,000 head annual capacity. There are no known studies that indicate in-plant scale diseconomies. So it is fairly safe to conclude that there are economies of size in slaughter plants. Since most firms except those in the largest classes operate only one slaughter plant,<sup>15</sup> some of the same conclusions also apply to firms. However, when firm operations are considered, in-plant slaughter costs become only a part of the total cost picture. Such costs as sales, procurement, transportation, management, etc. also must be considered.

These factors undoubtedly produce an upturn in the firm cost curve at some output level. Consequently, firm size economies cannot persist indefinitely, but they may persist at least up to the minimally efficient plant size. Thus, it is reasonable to conclude that there are some economies to size of slaughter firm. In such a situation, a firm with a plant of less than minimum efficient size will endeavor, if possible, to alter its existing plant or acquire a new plant to achieve a scale of operations enabling it to slaughter at a cost as low as most of its competitors. This incentive for growth is probably greater than the incentive for a large, low cost firm, because for the small firm it means life or death. If it is successful, it will grow; if not, it will shrink and leave the industry. This model fits the observation of higher mean and variance of growth rates in small classes, but it does not fit the growth pattern of sheep and hog slaughter firms.

The sheep and hog slaughter segments have had different patterns of entry and exit than the cattle slaughter segment. There has been a net decrease in numbers of sheep and hog slaughter firms. Persisting firms have then assumed the slaughtering formerly done by firms that exited as well as the additional volume of increased livestock numbers. So each existing firm has grown relatively more than the industry segment. A somewhat different growth pattern might therefore be expected in these segments. Although how it should differ is not precisely known, it could offer an explanation of the different growth patterns in sheep and hog slaughter, leaving scale economies as a possible explanation of the inverse relation between class mean and variance of growth rates.

**Vertical Constraint.** Another possible explanation of the inverse relation between size and growth is vertical constraint on firm growth. A firm may be constrained in increasing the size of its slaughter operations because it finds it difficult to pursue equivalent growth in a vertically related process. This difficulty could be due to market conditions or technical scale factors in the related process. For example, if a firm must increase its meat processing size in order to increase its slaughtering size and if increasing size in the processing industry is difficult, a firm would be constrained from slaughter growth. This was the relation evaluated, but other vertical constraints could also apply.

If this were the case, small firms could be expected to have more difficulty expanding in a related industry than large firms, so the constraint would be operative on growth of small firms. This appears to be inconsistent with the observed growth pattern. Therefore, while vertical constraints may be a plausible explanation of the growth pattern, they were not a strong factor in slaughter firm growth insofar as they were measured in this study.

<sup>15</sup> The overall plant/firm ratio is about 1.4/1.

**Horizontal Constraint.** Horizontal constraint on firm growth also offers a possible explanation for the growth pattern. Horizontal constraint means constraint on slaughter growth of a livestock species due to difficulty in expanding a horizontally related process. The constraint could be due to nonuniform technical scale factors in the related process or market growth difficulty for the related process output. For example, if slaughter growth of all livestock species were an adjunct to growth in one species, it could be unprofitable to expand in the one species only. Thus, the firm could be said to be constrained from growth in the one species. Other horizontal constraints also could operate in the industry.

As with vertical constraint, large firms could more easily surmount the constraint described than small firms. Hence, large firms could be expected to have greater growth rates than small firms. While the explanation is plausible, it does not fit the facts, since small slaughter firms have shown greater growth than large firms. Therefore, this type of horizontal constraint does not seem to be a reasonable explanation for an inverse relation between growth and size of slaughter firms.

**Geographic Variability in Opportunity.** Because of some firms' favorable location in areas of rapidly increasing livestock supply or meat demand, they may have disproportionately favorable growth opportunity. Hence, there would be nonproportionate growth. It is possible that favorable location could be related to size. Large firms, for example, could have their plants in "all the good areas."

This possibility does not appear to fit the slaughter industry. If it did, large firms could be expected to grow more than small ones. But such is not the case. Further, evidence indicates that small firms have more generally entered the rapidly growing areas of livestock production and meat consumption than large firms. Therefore, geographic variability in growth opportunity may provide at least a partial explanation of the growth pattern in slaughter firms.

**Pattern of Technological Change.** New technology has been developed and introduced into the slaughter industry in recent years. Such developments could affect the proportionality of growth patterns if they favored some firm sizes or disadvantaged others. There is some evidence that this could be a factor in the slaughter industry.

In former years, technology favored the construction of large, integrated meatpacking plants. New technology has fostered development of small, specialized slaughter plants, particularly cattle slaughter plants. Old, large firms have been reluctant to begin construction of the new type of plant because of their high fixed investment in large integrated plants. So small firms have been in the forefront with new facilities, which have been relatively more profitable than the old, because it has been less difficult for small

firms to adjust. Furthermore, there is a greater proportion of new firms among the small than among the large. Since greater variability in success of operations among new firms can be expected, greater variability in growth also can be expected. This explanation fits the observed pattern of size change and therefore could be part of the reason for the kind of growth observed.

**Investment Alternatives.** Large meatpacking firms face a different set of investment alternatives than small firms. Most large firms have assets in brand names and sales organizations for merchandising processed meat products, which may give them an advantage relative to small firms. On the other hand, much fresh meat is sold as a graded, undifferentiated product. To participate in this market, a firm does not need a large sales organization, product promotion, or a brand image to appeal to the consumer. Specialized slaughter firms, including many small firms, may thereby have a cost advantage in slaughtering but a disadvantage in meat processing. Consequently, small slaughter firms may find it more profitable to expand slaughtering, while large firms expand meat processing.

Large meatpackers also have investment alternatives in other industries. Average return rates in many industries have been larger than in the slaughter industry in the past few years. Many large meatpacking firms have invested in chemicals, soap, sporting goods, and numerous other areas. The existence of such a range of investment opportunities lessens the possibility that large firms will invest in livestock slaughter. This fact may account for some of the relatively slow expansion of large slaughter firms.

#### Inter-Firm Factors

**Product Differentiation.** In a market in which product differentiation, marketing know how, etc. are important, previously successful sellers can be expected to grow faster than others. Presumably, firms that have been successful in the past are now the large firms.

While this explanation could plausibly account for firm growth in some industries, it does not fit the slaughter industry. Some product differentiation does exist in the slaughter market and a great deal exists in the market of the vertically-related processing industry. But the expected pattern of unequal growth arising from product differentiation does not prevail.

**Market Constraints in Related Industries.** There may be constraints on firm growth in either its input or output market. They may be vertical constraints from firms that supply its inputs or from firms that buy its output.

The two most prominent inputs for a slaughter firm are livestock and labor. Livestock is purchased from an industry characterized by nearly perfect competition, so constraints probably are not operative in this market. However, labor is purchased in a market

where it is alleged that small firms have an advantage over large. So the labor market could give small firms disproportionate growth advantage, which fits the facts of the growth pattern.

The major output of a slaughter firm is dressed meat or processed meat products. As mentioned earlier, product differentiation could give large firms an advantage in the processed meat market (which does not agree with the growth pattern), and small firms may be favored in the dressed meat market. It has been alleged that meat market demanders have bargaining power superior to that of suppliers and that to enhance this position they may endeavor to foster the growth of small firms. If the allegation is true, it could explain the growth pattern. However, the allegation could not be evaluated in this study.

**Anti-Competitive Behavior.** Constraints on growth in output and input markets also may be horizontal. The actions of large firms — collusion or predatory behavior, for example — could produce unequal growth. However, since it is difficult to construe the observed growth patterns as favorable for large firms, anti-competitive behavior apparently cannot be supported as the cause of unequal growth.

#### **Institutional Factors**

**Public Anti-Trust Policy.** Undoubtedly, anti-trust policy constrains the actions of large firms. Once the victim of public wrath, large slaughter firms are under close scrutiny by regulatory agencies. Also, because the policies of large firms have a greater impact on the industry than those of small firms, they are observed closely. So the growth of large slaughter firms may

be constrained by anti-trust policies to a greater extent than the growth of small firms. In view of the observed growth patterns, this explanation is plausible.

**Community Policy.** The public policy of communities in which slaughter firms are located may have an impact on growth. If a slaughter firm has good relations with the community or communities in which it is located, it may be very easy for the firm to expand its slaughter operations in the community. If relations are not good, growth may be difficult. Though small firms possibly could have better community relations than large firms, it is difficult to see why it should be systematically related to size, as the growth patterns suggest. Therefore, it probably does not explain observed growth patterns.

#### **Summary Of Factors**

The several possible causes of observed growth patterns can be summarized as follows:

- (1) Scale economies operating in a preverse way.
- (2) Patterns of technological change favoring new firms.
- (3) More investment alternatives available to large firms.
- (4) Advantage possessed by small firms in the labor market.
- (5) Public anti-trust policy constraining actions of large firms.

Though further research would be necessary to evaluate these causes thoroughly, they appear to fit the patterns of size change.

## **IMPLICATIONS OF GROWTH ANALYSIS**

### **For Projected Size Structure**

As originally conceived, the growth analysis was anticipated to lead to identification of associated variables so that precise predictions of future size structure could be formulated. This anticipation was not realized. The analysis did show that initial size is by far the most important associated variable among those analyzed. The technique employed to project size distributions assumed that the probability of size change depended solely on initial firm size. The fact that other variables also had some impact on growth impaired the validity of the projections as predictions. However, the analysis did reveal the small impact of the other variables, suggesting that the validity of the projections as predictions could not be greatly enhanced by incorporating the postulated variables into a predictor model. In other words, incorporation of the other variables hypothesized to be associated with growth would not have yielded appreciably better

predictions than the simple projections of past growth patterns. While it is unlikely that the economic forces affecting slaughter firm growth in the future will be exactly like those in the past, it appears that, in the aggregate, factors associated closely with firm size have an important bearing on a firm's propensity to grow.

### **For Industry Performance**

This study did not include a direct analysis of slaughter industry performance, but it is reasonable to surmise that growth analysis does have performance implications.

To evaluate performance, it is necessary to start with a performance norm. The economic concept of pure competition includes an internally consistent set of performance norms, but it does not include a dynamic economic environment. If the economy of the perfectly competitive model were to become dynamic



through a shift in input supply, equally proportionate firm growth would be expected. More specifically, if all slaughter firms had equal access to increasing livestock supplies (i.e., perfect knowledge, no locational disadvantage, no capital restraints, etc.), all could be expected to grow in equal proportion to the increased supply, providing that other assumptions of the competitive model were met. In this sense, a growth survey may generate implications about the nature of the competition in the industry.

Statistical tests on the degree of growth difference among classes indicated that both the mean and variance of growth rates were significantly different. Hence, the dynamically competitive growth norm was not met. Small slaughter firms grew significantly faster than large firms during 1950-62. Public policy may have been an influence, not merely in providing an equal opportunity for small firms, but in insuring the industry of many competing firms. The apparent growth success of small firms indicates that this performance norm was being satisfied.

Other performance data published by the National Commission on Food Marketing are available (6). These data show that profit rates in the slaughter industry generally are lower than in other food processing. Data also indicate that there is a rather low advertising expenditure in the slaughter industry and that there has been a considerable influx of new technology in recent years. This information, coupled with

the growth data, indicates that performance of the slaughter industry is favorable in at least some important dimensions.

### Cited References

1. Anthony, W. E., *Structural Changes in the Federally Inspected Livestock Slaughter Industry*, Agr. Econ. Rept. No. 83, USDA, ERS, Feb. 1966.
2. Anthony, W. E., *Structural Changes in the Federally Inspected Meat Processing Industry*, Agr. Econ. Rept. No. 129, USDA, ERS, Feb. 1968.
3. Cox, R. W. and F. R. Taylor, *Feasibility of Cooperatively Owned Slaughtering Plants*, Agr. Econ. Rept. No. 39, N. Dak. Agr. Exp. Sta., Fargo, Jan. 1965.
4. Freidman, Milton, "Comment," *Business Concentration and Price Policy*, Nat. Bureau of Econ. Res., Princeton, 1955, pp. 230-38.
5. Logan, S. H. and G. A. King, *Economies of Scale in Beef Slaughter Plants*, Giannini Foundation Res. Rept. No. 260, Calif. Agr. Exp. Sta., Davis, Dec. 1962.
6. National Commission on Food Marketing, *Organization and Competition in the Livestock and Meat Industry: Technical Study No. 1*, June 1966.

## APPENDIX A: SHARE OF SLAUGHTERING BY CUMULATIVE PERCENTAGES OF FIRMS

Table A-1. Share of FI national slaughter by cumulative percentage of firms by species, 1950, 1954, 1958, and 1962

1950		1954		1958		1962	
Cumulative percentage of firms	Percentage of market	Cumulative percentage of firms	Percentage of market	Cumulative percentage of firms	Percentage of market	Cumulative percentage of firms	Percentage of market
percent							
<b>Cattle</b>							
0	0	0	0	0	0	0	0
10	72	10	66	10	62	10	59
20	81	20	76	20	74	20	72
30	87	30	84	30	82	30	81
40	91	40	89	40	88	40	87
50	95	50	93	50	92	50	92
60	97	60	96	60	95	60	95
70	98	70	98	70	97	70	98
80	100*	80	99	80	99	80	99
90	100*	90	100	90	100*	90	100*
100	100	100	100	100	100	100	100
<b>Calves</b>							
0	0	0	0	0	0	0	0
10	84	10	83	10	77	10	72
20	92	20	92	20	90	20	88
30	96	30	96	30	96	30	95
40	98	40	98	40	98	40	98
50	99	50	99	50	99	50	99
60	100*	60	100*	60	100*	60	100*
70	100*	70	100*	70	100*	70	100*
80	100*	80	100*	80	100*	80	100*
90	100*	90	100*	90	100*	90	100*
100	100	100	100	100	100	100	100
<b>Sheep</b>							
0	0	0	0	0	0	0	0
10	91	10	91	10	90	10	89
20	97	20	98	20	98	20	98
30	99	30	100*	30	100*	30	99
40	100*	40	100*	40	100*	40	100*
50	100*	50	100*	50	100*	50	100*
60	100*	60	100*	60	100*	60	100*
70	100*	70	100*	70	100*	70	100*
80	100*	80	100*	80	100*	80	100*
90	100*	90	100*	90	100*	90	100*
100	100	100	100	100	100	100	100
<b>Hogs</b>							
0	0	0	0	0	0	0	0
10	81	10	79	10	74	10	73
20	90	20	89	20	85	20	85
30	94	30	94	30	91	30	92
40	97	40	97	40	95	40	97
50	98	50	99	50	98	50	99
60	99	60	99	60	99	60	100*
70	100*	70	100*	70	100*	70	100*
80	100*	80	100*	80	100*	80	100*
90	100*	90	100*	90	100*	90	100*
100	100	100	100	100	100	100	100

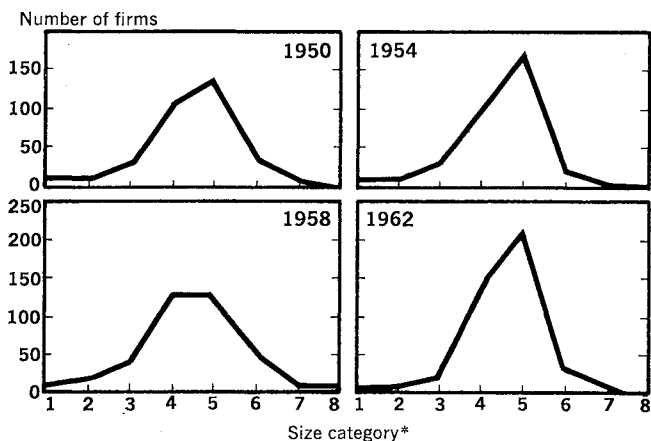
\* The rest of the firms have less than 0.5 percent of the market.

Table A-1 (continued). Share of FI national slaughter by cumulative percentage of firms by species, 1950, 1954, 1958, and 1962

1950		1954		1958		1962	
Cumulative percentage of firms	Percentage of market	Cumulative percentage of firms	Percentage of market	Cumulative percentage of firms	Percentage of market	Cumulative percentage of firms	Percentage of market
percent							
<b>All species</b>							
0	0	0	0	0	0	0	0
10	78	10	74	10	70	10	68
20	85	20	82	20	79	20	78
30	90	30	87	30	86	30	85
40	93	40	91	40	90	40	90
50	95	50	94	50	93	50	93
60	97	60	97	60	96	60	96
70	99	70	98	70	98	70	97
80	99	80	99	80	99	80	99
90	100*	90	100*	90	100*	90	100*
100	100	100	100	100	100	100	100

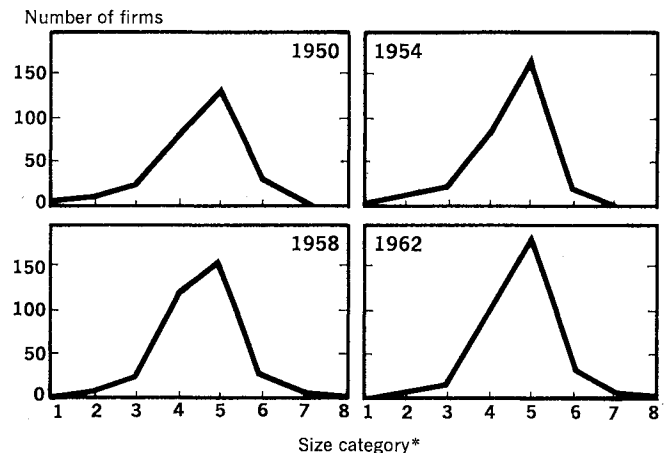
\* The rest of the firms have less than 0.5 percent of the market.

## APPENDIX B: SIZE DISTRIBUTIONS OF SLAUGHTER FIRMS



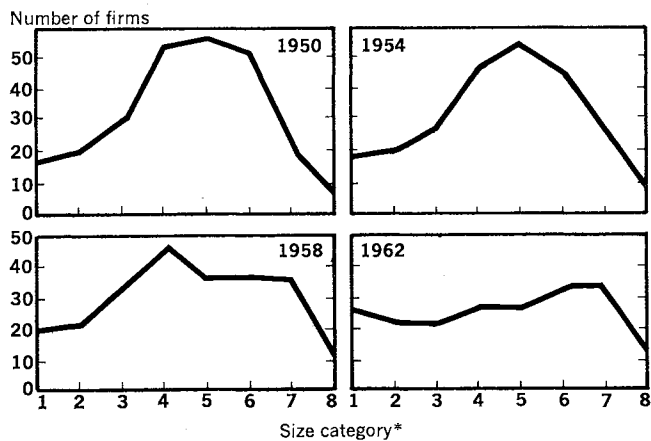
\* Size increases from 1 to 8.

Figure B-1. Slaughtering increases of all slaughter firms by size of firm



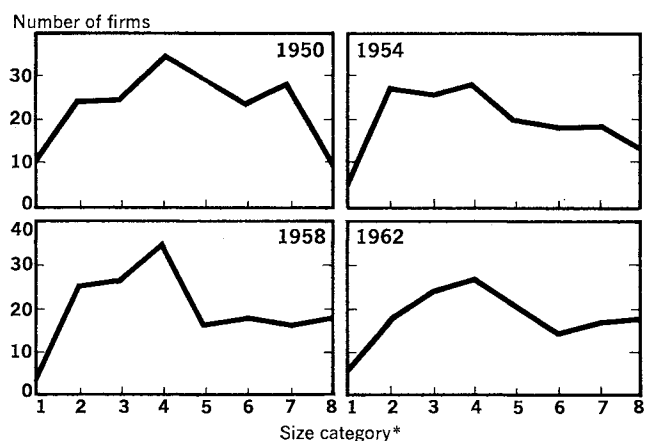
\* Size increases from 1 to 8.

Figure B-2. Slaughtering increases of cattle slaughter firms by size of firm



\* Size increases from 1 to 8.

Figure B-3. Slaughtering increases of calf slaughter firms by size of firm



\* Size increases from 1 to 8.

Figure B-4. Slaughtering increases of sheep slaughter firms by size of firm

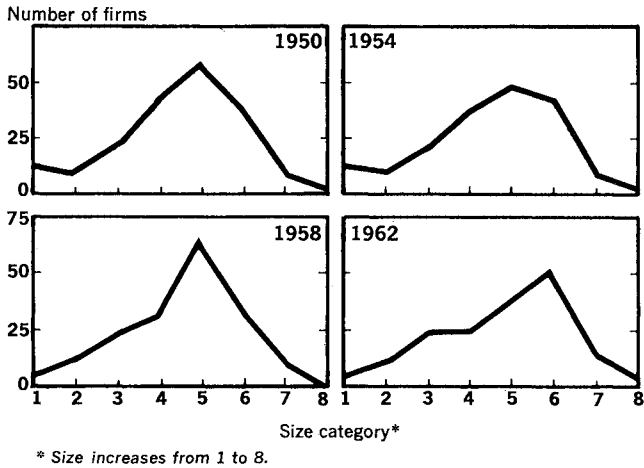
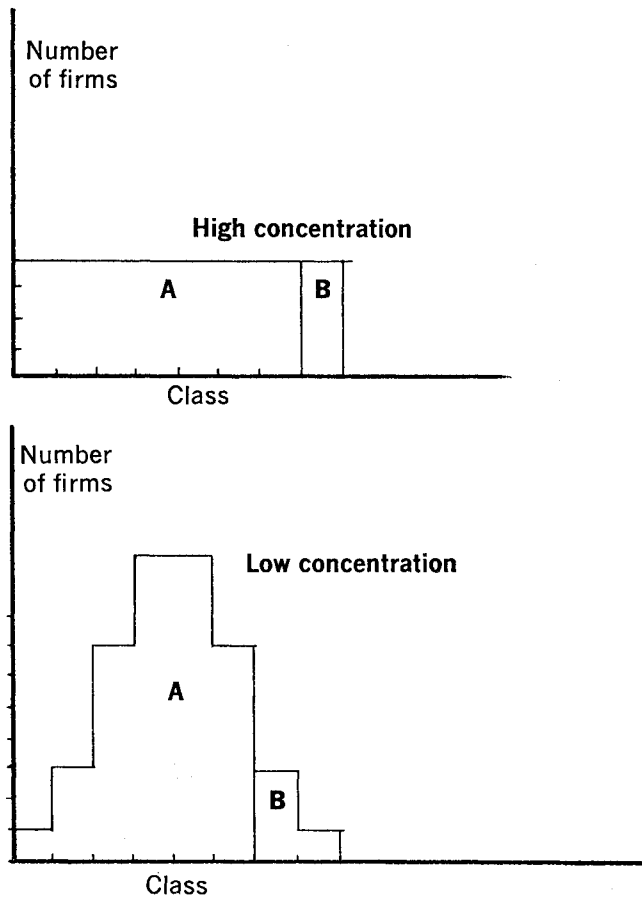


Figure B-5. Slaughtering increases of hog slaughter firms by size of firm

### APPENDIX C: CONCENTRATION RATIOS AND SIZE DISTRIBUTIONS

To interpret the size distribution in conjunction with industry concentration data, one must recognize the relation between the two. The concentration ratio expresses the amount of slaughtering done by the few largest firms relative to the industry total without regard for the number of firms in the industry. In figure C-1, the concentration ratio is expressed schematically as the ratio of area B to the area A + B. In a highly concentrated industry, B is large relative to A; if concentration is low, B is small relative to A. However, with high concentration, there is an *equal* number of firms among all classes. With low concentration, there is an *unequal* number of firms among classes. But the concentration ratio has no reference to the number of firms. In figure C-1, the industry of low concentration has relative size equality; most of the firms are in the middle classes. The industry of high concentration, with an equal number of firms in each class, has relative size inequality; many firms are in both the small and large classes. Hence, size equality implies unequal numbers of firms among classes, and size inequality implies equal numbers of firms among classes. In the extreme case of size equality, all firms would be in the same class.

Figure C-1. Schematic relationship between industry concentration and size distribution



## APPENDIX D: SOURCES OF CHANGING SIZE STRUCTURE BY SPECIES

### FI Cattle Slaughter Firms

FI cattle slaughter firms were larger and more nearly equal in size in 1962 than in 1950. In total, 175 of the cattle slaughter firms that were in the industry in 1950 were still in it in 1962 (table D-1). These firms grew substantially between 1950 and 1962 and were larger than the average of all cattle slaughterers in both 1950 and 1962. Concurrently, variation in size among this group declined from .80 to .58. Relative variation declined from 19.8 to 13.1 percent.

This trend was reinforced by the sizes of entering and exiting firms. Mean size of the 204 entering firms was 4.02 in 1962 (table D-1). In 1950, mean size of the 126 exiting firms was 3.81. Since firms that left the industry were replaced by larger firms and since there were more entering than exiting firms, the net impact on size structure was a larger average total size.

Entering firms were less equal in size in 1962 than exiting firms had been in 1950, although the relative size variation of both groups was just over 20 percent (table D-1). This characteristic had an impact on size structure counter to the trend toward size equality of persisting firms. However, the impact was small and did not change the direction of the trend toward size equality.

### FI Calf Slaughter Firms

Average volume of FI calf slaughter firms increased during 1950-62. Size variation also increased.

The average size of the 99 persisting calf slaughter firms decreased slightly between 1950 and 1962 (table D-2): It was 3.32 in 1950 and 3.31 in 1962. In both years, it was larger than the mean size of all calf slaughter firms. Inequality in size among persisting firms increased slightly. While the standard deviation increased from 1.21 to 1.24, relative variation increased from 36.4 to 37.5 percent.

The impact on size structure of the slight decline in mean size of persisting firms was reversed by the size characteristics of entering and exiting firms. The 158 FI calf slaughterers that ceased operations had a mean size of 3.07. While the difference was very slight, it did produce a slight net increase in average industry size.

Size variation among FI calf slaughter firms was influenced significantly by the size pattern of exiting and entering firms. Relative size variation of exiting firms was 33.3 percent in 1950, while size variation of entering firms was 44.6 percent in 1962 (table D-2). Size inequality of firms that exited was less than the inequality among persisting firms in 1950. Size inequality of entering firms was greater than the inequality of persisting firms in 1962. Hence, the greater inequality of size in entering firms relative to exiting firms reinforced the movement of persisting firms toward industry inequality.

**Table D-1. Change in mean and standard deviation of logarithms of annual slaughter of FI cattle slaughter firms, 1950-62**

Firm group	Mean		Standard deviation		Percentage variation*	
	1950	1962	1950	1962	1950	1962
All firms (301 in 1950, 379 in 1962) . . . . .	3.96	4.21	.80	.76	20.2	18.1
Persisting firms (175)† . . . . .	4.05	4.43	.80	.58	19.8	13.1
Exiting firms (126)‡ . . . . .	3.81	...	.77	...	20.2	...
Entering firms (204)§ . . . . .	...	4.02	...	.82	...	20.4

\* Percentage variation =  $\frac{\text{standard deviation}}{\text{mean}} \times 100$ .

† Firms operating in both 1950 and 1962.

‡ Firms operating in 1950 but not in 1962.

§ Firms operating in 1962 but not in 1950.

**Table D-2. Change in mean and standard deviation of logarithms of annual slaughter of FI calf slaughter firms, 1950-62**

Firm group	Mean		Standard deviation		Percentage variation*	
	1950	1962	1950	1962	1950	1962
All firms (257 in 1950, 218 in 1962) . . . . .	3.16	3.18	1.10	1.32	34.8	41.5
Persisting firms (99)† . . . . .	3.32	3.31	1.21	1.24	36.4	37.5
Exiting firms (158)‡ . . . . .	3.06	...	1.02	...	33.3	...
Entering firms (119)§ . . . . .	...	3.07	...	1.37	...	44.6

\* Percentage variation =  $\frac{\text{standard deviation}}{\text{mean}} \times 100$ .

† Firms operating in both 1950 and 1962.

‡ Firms operating in 1950 but not in 1962.

§ Firms operating in 1962 but not in 1950.

**Table D-3. Change in mean and standard deviation of logarithms of annual slaughter of FI sheep slaughter firms, 1950-62**

Firm group	Mean		Standard deviation		Percentage variation*	
	1950	1962	1950	1962	1950	1962
All firms (187 in 1950, 158 in 1962) . . . . .	2.90	2.82	1.44	1.60	49.7	56.7
Persisting firms (75)† . . . . .	3.32	3.77	1.42	1.44	42.8	38.2
Exiting firms (112)‡ . . . . .	2.62	...	1.38	...	52.7	...
Entering firms (83)§ . . . . .	...	2.41	...	1.46	...	60.6

\* Percentage variation =  $\frac{\text{standard deviation}}{\text{mean}} \times 100$ .

† Firms operating in both 1950 and 1962.

‡ Firms operating in 1950 but not in 1962.

§ Firms operating in 1962 but not in 1950.

### FI Sheep Slaughter Firms

Average FI sheep slaughter firm volume decreased from 1950 to 1962, but there was an increase in variation among firm sizes.

The 75 FI sheep slaughter firms that operated in both 1950 and 1962 experienced appreciable growth. Their size averaged 3.32 in 1950 and 3.77 in 1962 (table D-3). Variation in size among these firms also increased, but by a relatively small amount. Their relative size variation thereby decreased from 42.8

**Table D-4. Change in mean and standard deviation of logarithms of annual slaughter of FI hog slaughter firms, 1950-62**

Firm group	Mean		Standard deviation		Percentage variation*	
	1950	1962	1950	1962	1950	1962
All firms (199 in 1950, 189 in 1962) . . . . .	4.35	4.42	1.16	1.29	26.7	29.2
Persisting firms (93)† . . . . .	4.78	4.92	.71	1.10	14.9	22.4
Exiting firms (106)‡ . . . . .	3.97	...	1.33	...	33.5	...
Entering firms (96)§ . . . . .	...	3.94	...	1.28	...	32.5

\* Percentage variation =  $\frac{\text{standard deviation}}{\text{mean}} \times 100$ .

† Firms operating in both 1950 and 1962.

‡ Firms operating in 1950 but not in 1962.

§ Firms operating in 1962 but not in 1950.

to 38.2 percent. Trends in the size structure of persisting firms obviously were different from the aggregate changes in the structure of the industry as a whole.

Comparison of the size profile of entering and exiting firms revealed the main element of change in aggregate size structure. Mean size of the 83 entering firms was 2.41 in 1962, while mean size of the 112 exiting firms had been 2.62 in 1950 (table D-3). The impact of this difference on the total group was greater than the impact of the growing average size of persisting firms.

Size inequality among entering firms was greater than among exiting firms. The 60.6 percent relative variation in size of entering firms was greater than the 52.7 percent variation in size of exiting firms (table D-3). The impact of this characteristic was greater than the impact of the decreasing relative size inequality of persisting firms, which led to the increase in relative size variation of the total group of FI sheep slaughter firms.

## FI Hog Slaughter Firms

FI hog slaughter firms had a greater volume in 1962 than in 1950. Size variation among FI hog slaughter firms also increased, but rather modestly.

Changes in size characteristics for the 93 persisting FI hog slaughter firms paralleled those of the total industry. Mean size of persisting firms grew from 4.78 to 4.92 (table D-4). Concurrently, the standard deviation of their sizes increased from .71 to 1.10, leading to an increase in relative variation from 14.9 percent in 1950 to 22.4 percent in 1962. However, size inequality among the persisting firms was less than the size inequality among all hog slaughter firms.

Difference in mean size of exiting and entering firms, though slight, was counter to the growth in persisting firm size. Mean size of the 106 exiting FI hog slaughterers was 3.97 in 1950 (table D-4). Mean size of the 96 firms entering in 1962 was 3.94. The difference was so slight that the thrust of change due to the growth of persisting firms was not overweighed.

Difference in size inequality of entering and exiting firms also was counter to the change in size variation of persisting firms. The exiting firms had a standard size deviation of 1.33 in 1950, while the entering firms had a smaller standard size deviation, 1.28, in 1962 (table D-4). The percentage variation of both the exiting and entering firms was much greater than the persisting firms, which produced the quite large percentage variation in size of all FI hog slaughterers. However, the relatively smaller size variation of entering firms did not outweigh the substantial increase in the inequality of persisting firms.

## APPENDIX E: READING SIZE TRANSITION TABLES

The purpose of size transition tables is to identify the classes in which firms are located at two different points in time—in this case, 1950 and 1962. By recording entry of new firms, exit of old firms, and size changes of persisting firms, it is possible to trace the total number of firms moving into and out of the industry in each class and the number of firms moving among each of the classes within the industry, as well as the total number of firms in each class in 1950 and 1962. Alternatively stated, transition tables record the “fate” of firms in each class in 1950 and the “history” of firms in each class in 1962.

In these tables, the row headings identify size in 1950, and the column headings identify size in 1962. These headings mark out boxes within the tables labeling size in both years. For example, in table 4 the box in the row labeled I under the column labeled I contains the number of firms that were in class I in both

1950 and 1962. The box in the row labeled I under the column labeled II shows the number of firms that were in class I in 1950 but had grown to class II by 1962. The box in the row labeled II under the column labeled I shows the number of firms that were in class II in 1950 that had shrunk to class I in 1962. The boxes on the diagonal from the upper left to the lower right of the tables contain the number of firms that were in the same classes in 1950 and 1962. The **exits** column indicates the number of firms that were in each class in 1950 that exited before 1962. The **entries** row shows the number of firms in each class in 1962 that had entered the industry since 1950. The **firms in 1950** column is a summation of each of the rows, showing total number of firms in each class in 1950. The last row, **total firms in 1962**, shows the total number of firms in each class in 1962.

## APPENDIX F: SIZE TRANSITIONS OF FIRMS BY SPECIES

### F1 Cattle Slaughter Firms

**Transitions: 1950-62.** During 1950-62, the size distribution of cattle slaughter firms changed somewhat. Although the peak of the distribution remained in class V, it became much more pronounced as numbers of class V firms increased relative to those in other classes (table F-1). There was a slight decrease in number of very small firms (class I), a slight increase in number of class II firms, and a slight decrease in number of class III firms. The most substantial decrease in numbers occurred in class IV, which lost 32 firms via growth into class V. Numbers in classes V, VI, and VII grew, but the number in class VIII remained constant. The greatest increase in numbers was in class V. A portion of the increase was due to net entry of new firms into the category, but substantial increase was due to size changes of persisting firms. Growth of the 32 firms from class IV and 5 firms from class III contributed substantially to the increase. The growth of class VI, which more than doubled, was augmented by the growth of 16 firms that initially were in class V. Growth of two firms from class VI accounted for the increase in number of class VII firms. Thus, a large portion of the rightward skewing of the size distribution during 1950-62 was due to growth of firms initially in the middle classes.

There is evidence of moderately high size mobility, both in terms of entry and exit and in number of firms moving from their initial class throughout all classes. Yet most growth was not extensive in the sense of movement over a great number of classes. The majority of firms that moved into a different category did not move more than one class.

**Transitions: 1950-54.** During 1950-54, the peak of the cattle slaughter size distribution increased and

shifted toward the right (table F-2). This took place not only because entry exceeded exit, but also because 38 class IV firms grew into class V and 12 class V firms grew into class VI. Although most of the growth was from the middle classes, growth in every class exceeded shrinkage. So there was a general upward trend in size of persisting firms.

**Transitions: 1954-58.** Between 1954 and 1958, there was an additional decrease in number of small firms (classes I and II), while there was a growth in the number of class IV through class VIII firms (table F-3). The result was an increase in the height of the distribution peak, with a slight shift in skewness toward the left. Entry and exit patterns were the chief causes of the shift. There was a substantial excess of entry over exit in class V, but the pattern was carried out by the size transitions of persisting firms. While 13 firms grew from class V into class VI, 11 firms shrank from class VI into class V, and 15 grew from class VI into class VII. Thus, number of firms in class VI increased slightly, but the number in class V increased much more and the number in class VII increased moderately more.

**Transitions: 1958-62.** During 1958-62, the cattle slaughter firm size distribution grew more peaked and became more skewed to the right (table F-4). As in previous periods, entry exceeded exit in most classes, but much of the shift was due to net movement of firms from class IV into class V. There also was some growth of firms from class III into class V. And shrinkage from class VI into class V, coupled with some shrinkage from class V into class IV, left a net decrease in number of firms in class IV. While the number of class IV firms decreased, growth from class V into class VI yielded an increase in number of class

Table F-1. Size transitions of F1 cattle slaughter firms, 1950-62

Class, 1950*	Exits†	Class, 1962*								Firms in 1950	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
		number of firms										
I	9	0	1	0	0	0	1	0	0	11	...	...
II	9	0	2	0	3	0	0	0	0	14	...	...
III	14	0	0	2	5	5	3	0	0	29	...	...
IV	44	0	2	4	24	32	3	0	0	109	...	...
V	43	0	1	2	4	48	16	0	0	114	...	...
VI	7	0	0	0	0	1	10	2	0	20	...	...
VII	0	0	0	0	0	0	0	2	0	2	...	...
VIII	0	0	0	0	0	0	0	0	2	2	...	...
Total firms in 1950	...	...	...	...	...	...	...	...	...	301	...	...
Total exits	126	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	0	6	8	36	86	33	4	2	...	...	...
Entries‡	...	6	13	15	58	92	20	0	0	...	204	...
Firms in 1962	...	6	19	23	94	178	53	4	2	...	...	379

\* Class intervals (number of head slaughtered per year): I, 1-144; II, 145-665; III, 666-3,041; IV, 3,042-13,969; V, 13,970-63,909; VI, 63,910-293,799; VII, 293,800-1,341,000; and VIII, greater than 1,341,000.

† Number of firms operating in 1950 that had quit by 1962.

‡ Number of firms operating in 1962 that had started since 1950.

**Table F-2. Size transitions of FI cattle slaughter firms, 1950-54**

Class, 1950*	Exits†	Class, 1954*								Firms in 1950	Total entries	Total firms in 1954
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	7	3	0	0	0	0	1	0	0	11	...	...
II	6	0	4	2	2	0	0	0	0	14	...	...
III	8	2	0	6	10	3	0	0	0	29	...	...
IV	18	0	1	2	50	38	0	0	0	109	...	...
V	10	0	0	1	3	88	12	0	0	114	...	...
VI	1	0	0	0	0	0	15	4	0	20	...	...
VII	0	0	0	0	0	0	0	2	0	2	...	...
VIII	0	0	0	0	0	0	0	0	2	2	...	...
Total firms in 1950										301	...	...
Total exits	50										...	...
Persisting firms		5	5	11	65	129	28	6	2		...	...
Entries‡		7	6	11	19	26	1	0	0		70	...
Firms in 1954		12	11	22	84	155	29	6	2			321

\* See starred footnote, table F-1.

† Number of firms operating in 1950 that had quit by 1954.

‡ Number of firms operating in 1954 that had started since 1950.

**Table F-3. Size transitions of FI cattle slaughter firms, 1954-58**

Class, 1954*	Exits†	Class, 1958*								Firms in 1954	Total entries	Total firms in 1958
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	11	1	0	0	0	0	0	0	0	12	...	...
II	4	2	1	1	2	1	0	0	0	11	...	...
III	4	1	2	7	6	2	0	0	0	22	...	...
IV	16	1	0	7	46	13	1	0	0	84	...	...
V	21	0	0	0	11	108	15	0	0	155	...	...
VI	2	0	0	0	0	6	21	0	0	29	...	...
VII	0	0	0	0	0	0	0	5	0	6	...	...
VIII	0	0	0	0	0	0	0	0	2	2	...	...
Total firms in 1954										321	...	...
Total exits	58										...	...
Persisting firms		5	3	15	65	130	38	5	2		...	...
Entries‡		1	6	9	38	29	1	0	0		84	...
Firms in 1958		6	9	24	103	159	39	5	2			347

\* See starred footnote, table F-1.

† Number of firms operating in 1954 that had quit by 1958.

‡ Number of firms operating in 1958 that had started since 1954.

**Table F-4. Size transitions of FI cattle slaughter firms, 1958-62**

Class, 1958*	Exits†	Class, 1962*								Firms in 1958	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	5	0	1	0	0	0	0	0	0	6	...	...
II	5	0	2	0	2	0	0	0	0	9	...	...
III	4	0	3	5	7	5	0	0	0	24	...	...
IV	20	0	1	4	52	25	1	0	0	103	...	...
V	23	0	0	1	9	108	18	0	0	159	...	...
VI	7	0	0	1	0	4	27	0	0	39	...	...
VII	0	0	0	0	0	0	1	4	0	5	...	...
VIII	0	0	0	0	0	0	0	0	2	2	...	...
Total firms in 1958										347	...	...
Total exits	64										...	...
Persisting firms		0	7	11	70	142	47	4	2		...	...
Entries‡		6	12	12	24	36	6	0	0		96	...
Firms in 1962		6	19	23	94	178	53	4	2			379

\* See starred footnote, table F-1.

† Number of firms operating in 1958 that had quit by 1962.

‡ Number of firms operating in 1962 that had started since 1958.



Table F-5. Size transitions of FI calf slaughter firms, 1950-62

Class, 1950*	Exits†	Class, 1962*								Firms in 1950	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	13	1	1	2	0	0	0	0	0	17	...	...
II	19	0	1	0	0	0	0	0	0	20	...	...
III	23	3	0	0	0	1	0	1	0	28	...	...
IV	41	1	5	3	3	1	0	0	0	53	...	...
V	31	1	0	5	9	9	2	0	0	57	...	...
VI	22	2	0	0	3	6	11	7	0	51	...	...
VII	8	0	0	0	0	2	2	10	1	23	...	...
VIII	1	0	0	0	0	0	1	2	4	8	...	...
Total firms in 1950	...	...	...	...	...	...	...	...	...	257	...	...
Total exits	158	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	8	7	10	14	19	16	20	5	...	...	...
Entries‡	...	10	17	20	14	16	24	13	5	...	119	...
Firms in 1962	...	18	24	30	28	35	40	33	10	...	...	218

\* Class intervals (number of head slaughtered per year): I, 0-19; II, 20-80; III, 81-331; IV, 332-1,362; V, 1,363-5,632; VI, 5,633-23,484; VII, 23,485-94,760; and VIII, greater than 94,760.

† Number of firms operating in 1950 that had quit by 1962.

‡ Number of firms operating in 1962 that had started since 1950.

Table F-6. Size transitions of FI calf slaughter firms, 1950-54

Class, 1950*	Exits†	Class, 1954*								Firms in 1950	Total entries	Total firms in 1954
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	12	3	0	1	1	0	0	0	0	17	...	...
II	12	3	1	1	2	1	0	0	0	20	...	...
III	14	2	2	7	3	0	0	0	0	28	...	...
IV	7	2	7	4	22	9	2	0	0	53	...	...
V	7	1	1	1	9	26	11	1	0	57	...	...
VI	8	0	3	2	0	5	27	6	0	51	...	...
VII	4	0	0	0	0	0	0	16	3	23	...	...
VIII	1	0	0	0	0	0	0	1	6	8	...	...
Total firms in 1950	...	...	...	...	...	...	...	...	...	257	...	...
Total exits	65	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	11	14	16	37	41	40	24	9	...	...	...
Entries‡	...	8	4	9	8	10	10	5	1	...	55	...
Firms in 1954	...	19	18	25	45	51	50	29	10	...	...	247

\* See starred footnote, table F-5.

† Number of firms operating in 1950 that had quit by 1954.

‡ Number of firms operating in 1954 that had started since 1950.

VI firms. Hence, the size distribution not only became more peaked, but also shifted to the right.

### FI Calf Slaughter Firms

**Transitions: 1950-62.** Between 1950 and 1962, the total number of calf slaughter firms decreased as exit exceeded entry (table F-5). Their size distribution, which peaked at class V in 1950, flattened during the period and peaked in class VI in 1962. While the number of class IV, V, and VI firms decreased, numbers in other classes increased. Entry and exit throughout the period accounted for a large part of the change. Yet there was some growth and considerable shrinkage that also had an impact on the shape of the size distribution. Compared with the size transitions that have been considered, table F-5 shows less growth and relatively more shrinkage into smaller classes. Not only did a greater number of firms shrink, but down

movement was throughout more classes. Classes IV, V, and VI showed high shrinkage of firms into smaller categories. The most pronounced growth was from class VI, out of which seven firms grew into class VII. This accounts for a large part of the total growth in number of class VII firms.

**Transitions: 1950-54.** During 1950-54, there was only a slight change in the size distribution of calf slaughter firms (table F-6). Yet the peak shifted in a more pronounced manner to the right. While the total number of calf slaughter firms decreased, numbers did not decrease equally in all classes. The more pronounced peak appears because of a relatively great decrease in number of class IV firms. Over half the persisting class IV firms moved to different classes: 11 of them grew to classes V and VI and 13 shrank to classes I, II, and III. The pattern of movement from class IV was somewhat typical of that in all

classes in that there were more firms that decreased in size than increased.

**Transitions: 1954-58.** The 1954-58 period was like the other periods in that exit of FI calf slaughter firms exceeded entry (table F-7). Most of the entering firms replaced firms exiting from the middle and lower classes. The entry/exit pattern helps explain the shift in the shape of the size distribution. But the changing shape is in larger measure accounted for by changes in size of persisting firms. A substantial number of firms that initially were in class V shrank to class IV. A few class VI firms also decreased in size to class IV. As a result, the peak of the size distribution shifted to the left, from class V to class IV. Number of firms in class VI also decreased, while the number in class III increased (largely through shrinkage of firms initially in class IV). A major impediment in symmetry of the 1958 distribution was an excessive number of class VII firms. This development was due largely to

growth into class VII of firms that initially were in classes V and VI, but there also was some shrinkage of class VIII firms into class VII.

**Transitions: 1958-62.** During the 1958-62 period, there was again a decrease in the number of calf slaughter firms and a shift of the size distribution peak into class VI (table F-8). This situation came about largely via exit of firms that initially were in class IV. Although 11 firms that initially were in class V shrank to class IV, transition into class IV was more than offset by growth of class IV firms into classes V, VI, and VII and by substantial shrinkage into classes I, II, and III. Thus, the number of class IV firms was diminished by 20. Some changes also took place in other classes. But the net changes were relatively small, although there was more total size movement among calf slaughter firms in this period than in the two previous periods.

Table F-7. Size transitions of FI calf slaughter firms, 1954-58

Class, 1954*	Exits†	Class, 1958*								Firms in 1954	Total entries	Total firms in 1958
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	13	4	0	1	0	1	0	0	0	19	...	...
II	10	4	2	0	1	0	1	0	0	18	...	...
III	13	2	4	6	0	0	0	0	0	25	...	...
IV	15	1	3	10	12	3	1	0	0	45	...	...
V	13	1	1	1	16	16	2	1	0	51	...	...
VI	12	1	0	0	3	9	19	6	0	50	...	...
VII	2	0	0	0	0	0	5	22	0	29	...	...
VIII	0	0	0	0	0	0	0	3	7	10	...	...
Total firms in 1954	...	...	...	...	...	...	...	...	...	247	...	...
Total exits	78	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	13	10	18	32	29	28	32	7	...	...	...
Entries‡	...	6	11	13	16	7	10	5	1	...	69	...
Firms in 1958	...	19	21	31	48	36	38	37	8	...	...	238

\* See starred footnote, table F-5.

† Number of firms operating in 1954 that had quit by 1958.

‡ Number of firms operating in 1958 that had started since 1954.

Table F-8. Size transitions of FI calf slaughter firms, 1958-62

Class, 1958*	Exits†	Class, 1962*								Firms in 1958	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	13	4	0	2	0	0	0	0	0	19	...	...
II	11	1	1	3	1	3	1	0	0	21	...	...
III	14	3	6	5	1	1	0	1	0	31	...	...
IV	21	3	4	8	7	1	3	1	0	48	...	...
V	8	2	1	0	11	11	3	0	0	36	...	...
VI	7	0	1	1	0	8	18	2	1	38	...	...
VII	6	1	0	1	0	1	5	23	0	37	...	...
VIII	1	0	0	0	0	0	0	1	6	8	...	...
Total firms in 1958	...	...	...	...	...	...	...	...	...	238	...	...
Total exits	81	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	14	13	20	20	25	30	28	7	...	...	...
Entries‡	...	4	11	10	8	10	10	5	3	...	61	...
Firms in 1962	...	18	24	30	28	35	40	33	10	...	...	218

\* See starred footnote, table F-5.

† Number of firms operating in 1958 that had quit by 1962.

‡ Number of firms operating in 1962 that had started since 1958.

## FI Sheep Slaughter Firms

**Transitions: 1950-62.** Between 1950 and 1962, exit of sheep slaughter firms exceeded entry and there was a net decline in the number of sheep slaughter firms (table F-9). As the number of firms declined, the shape of firm size distributions changed. While the peak of the distribution remained in class IV, the number of middle-sized firms declined and the number of small and large firms increased. Although the relatively great amount of entry and exit explains much of this shift, size transitions of persisting firms also were instrumental.

A comparatively small number of sheep slaughter firms remained in their class throughout the period. The number of firms that grew in size was about equal to the number that decreased. However, most of the growth was to a class adjacent to the initial one, while size decrease generally was to a greater number of

classes. Most of the increase in numbers of large firms (those in the largest class) came via growth of firms that initially were in class VII. Meanwhile, transition from class VII accounted for a substantial portion of the decline in the number of firms in that category. The decline in the number of firms in the peak class (class IV) also was due in large measure to size transition. Four firms that initially were in class IV grew to class V, while eight shrank to classes II and III.

**Transitions: 1950-54.** Size transitions for the sub-periods within 1950-62 varied a great deal. Transitions for 1950-54 are shown in table F-10. Net exit (exit minus entry) during this period exceeded net exit for the entire 1950-62 period. This result is plausible because of re-entry in a later period by firms that had exited during 1950-54. Although the peak of the size distribution remained in class IV, the peak was lowered considerably relative to the rest of the distribu-

Table F-9. Size transitions of FI sheep slaughter firms, 1950-62

Class, 1950*	Exits†	Class, 1962*								Firms in 1950	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
number of firms												
I	2	0	0	0	0	0	0	0	0	2	...	...
II	21	0	1	4	0	0	0	0	0	26	...	...
III	18	0	3	2	0	0	0	0	0	23	...	...
IV	20	0	2	6	9	4	0	0	0	41	...	...
V	21	0	0	2	3	4	1	0	1	32	...	...
VI	14	0	0	0	0	1	5	3	1	24	...	...
VII	15	0	0	0	2	1	1	5	6	30	...	...
VIII	1	0	0	0	0	0	0	1	7	9	...	...
Total firms in 1950										187		
Total exits	112											
Persisting firms		0	6	14	14	10	7	9	15			
Entries‡		4	20	10	16	15	8	7	3		83	
Firms in 1962		4	26	24	30	25	15	16	18			158

\* Class intervals (number of head slaughtered per year): I, 0-5; II, 6-17; III, 18-103; IV, 104-607; V, 608-3,570; VI, 3,571-20,989; VII, 20,990-123,300; and VIII, greater than 123,300.

† Firms operating in 1950 that had quit by 1962.

‡ Firms operating in 1962 that had started since 1950.

Table F-10. Size transitions of FI sheep slaughter firms, 1950-54

Class, 1950*	Exits†	Class, 1954*								Firms in 1950	Total entries	Total firms in 1954
		I	II	III	IV	V	VI	VII	VIII			
number of firms												
I	2	0	0	0	0	0	0	0	0	2	...	...
II	15	2	5	4	0	0	0	0	0	26	...	...
III	12	0	9	1	1	0	0	0	0	23	...	...
IV	8	0	4	10	15	4	0	0	0	41	...	...
V	10	0	0	2	7	10	3	0	0	32	...	...
VI	9	0	0	0	0	1	11	3	0	24	...	...
VII	7	0	0	0	1	1	4	13	4	30	...	...
VIII	0	0	0	0	0	0	0	0	9	9	...	...
Total firms in 1950										187		
Total exits	63											
Persisting firms		2	18	17	24	16	18	16	13			
Entries‡		3	12	7	2	4	1	3	1		33	
Firms in 1954		5	30	24	26	20	19	19	14			157

\* See starred footnote, table F-9.

† Firms operating in 1950 that had quit by 1954.

‡ Firms operating in 1954 that had started since 1950.

tion. Numbers in class IV declined by shrinkage of 10 original class IV firms into class III and 4 firms into class II. At the same time, four firms grew into class V. Numbers in class V also declined via shrinkage of nine firms into classes III and IV and growth of three firms into class VI. Class VII is the only remaining class exhibiting a substantial decline in firm numbers through growth of four firms into class VIII and shrinkage of six firms into classes IV, V, and VI.

**Transitions: 1954-58.** During the 1954-58 period, little change appeared in the relative number of sheep slaughter firms per class (table F-11), although entry exceeded exit slightly. However, the number of firms in the peak class (class IV) and the largest class increased moderately. Numbers in class IV increased from the growth of firms that initially were in classes II and III and from shrinkage of firms that initially were in class V. The number of firms in class VIII also increased slightly, due chiefly to the growth of three

firms from class VII. Relative to the other two time periods, there was more growth and slightly less decrease in the size of persisting firms during this period. This did not, however, have a great impact on size distribution because of the net entry of new firms into the small classes.

**Transitions: 1958-62.** The shape of the FI sheep slaughter firm size distribution was relatively constant between 1958 and 1962, and entry and exit approximately balanced (table F-12). However, there was some increase in the number of large firms and some decrease in the number of small ones. There was a slight decrease in the number of firms in the four smallest classes and a slight increase in the number in the four largest ones. One reason for this occurrence was that the number of entries exceeded exits in the top four classes, but not in the lower four. Further, there was more growth of initially small firms into the large classes than there was shrinkage of large

**Table F-11. Size transitions of FI sheep slaughter firms, 1954-58**

Class, 1954*	Exits†	Class, 1958*								Firms in 1954	Total entries	Total firms in 1958
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	3	0	2	0	0	0	0	0	0	5	...	...
II	13	2	7	3	3	2	0	0	0	30	...	...
III	9	0	3	7	3	2	0	0	0	24	...	...
IV	6	0	1	3	11	3	1	1	0	26	...	...
V	7	0	0	2	4	6	1	0	0	20	...	...
VI	5	0	0	0	1	2	8	3	0	19	...	...
VII	5	0	0	0	0	0	1	10	3	19	...	...
VIII	0	0	0	0	0	0	0	1	13	14	...	...
Total firms in 1954	...	...	...	...	...	...	...	...	...	157	...	...
Total exits	48	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	2	13	15	22	15	11	15	16	...	...	...
Entries‡	...	2	16	11	11	5	3	2	1	...	51	...
Firms in 1958	...	4	29	26	33	20	14	17	17	...	...	160

\* See starred footnote, table F-9.

† Firms operating in 1954 that had quit by 1958.

‡ Firms operating in 1958 that had started since 1954.

**Table F-12. Size transitions of FI sheep slaughter firms, 1958-62**

Class, 1958*	Exits†	Class, 1962*								Firms in 1958	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	3	0	1	0	0	0	0	0	0	4	...	...
II	17	1	4	4	2	1	0	0	0	29	...	...
III	13	1	4	4	3	1	0	0	0	26	...	...
IV	7	0	1	8	10	6	1	0	0	33	...	...
V	8	0	0	2	2	6	2	0	0	20	...	...
VI	3	0	0	0	1	2	6	1	1	14	...	...
VII	4	0	0	1	0	1	0	9	2	17	...	...
VIII	4	0	0	0	0	0	0	1	12	17	...	...
Total firms in 1958	...	...	...	...	...	...	...	...	...	160	...	...
Total exits	59	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	2	10	19	18	17	9	11	15	...	...	...
Entries‡	...	2	16	5	12	8	6	5	3	...	57	...
Firms in 1962	...	4	26	24	30	25	15	16	18	...	...	158

\* See starred footnote, table F-9.

† Firms operating in 1958 that had quit by 1962.

‡ Firms operating in 1962 that had started since 1958.

firms into the small classes. Nevertheless, the net change in the size distribution shape was slight.

### FI Hog Slaughter Firms

**Transitions: 1950-62.** During the 1950-62 period, the shape of the size distribution of hog slaughter firms underwent some change. The peak of the distribution shifted from class V to class VI (table F-13). The number of firms in classes IV and V declined, which had the effect of skewing the distribution farther to the right. The number of firms in classes II and III increased, but the increase was by only three firms in each class. These shifts came about while there was a net decrease of 10 in the total number of hog slaughter firms. In most classes, entry and exit were nearly in balance, but the full impact of total net exits was felt in class IV. Decline also was felt in class IV through the growth of six firms into classes

V and VI and the shrinkage of six firms into classes II and III. The number of firms in class V declined chiefly through the growth of 18 firms from class V into class VI. These 18 firms also accounted for most of the total growth in numbers in class VI. The growth of firms that initially were in classes III and IV and the entry of one firm also added to this growth.

**Transitions: 1950-54.** During the 1950-54 subperiod, a slight change became apparent in the shape of the distribution (table F-14). While its peak remained in the same class, numbers in the middle categories declined. They decreased primarily because of growth and shrinkage, rather than because of net exit from the classes. Nine firms from class IV shrank to classes II and III, while five firms grew to classes V and VI. Nine firms from class V also shrank to smaller classes, while six grew to class VI. Meanwhile, the number

Table F-13. Size transitions of FI hog slaughter firms, 1950-62

Class, 1950*	Exits†	Class, 1962*								Firms in 1950	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	11	0	1	0	0	0	0	0	0	12	...	...
II	8	0	1	0	0	0	0	0	0	9	...	...
III	14	1	0	2	4	0	1	0	0	22	...	...
IV	30	0	1	5	8	3	3	0	0	30	...	...
V	26	0	0	1	1	17	18	0	0	26	...	...
VI	15	0	0	0	0	1	13	3	0	32	...	...
VII	2	0	0	0	0	0	1	6	0	9	...	...
VIII	0	0	0	0	0	0	0	0	2	2	...	...
Total firms in 1950	...	...	...	...	...	...	...	...	...	199	...	...
Total exits	106	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	1	3	8	13	21	36	9	2	...	...	...
Entries‡	...	10	9	17	20	22	16	2	0	...	96	...
Firms in 1962	...	11	12	25	33	43	52	11	2	...	...	189

\* Class intervals (number of head slaughtered per year): I, 0-114; II, 115-695; III, 696-4,232; IV, 4,233-25,740; V, 25,741-156,499; VI, 156,500-951,749; VII, 951,750-5,786,000; and VIII, greater than 5,786,000.  
 † Number of firms operating in 1950 that had quit by 1962.  
 ‡ Number of firms operating in 1962 that had started since 1950.

Table F-14. Size transitions of FI hog slaughter firms, 1950-54

Class, 1950*	Exits†	Class, 1954*								Firms in 1950	Total entries	Total firms in 1954
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I	7	4	1	0	0	0	0	0	0	12	...	...
II	6	2	1	0	0	0	0	0	0	9	...	...
III	10	2	0	7	3	0	0	0	0	22	...	...
IV	13	0	2	7	23	4	1	0	0	50	...	...
V	6	0	1	0	8	42	6	0	0	63	...	...
VI	5	1	0	0	0	3	22	1	0	32	...	...
VII	1	0	0	0	0	0	1	7	0	9	...	...
VIII	0	0	0	0	0	0	0	0	2	2	...	...
Total firms in 1950	...	...	...	...	...	...	...	...	...	199	...	...
Total exits	48	...	...	...	...	...	...	...	...	...	...	...
Persisting firms	...	9	5	14	34	49	30	8	2	...	...	...
Entries‡	...	5	4	9	6	5	3	0	0	...	32	...
Firms in 1954	...	14	9	23	40	54	33	8	2	...	...	183

\* See starred footnote, table F-13.  
 † Number of firms operating in 1950 that had quit by 1954.  
 ‡ Number of firms operating in 1954 that had started since 1950.

**Table F-15 Size transitions of FI hog slaughter firms, 1954-58**

Class, 1954*	Exits†	Class, 1958*								Firms in 1954	Total entries	Total firms in 1958
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I .....	9	3	1	0	1	0	0	0	0	14	...	...
II .....	8	0	1	0	0	0	0	0	0	9	...	...
III .....	7	1	3	7	5	0	0	0	0	23	...	...
IV .....	12	0	2	1	16	8	1	0	0	40	...	...
V .....	9	0	0	0	1	32	12	0	0	54	...	...
VI .....	3	0	0	0	0	3	27	0	0	33	...	...
VII .....	0	0	0	0	0	0	0	8	0	8	...	...
VIII .....	0	0	0	0	0	0	0	0	2	2	...	...
Total firms in 1954 .....	...	...	...	...	...	...	...	...	...	183	...	...
Total exits .....	48	...	...	...	...	...	...	...	...	...	...	...
Persisting firms .....	...	4	7	8	23	43	40	8	2	...	...	...
Entries‡ .....	...	3	5	14	7	10	6	0	0	...	45	...
Firms in 1958 .....	...	7	12	22	30	53	46	8	2	...	...	180

\* See starred footnote, table F-13.  
 † Number of firms operating in 1954 that had quit by 1958.  
 ‡ Number of firms operating in 1958 that had started since 1954.

**Table F-16. Size transitions of FI hog slaughter firms, 1958-62**

Class, 1958*	Exits†	Class, 1962*								Firms in 1958	Total entries	Total firms in 1962
		I	II	III	IV	V	VI	VII	VIII			
..... number of firms .....												
I .....	5	0	2	0	0	0	0	0	0	7	...	...
II .....	9	0	2	1	0	0	0	0	0	12	...	...
III .....	7	1	2	8	3	1	0	0	0	22	...	...
IV .....	6	0	1	3	18	1	1	0	0	30	...	...
V .....	13	0	0	1	0	28	11	0	0	53	...	...
VI .....	8	0	0	0	0	1	33	4	0	46	...	...
VII .....	1	0	0	0	0	0	0	7	0	8	...	...
VIII .....	0	0	0	0	0	0	0	0	2	2	...	...
Total firms in 1958 .....	...	...	...	...	...	...	...	...	...	180	...	...
Total exits .....	49	...	...	...	...	...	...	...	...	...	...	...
Persisting firms .....	...	1	7	13	11	31	45	11	2	...	...	...
Entries‡ .....	...	10	5	12	12	12	7	0	0	...	58	...
Firms in 1962 .....	...	11	12	25	33	43	52	11	2	...	...	189

\* See starred footnote, table F-13.  
 † Number of firms operating in 1958 that had quit by 1962.  
 ‡ Number of firms operating in 1962 that had started since 1958.

of firms in all other categories remained relatively constant.

**Transitions: 1954-58.** During the 1954-58 period, the size distribution became skewed farther to the right, although its peak remained in class V (table F-15). While exit exceeded entry by three firms, numbers in classes I-IV decreased and numbers in classes V-VIII increased. There was a relatively small amount of size movement within the period. Apparent net movement from the smaller classes into the larger was chiefly attributable to the growth of 8 firms from class IV into class V, coupled with the growth of 12 firms from class V into class VI. Thus, while the total number of firms experiencing size transition was nearly as great as during 1950-54, much of the movement was by firms moving up one class from classes IV and V.

**Transitions: 1958-62.** The 1958-62 period is the only one in which entries exceeded exits and total number

of FI hog slaughter firms increased (table F-16). During this period, there also was a shift in the shape of the size distribution, as its peak moved from class V to class VI. Apart from the peak's skewing to the right, a few more firms appeared in class I and class VII. Although one of the new arrivals in class I was a firm that had shrunk from class III, most of them were new entrants into hog slaughter. All of the increase in numbers in class VII was due to firms that grew from class VI during the period. The shift in the peak of the distribution from class V to class VI was due almost solely to the growth of firms from class V into class VI. The firm that shrank from class VI into class V was replaced by one that had grown from class IV into class VI. Looking at the overall movement, there were many more firms that experienced decrease, since 24 firms grew and 9 shrank. Most of the growth, however, was limited to transition to an adjoining class and almost half the total number of growing firms were from class V.

## APPENDIX G: PROJECTED SIZE DISTRIBUTIONS OF ALL FI SLAUGHTER FIRMS BY YEAR

Table G-1. Projected size distributions, all FI slaughter firms

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
<b>Projections from the 1954 distribution × 1950-54 probability matrices</b>								
1958 .....	11	15	21	94	176	39	8	2
1962 .....	11	14	19	83	185	48	9	2
1966 .....	10	13	18	77	190	56	11	1
1970 .....	10	13	18	73	192	62	13	1
1974 .....	10	12	17	71	192	66	14	1
1978 .....	10	12	17	69	192	70	16	1
Equilibrium .....	10	12	16	66	184	75	25	0
<b>Projections from the 1958 distribution × 1954-58 probability matrices</b>								
1962 .....	4	2	23	146	163	48	9	1
1966 .....	4	2	20	146	165	56	9	1
1970 .....	4	2	19	145	167	63	9	1
1974 .....	4	2	18	143	167	69	10	0
1978 .....	3	2	18	141	168	74	10	0
1982 .....	3	2	17	140	168	78	10	0
Equilibrium .....	3	1	13	105	130	80	138	0
<b>Projections from the 1962 distribution × 1958-62 probability matrices</b>								
1966 .....	1	1	12	21	42	167	147	42
1970 .....	1	1	7	13	22	56	94	265
1974 .....	1	1	6	9	18	40	43	386
1978 .....	0	0	4	7	13	30	32	448
1982 .....	0	0	3	5	10	22	24	495
1986 .....	0	0	2	4	7	16	17	529
Equilibrium .....	0	0	0	0	0	0	0	622

## APPENDIX H: PROJECTED SIZE DISTRIBUTIONS OF FI SLAUGHTER FIRMS BY SPECIES

### FI Cattle Slaughter Firms

If the patterns of cattle slaughter firm size transition that existed during 1950-62 continue, size structure will not change greatly in the near future. The number of small firms will decline moderately, and the number of large firms will increase slightly (table H-1). Throughout the projection period, the number of firms decline gradually in classes I-V, increase gradually in classes VI and VII, and remain constant in class VIII. At the same time, the total number of cattle slaughter firms slowly increases. Thus, if the past pattern continues, the cattle slaughter sector will contain an increasing number of relatively large firms whose size will be just under that of the currently largest firms.

An increasing number of firms in the large classes, accompanied by gradually decreasing numbers in the small, reflects the growth patterns of cattle slaughter firms discussed earlier. The small firms had greater growth rates than the large, so a net movement of small firms into the large classes would be expected unless entry and exit patterns allow maintenance of numbers in the small classes. Since numbers decline in the small classes, entry and exit patterns obviously do not have that effect, although they may result in a

greater number of firms remaining in the small classes than would be due to growth alone.

Two generalizations about mobility of size structure can be drawn from the projections. In one dimension, the structure does not appear to be highly subject to change. Projections over the period do not show a great deal of change: The 1974 projection is not greatly different from that for 1962, and the 2034 projection is not greatly different from that for 1974. On the other hand, the equilibrium projection has a configuration considerably different from the present as well as from the 2034 projection. This suggests that the longrun size structure of cattle slaughter firms is subject to considerable change but that change is not taking place very rapidly.

The projected size distributions of cattle slaughter firms show substantial difference, depending on the base period (table H-2). The size transitions of 1950-54 generate a size structure much like that from the 1950-62 projection. All firms are in the two largest classes. On the other hand, projections from both 1954-58 and 1958-62 yield a size structure not too different from that of the present and may be a better indicator of shortrun future changes. The concentration of firms is in classes IV, V, and VI. A somewhat

**Table H-1. Projected size distributions, FI cattle slaughter firms**

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
1974	3	13	14	62	152	70	10	2
1986	4	12	14	60	144	76	17	2
1998	4	12	14	58	139	78	26	2
2010	4	12	13	57	136	78	34	2
2022	3	12	13	56	133	78	42	2
2034	3	12	13	55	131	77	51	2
Equilibrium	0	0	0	0	1	0	495	62

**Table H-2. Projected size distributions, FI cattle slaughter firms**

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
<b>Projections from the 1954 distribution × 1950-54 probability matrices</b>								
1958	11	9	18	67	172	40	12	2
1962	10	8	16	58	179	50	20	2
1966	9	7	16	53	180	58	30	2
1970	9	7	15	49	178	64	41	2
1974	8	7	14	47	174	68	54	2
1978	8	6	14	45	170	71	68	2
Equilibrium	0	0	0	0	0	0	564	71
<b>Projections from the 1958 distribution × 1954-58 probability matrices</b>								
1962	5	8	24	105	160	46	4	2
1966	5	7	24	105	162	52	3	2
1970	5	7	24	105	164	56	3	2
1974	5	7	23	104	166	59	2	2
1978	5	7	23	104	167	61	2	2
1982	5	7	23	103	168	63	2	2
Equilibrium	4	6	20	90	154	60	0	70
<b>Projections from the 1962 distribution × 1958-62 probability matrices</b>								
1966	4	18	76	62	145	64	4	2
1970	4	24	66	70	135	71	4	2
1974	4	24	68	69	128	74	4	2
1978	4	25	68	70	125	76	4	2
1982	4	25	68	70	123	76	4	2
1986	4	25	67	70	122	77	4	2
Equilibrium	4	22	60	62	107	69	3	69

greater number of firms in the smaller classes is projected from the 1958-62 period than from the 1954-58 base period. Obviously, the projection from 1950-62 is heavily influenced by the transitions in 1950-54. Between 1950-54 and 1954-58, there appears to be a radical shift favoring persistence of small cattle slaughter firms. This shift in impact of economic forces affecting growth appears to have continued into 1958-62.

**FI Calf Slaughter Firms**

Projections of size structure of calf slaughter firms from the 1950-62 period indicate some change (table H-3). If the growth patterns from this period continue, there will be a greater number of small and large calf slaughter firms but fewer middle-sized firms by 1974. Increases are predicted for classes I, II, VII, and VIII. Beyond 1974, there is very little predicted change in size structure, but there is a gradual increase in the

number of firms in the largest class. Accompanying this predicted change in firm size configuration, there will be a decrease in the total number of calf slaughter firms. The number is predicted to decrease to 172 by 1974. After that year, numbers stay virtually constant.

The projections reflect the forces of change that are acting upon the size structure of the industry. Within a relatively short time, the number of firms in classes III, IV, V, and VI declines, while the number in all other classes increases. Hence, mobility is implied in the sense that there is a tendency for rather rapid change in the size configuration of this industry segment. But there is little change in the projections from 1974 to 2034 and little additional change toward equilibrium. This fact implies that patterns of firm size transition during 1950-62 did not produce a drastic longrun change in structure despite some shortrun changes.

Projections of equilibrium size distribution of calf slaughter firms vary moderately, depending on the



**Table H-3. Projected size distributions, FI calf slaughter firms**

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
1974 .....	14	17	21	20	26	31	31	12
1986 .....	13	18	21	19	25	32	31	14
1998 .....	13	18	21	19	25	32	32	14
2010 .....	13	17	21	19	25	32	32	15
2022 .....	13	17	21	18	25	32	32	16
2034 .....	13	17	21	18	25	32	32	16
Equilibrium .....	13	17	21	18	25	32	33	16

**Table H-4. Projected size distributions, FI calf slaughter firms**

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
<b>Projections from the 1954 distribution × 1950-54 probability matrices</b>								
1958 .....	17	16	22	39	45	47	33	12
1962 .....	17	15	21	36	42	44	35	14
1966 .....	16	14	21	34	39	42	37	16
1970 .....	16	14	20	32	38	41	38	18
1974 .....	16	13	20	31	37	39	39	19
1978 .....	16	13	20	31	36	39	39	20
Equilibrium .....	15	12	19	29	34	37	42	26
<b>Projections from the 1958 distribution × 1954-58 probability matrices</b>								
1962 .....	19	20	31	41	28	33	40	6
1966 .....	18	20	30	37	25	31	41	5
1970 .....	18	20	29	35	23	31	42	5
1974 .....	18	20	28	34	23	31	42	4
1978 .....	18	20	28	34	22	31	42	4
1982 .....	18	20	28	34	22	31	42	3
Equilibrium .....	18	20	28	34	22	31	40	3
<b>Projections from the 1962 distribution × 1958-62 probability matrices</b>								
1966 .....	16	21	25	24	34	38	29	12
1970 .....	15	20	23	23	32	36	26	14
1974 .....	14	19	22	23	32	35	25	15
1978 .....	14	19	22	23	31	34	25	15
1982 .....	14	19	22	22	31	34	24	16
1986 .....	13	19	22	22	31	34	24	16
Equilibrium .....	13	19	22	22	30	33	24	18

base period from which they are made (table H-4). The projection from 1950-54 indicates a greater number of firms than the projection from 1950-62. There also are relatively more firms in the large classes. The projection from 1954-58 generates a smaller net number of firms than the 1950-54 base, although the number is larger than that from the 1950-62 base. Relatively fewer firms appear in the large classes than from the 1950-54 base. The projected equilibrium from the 1958-62 base indicates a rather equal spread of firms among classes. The distribution has fewer firms than the projection from 1954-58 and its shape closely resembles the projections from 1954-58 and 1958-62. Comparison among projections suggests that there was little change in the impact of forces affecting growth during 1950-62. While there was a trend toward successively fewer firms throughout the period, the type of size structure indicated by transition patterns changed little.

#### FI Sheep Slaughter Firms

If the impact of factors generating growth continues unabated, the number of sheep slaughter firms will continue to decline (table H-5). There will be only 136 firms by 1974, but beyond that year there will be virtually no change in numbers. Compared with the 1962 distribution, numbers in all classes except I and VIII will decline. The number of firms in class I will increase somewhat, and the number in class VIII will increase relatively more. Numbers in the middle classes decline throughout the projected period, while there is a slight increase in the number of the largest firms. On the whole, then, the predicted distributions will contain fewer firms, more large firms, and a relatively more equal distribution of firms among classes.

The projections imply that firms are exiting from the small and middle classes (either through growth or true exit) at a relatively greater rate than from the

**Table H-5. Projected size distributions, FI sheep slaughter firms**

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
1974 .....	11	14	23	23	19	12	12	22
1986 .....	11	15	19	22	18	11	12	23
1998 .....	11	15	19	21	18	11	12	25
2010 .....	11	15	18	21	18	11	12	26
2022 .....	11	15	18	21	18	11	12	27
2034 .....	11	15	18	21	18	11	13	27
Equilibrium .....	11	14	18	21	18	11	13	30

**Table H-6. Projected size distributions, FI sheep slaughter firms**

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
<b>Projections from the 1954 distribution × 1950-54 probability matrices</b>								
1958 .....	10	27	22	18	14	14	13	17
1962 .....	10	25	20	13	11	11	10	20
1966 .....	10	24	18	11	10	8	9	23
1970 .....	10	23	17	10	9	7	8	25
1974 .....	9	23	17	9	8	6	7	27
1978 .....	9	22	16	8	8	6	7	29
Equilibrium .....	0	1	0	0	0	0	0	608
<b>Projections from the 1958 distribution × 1954-58 probability matrices</b>								
1962 .....	14	18	26	35	18	12	15	19
1966 .....	13	17	26	34	19	11	14	21
1970 .....	13	17	26	34	18	10	14	23
1974 .....	13	17	26	33	18	10	14	24
1978 .....	13	17	26	33	18	10	14	26
1982 .....	13	17	26	33	18	10	14	27
Equilibrium .....	12	16	25	31	17	10	17	49
<b>Projections from the 1962 distribution × 1958-62 probability matrices</b>								
1966 .....	11	17	23	28	25	16	15	19
1970 .....	12	16	22	27	24	16	15	20
1974 .....	11	15	21	27	23	16	15	21
1978 .....	11	15	21	26	23	17	15	22
1982 .....	11	15	20	26	23	16	15	22
1986 .....	11	15	20	26	23	16	15	23
Equilibrium .....	11	15	20	26	23	16	15	24

large classes. The equilibrium projection is of the same general shape as the yearly projections. It is, however, more skewed to the right. The direction in which it is skewed implies relatively greater net exit from the small classes than from the large.

The projections do imply some size structure mobility in that the projected configurations change rapidly from the present, with relatively more large firms and a smaller total number of firms. But nearly all the changes are realized by the first year of the projection period. Beyond this, change occurs very slowly. Therefore, some shortrun but little longrun change is implied. However, since the projections change gradually and the equilibrium is somewhat different from the last yearly projection, longrun movement toward equilibrium takes place very slowly.

Projected equilibrium size distribution of sheep slaughter firms is greatly different among periods within 1950-62 (table H-6). The projection from 1950-

54 reflects a marked decline in number of firms in the small classes and growth into the largest class. The projection from 1954-58 indicates a rather large number of large firms, but the distribution is spread throughout all classes. The projection from 1958-62 contains the largest number of firms in the middle classes. These projections reflect a profound change in the impact of factors affecting growth between the 1950-54 and 1954-58 periods. Only a slight difference between 1954-58 and 1958-62 is apparent.

#### FI Hog Slaughter Firms

If the growth patterns of 1950-62 persist, the number of hog slaughter firms will decrease slightly (table H-7). By 1974, there will be a decline to 166 firms, but from 1974 to 2034 the number of firms will remain virtually unchanged. The decline to 1974 will be chiefly from class V firms. Beyond 1974, numbers in

**Table H-7. Projected size distributions, FI hog slaughter firms**

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
1974 .....	9	10	20	27	32	51	15	2
1986 .....	9	10	19	25	30	48	18	2
1998 .....	9	10	19	25	30	47	20	2
2010 .....	9	10	19	25	29	46	22	2
2022 .....	9	10	19	25	29	46	23	2
2034 .....	9	10	19	25	29	46	24	2
Equilibrium .....	8	9	17	22	26	41	24	64

**Table H-8. Projected size distributions, FI hog slaughter firms**

Year of projection	Class							
	I	II	III	IV	V	VI	VII	VIII
<b>Projections from the 1954 distribution × 1950-54 probability matrices</b>								
1958 .....	14	8	21	34	47	32	7	2
1962 .....	14	8	20	30	42	31	7	2
1966 .....	14	8	20	28	38	30	6	2
1970 .....	14	8	19	26	36	28	6	2
1974 .....	14	8	19	25	34	27	5	2
1978 .....	14	8	19	25	32	26	5	2
Equilibrium .....	13	7	17	21	25	19	3	71
<b>Projections from the 1958 distribution × 1954-58 probability matrices</b>								
1962 .....	5	11	20	25	51	56	8	2
1966 .....	5	10	20	22	49	63	8	2
1970 .....	5	10	19	21	48	68	8	2
1974 .....	5	10	19	20	48	73	8	2
1978 .....	4	9	19	20	48	76	8	2
1982 .....	4	9	19	19	48	79	8	2
Equilibrium .....	3	7	14	15	40	74	71	71
<b>Projections from the 1962 distribution × 1958-62 probability matrices</b>								
1966 .....	10	13	25	34	36	54	16	2
1970 .....	10	13	25	34	32	54	20	2
1974 .....	10	13	25	35	31	54	25	2
1978 .....	10	13	25	35	30	53	30	2
1982 .....	10	13	24	35	30	52	34	2
1986 .....	10	13	24	35	29	51	39	2
Equilibrium .....	0	0	0	0	0	1	561	71

all classes will change very little. There will be a continued modest decline in classes V and VI, accompanied by an increase in class VII.

The equilibrium projection contains a relatively greater number of firms in the large classes. The projections suggest that small firms have a greater growth rate than large and are moving into the larger classes.

These projections imply a small degree of structural mobility in the 1950-62 transitions. The yearly projections do not differ greatly from each other nor from the 1962 distribution. Hence, inherent rapid shortrun changes were not present during 1950-62, i.e., transition patterns did not produce a rapidly changing size structure. Nevertheless, the equilibrium projection points to some change in configuration, indicating that the transition pattern is evidence of the forces of longrun structural change.

The projected size distributions of equilibrium hog slaughter firms also reflect a change within the period (table H-8). Compared with the projection from the 1950-62 base, the projection from 1950-54 contains about the same number of firms in the small classes but relatively more in the largest class. The projection from the 1954-58 base contains somewhat fewer firms in the small classes but substantially more in the three largest ones. The total number of firms also is greater. The projection from 1958-62 yields a size structure with all firms but one in the two largest classes. The total number of firms at equilibrium is substantially greater. Thus it appears that the impact of growth factors shifted moderately between 1950-54 and 1954-58 and greatly between 1954-58 and 1958-62. The projection from 1950-62 appears heavily weighted by the 1950-54 transition pattern, since relatively more large firms and a greater total number of firms appear as a result of transitions in other years.

## APPENDIX I: GROWTH OF FI SLAUGHTER FIRMS BY SPECIES

### Growth Of Cattle Slaughter Firms

The size distributions of cattle slaughter firms closely resemble those of all slaughter firms. So the growth characteristics of these firms would be expected to resemble those of all slaughter firms. FI cattle slaughter firms operated in the most rapidly expanding segment of the industry. During 1950-62, total commercial cattle slaughter increased by 46 percent and FI slaughter increased by 54 percent. There was substantial growth throughout the period, except for 1954-58, when slaughter decreased by about 5 percent. The overall growth of the industry should therefore have produced a favorable environment for individual firm growth.

#### Growth: 1950-62

For the 1950-62 period, small cattle slaughter firms grew at a much greater rate than large firms (table I-1). On the average, small firms that persisted for the period grew by 500 times, while the largest firms decreased in size by one-tenth. Apparently, there was a highly inverse relation between size and growth. The same was true for the variance of growth rates: Variance was very high among small classes but decreased substantially among the large ones. Statistical tests for homogeneity of the mean and variance of growth rates supported this conclusion. They strongly rejected growth equality among firms.

#### Growth: 1950-54

The mean and variance of cattle slaughter firm growth during 1950-54 were less than for the entire 1950-62 period (table I-1). But again both the mean

and variance of growth rates were inversely related to class, with variance in the smallest class being extremely high. Hence, growth rates apparently were not equal. Statistical tests of homogeneity of growth mean and variance also rejected an hypothesis of equal growth rate.

#### Growth: 1954-58

During the 1954-58 period, both mean and variance of growth rates were less than during 1950-54 (table I-1). Nevertheless, both growth mean and variance of the larger classes apparently were less than for the smaller ones. Growth, therefore, was not proportionate; tests for homogeneity of mean and variance supported this conclusion. They also evidenced about the same degree of growth rate inequality as during the 1950-54 period.

#### Growth: 1958-62

Growth rates of cattle slaughter firms during 1958-62 were slightly greater and somewhat more variable than during 1954-58 (table I-1). Variance of growth rates appeared to remain inversely related to class. But mean growth rates apparently had a very weak, if any, inverse relation during 1958-62.

Statistical tests of growth rate equality showed that growth rate variances were unequal during 1958-62. However, the differences between mean growth rates among classes were not significant. This fact indicates that growth rates during 1958-62 were less unequal than they were during 1950-54 and 1954-58.

In summary, small cattle slaughter firms grew significantly faster than large firms during 1950-62. In only the last 4 years of the period were growth rates

**Table I-1. Characteristics of growth rates by class, FI cattle slaughter firms, 1950-62**

Characteristic	Class							
	I	II	III	IV	V	VI	VII	VIII
<b>1950-62</b>								
Expected growth .....	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Mean growth .....	500.70	11.13	23.19	2.80	1.64	1.96	.64	.90
Standard deviation .....	706.11	10.65	30.40	2.37	.82	1.27	.41	.19
<b>1950-54</b>								
Expected growth .....	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
Mean growth .....	253.20	4.30	5.42	1.96	1.51	1.50	.99	1.29
Standard deviation .....	497.88	3.40	6.72	1.30	.57	.76	.36	.14
<b>1954-58</b>								
Expected growth .....	.94	.94	.94	.94	.94	.94	.94	.94
Mean growth .....	2.55	7.93	2.87	1.37	1.16	1.05	.86	.77
Standard deviation .....	0	9.84	2.94	1.46	1.06	.36	.21	.08
<b>1958-62</b>								
Expected growth .....	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Mean growth .....	1.49	14.10	6.53	1.70	1.30	1.07	1.13	.91
Standard deviation .....	0	31.20	13.15	2.96	1.92	1.59	1.87	1.81

not significantly different among sizes. Growth rate variability also was greater among small firms than among large. During all of 1950-62, growth variation was unequal among classes.

### Growth Of Calf Slaughter Firms

The shapes of the size distributions of FI calf slaughter firms were different from those of all slaughter firms. Furthermore, there was a decline in calf slaughter during 1950-62, contrary to the trend in total slaughtering and in slaughtering of each of the other livestock species. Total commercial calf slaughter decreased by 25 percent, while FI calf slaughter decreased by 16 percent. In only the 1950-54 section of the 1950-62 period was there growth in commercial calf slaughter. Growth patterns therefore can be expected to be different from those of other firm groups.

#### Growth: 1950-62

During the 1950-62 period, growth rates of calf slaughter firms varied considerably among classes (table I-2). But the extent of variation within classes also differed widely. For both the mean and variance, there was not the degree of inverse relationship with class that was apparent in the growth pattern of all slaughter firms.

Results of the statistical tests on homogeneity of mean and variance yielded a mixed conclusion. Differences in growth rate variance were significant, but differences between mean growth rates among classes were not significantly different from chance differences.

#### Growth: 1950-54

Growth rates during 1950-54 varied somewhat among classes (table I-2). As for 1950-62, mean growth

rates apparently were not inversely related to size. But unlike the 1950-62 pattern, growth rate variance appeared to be inversely related. The statistical tests rejected an hypothesis of equal variance of growth rates but accepted an hypothesis of equal mean growth rates.

#### Growth: 1954-58

During the 1954-58 period, variance and mean of growth rates were higher in the small classes than in the large (table I-2). Both mean and variance in the two smallest classes were greater than they were in any other period, and they were among the smallest of any period in the three largest classes. As in other periods, the statistical tests led to a conclusion of equal mean growth rates but unequal growth rate variance among calf slaughter firms.

#### Growth: 1958-62

Mean and variance of growth rates during 1958-62 were greater than during the previous period (table I-2). While there was some variation in mean among classes, there was even more in variance, but there apparently was no inverse relation between class and either of the two parameters. The statistical tests implied that mean growth rates among classes were equal, but that variances in growth rates were unequal.

In summary, the patterns of FI calf slaughter firms during 1950-62 only vaguely resembled those of all FI slaughter firms. Small firms in some classes appeared to have greater growth rates than large firms. However, growth rates among all classes were not judged to be significantly different. There was a substantial difference in growth rate variance among classes. Small firms generally had greater growth rate variability than large firms, but growth variation did

Table I-2. Characteristics of growth rates by class, FI calf slaughter firms, 1950-62

Characteristic	Class							
	I	II	III	IV	V	VI	VII	VIII
	<b>1950-62</b>							
Expected growth	.64	.64	.64	.64	.64	.64	.64	.64
Mean growth	26.33	1.12	46.74	.43	.73	1.20	.98	.50
Standard deviation	27.62	1.57	101.15	.62	.93	1.25	.75	.37
	<b>1950-54</b>							
Expected growth	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
Mean growth	16.46	17.78	1.19	2.00	1.58	1.27	1.39	1.11
Standard deviation	26.65	36.40	.99	4.72	2.38	1.20	.45	.51
	<b>1954-58</b>							
Expected growth	.70	.70	.70	.70	.70	.70	.70	.70
Mean growth	91.74	71.47	.68	1.50	1.12	.95	.82	.80
Standard deviation	168.68	198.19	.66	3.08	2.32	.82	.36	.25
	<b>1958-62</b>							
Expected growth	.79	.79	.79	.79	.79	.79	.79	.79
Mean growth	2.90	52.07	11.54	4.19	1.22	1.13	.88	.78
Standard deviation	3.42	96.90	46.15	10.68	2.22	1.57	.46	.21

not appear to decrease uniformly with increased class size.

### Growth Of Sheep Slaughter Firms

The size distributions of FI sheep slaughter firms only vaguely resemble those of other slaughter firms. During 1950-62, the shape of the distribution shifted in a manner different from shifts in other segments of the industry. A relatively greater number of firms appeared in the small classes at the end of the period. Total commercial sheep slaughter grew during 1950-62 by 31 percent, while FI sheep slaughter grew by 21 percent. Only during 1954-58 did sheep slaughter decline. Hence, FI sheep slaughter firms were operating in an expanding industry. While total expansion was not as great as it was in cattle slaughter, the expansion pattern resembled that of cattle slaughter. Thus, it is reasonable to expect similar firm growth patterns.

#### Growth: 1950-62

For the 1950-62 period, both mean and variance of sheep slaughter firm growth rates exhibited rather high variation among classes (table I-3). However, there apparently was no systematic relationship between growth and class. Both mean and variance of growth rates were largest in class V, and they were of an approximately equal magnitude in the classes at each end of the range. Statistical tests rejected equality of both the mean and variance rate among classes.

#### Growth: 1950-54

Both the variances and means of growth rates of FI sheep slaughter firms that persisted during 1950-54 were less than for the entire 1950-62 period and for either 1954-58 or 1958-62 (table I-3). Although firms

in the smallest class had the highest mean growth, there appeared to be no systematic relationship between size and growth. Variability of growth also was greatest among the smallest firms, but there appeared to be no systematic relationship between size and variance of growth. Even though small sheep slaughter firms apparently did not grow faster than large firms, there was significant inequality in growth. Statistical tests rejected equality of both mean and variance of growth during 1950-54.

#### Growth: 1954-58

Sheep slaughter firms persisting during the 1954-58 period experienced slightly higher growth rates than during 1950-54 (table I-3). Further, there appeared to be an inverse relationship between size and both mean and variance of growth rates. The four smallest classes had higher growth rate means and variances than the four largest classes. Statistical tests partially supported and partially rejected the apparent conclusion. Variances of growth rates were judged to be unequal, but mean growth rates were judged to be not significantly different among classes.

#### Growth: 1958-62

During 1958-62, mean and variance of growth rate among sheep slaughter firms were greater in the small classes than in the large (table I-3). Apparently, an inverse relation was stronger for variance than for mean. Average variance was substantially higher in the four smallest classes than in the four largest, while average mean was only moderately higher. In fact, the conclusion of the statistical test for equality was that differences among growth rates were not significant. Differences among variances, however, were judged to be substantially greater than differences due to chance.

Table I-3. Characteristics of growth rates by class, FI sheep slaughter firms, 1950-62

Characteristic	Class							
	I	II	III	IV	V	VI	VII	VIII
<b>1950-62</b>								
Expected growth .....	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24
Mean growth .....	4.37	3.31	.47	1.51	67.08	3.03	1.54	1.06
Standard deviation .....	2.88	.54	.43	2.12	209.32	2.71	2.25	.44
<b>1950-54</b>								
Expected growth .....	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Mean growth .....	3.53	2.54	.66	1.16	1.21	1.66	1.52	1.14
Standard deviation .....	5.79	2.51	1.00	1.56	1.28	1.66	1.44	.25
<b>1954-58</b>								
Expected growth .....	.86	.86	.86	.86	.86	.86	.86	.86
Mean growth .....	62.17	3.17	3.81	14.92	.94	1.22	1.33	.94
Standard deviation .....	86.75	5.23	6.64	47.80	1.40	.86	1.14	.33
<b>1958-62</b>								
Expected growth .....	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
Mean growth .....	19.04	21.86	4.18	2.13	1.14	5.67	1.47	1.08
Standard deviation .....	35.19	44.01	8.61	3.58	1.14	15.57	1.39	.43

**Table I-4. Characteristics of growth rates by class, FI hog slaughter firms, 1950-62**

Characteristic	Class							
	I	II	III	IV	V	VI	VII	VIII
	<b>1950-62</b>							
Expected growth .....	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
Mean growth .....	4.40	.75	63.08	5.53	2.51	1.90	1.07	.91
Standard deviation .....	*	*	172.15	11.49	2.10	1.57	.44	.17
	<b>1950-54</b>							
Expected growth .....	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Mean growth .....	3.62	.22	2.64	1.32	1.21	1.06	.93	.93
Standard deviation .....	4.04	.22	3.61	2.21	1.11	.62	.32	.09
	<b>1954-58</b>							
Expected growth .....	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Mean growth .....	9.82	2.07	2.12	2.34	1.62	1.26	1.10	.96
Standard deviation .....	19.29	*	4.38	5.29	2.50	1.85	1.68	1.92
	<b>1958-62</b>							
Expected growth .....	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
Mean growth .....	1.61	1.00	2.21	2.15	1.47	1.35	1.09	1.02
Standard deviation .....	3.25	1.78	5.19	6.26	2.23	2.01	1.67	2.04

\* Class contains one firm.

To summarize, growth of FI sheep slaughter firms varied considerably among classes during 1950-62. For the entire period and for the three subperiods within the period, growth rate variability among classes was significantly different. While mean growth rates were unequal for the entire period, they were not significantly different among classes for the three 4-year periods within 1950-62. For the entire period, the greatest growth rate was in class V, but for the years within the period, the greatest growth rates were in smaller classes. In 1950-54 and 1954-58, the greatest growth rate was among class I firms. In 1958-62, class II firms had the largest growth rates. A part of the discrepancy between the most rapidly growing classes in 1950-62 and the subperiods within the period was due to the difference in the firms included in the classes. While all firms operating in 1950-62 also were slaughtering in the subperiods, some of the firms operating in the subperiods were not operating for the entire period. Some firms that were slaughtering in 1950-54 exited before 1962, some firms operating in 1954-58 entered after 1950 and/or exited before 1962, and some firms operating in 1958-62 entered after 1950. Hence, relative growth among classes in 1950-62 could not be the same as for the subperiods. Another part of the discrepancy in relative growth rate was due to the fact that any given class could have experienced rapid growth during a 4-year period and yet not have sustained growth for 12 years. The observed shifts in relative growth among classes may imply a shift in the forces affecting growth in the sheep slaughter industry.

### Growth Of Hog Slaughter Firms

The size distributions of FI hog slaughter firms resembled those of all slaughter firms throughout 1950-

62. The peak of the distribution was in the middle classes, with a relatively small number of extremely small and extremely large firms. The hog slaughter industry grew during the period: Slaughtering increased from 69.5 million head in 1950 to 79.3 million head in 1962. While total commercial slaughter increased by 14 percent, FI slaughter increased by 18 percent. Hog slaughter did decline in 1950-54, but it expanded in 1954-58 and in 1958-62. The pattern of industry expansion was different from the patterns of the cattle and sheep segments, although FI hog slaughterers, like cattle and sheep slaughterers, were operating in an expanding industry.

#### Growth: 1950-62

Variance of growth rates among hog slaughter firms appeared to be inversely related to size during 1950-62 (table I-4). However, the pattern was incomplete because there was only one persisting firm in the two smallest classes. Mean growth rates appeared to vary substantially among classes. Although rates generally were greater in the smaller classes, the inverse relationship was not marked. The greatest average growth rate was among firms in class III. Firms in this class also had the greatest variability in growth rate. Tests on growth equality indicated that both mean and variance of growth rates were unequal among classes.

#### Growth: 1950-54

Growth rates of persisting firms, while generally less during 1950-54 than during 1950-62, followed much the same pattern (table I-4). Some variation of variances and means among classes appeared, along with some suggestion of an inverse relationship with size. The inverse relationship between size and vari-

ance of growth rates appeared to be more pronounced than any possible relationship between size and mean growth rates. Although the largest mean and variance of growth was in the smallest class, the size of each measure was almost as great in class III. Statistical tests concluded that both mean and variance of growth rates were significantly different among classes in the 1950-54 period.

**Growth: 1954-58**

Growth and variance of growth of persisting hog slaughter firms were greater during 1954-58 than in the preceding period (table I-4). As in 1950-54, there appeared to be a slight inverse relationship between both mean and variance and size of firm. Means and variances were greater in the four smallest classes than in the four largest. Both the largest average growth and the largest variability of growth were in the smallest class. The tests of growth equality concluded that variances were unequal, but that mean growth rates were not significantly different.

**Growth: 1958-62**

Mean and variance of growth rates of hog slaughter firms were lower during 1958-62 than during the preceding period (table I-4). There was some suggestion of an inverse relationship between variance of growth rates and class, but there appeared to

be no such relationship between mean growth rates and class. In fact, there was very little apparent variation of mean growth among all classes. While the growth rates of firms in class I averaged 9.82, growth in other classes was between 1.1 and 2.3. Variance was highest in the smallest class and was about the same among the largest classes. The statistical tests on equality of growth indicated that mean growth rates were not significantly different, but variability of growth was unequal.

For all periods within 1950-62, the variability of growth of FI slaughter firms appeared to be less than for firms slaughtering other species. For the entire period, greatest mean growth and variance of growth were in class III. During 1950-54 and 1954-58, the greatest average growth was in the smallest class. In these two periods the small firms also had the greatest growth variability. During 1958-62, the greatest average growth was in classes III and IV. The greatest variability of growth was in class IV, but variability among class III firms was almost as great. Perhaps the most notable characteristic was that FI hog slaughter firm growth appeared less inversely related to size than it was for the entire industry. There also was less variation in mean growth rates among classes. Differences in growth variability among classes also were less than they were for all FI slaughter firms, although differences in variability of growth were greater than differences in mean growth.