

Measuring Size in Livestock Production

To examine change in industry concentration and structure, size of operation must be defined and measured. The meaning of size and its measurement varies among agricultural commodities. Among livestock commodities, size of operation typically refers to the number of head of inventories or sales.

County-level data from the census of agriculture (U.S. Dept. of Commerce, *Census of Agriculture*) are used to measure the size of livestock operations from 1969 to 1992. During this period the census of agriculture was conducted in 1969, 1974, 1978, 1982, 1987, and 1992. The census data include farm numbers, inventories, and sales of major livestock commodities in each U.S. county.² Livestock commodities examined in this report include hog, milk, cow-calf, fed cattle, broiler, and egg production. Data on farm sales of hogs and pigs, fed cattle,³ and broilers are used to measure the size of these operations. Size is measured with data on milk cow inventory for dairies, beef cow inventory for cow-calf operations, and layer hen and pullet inventory among egg producers. Data on cattle feedlots and head sold were not reported in the census of agriculture prior to 1978. Therefore, the analysis of fed cattle production is limited to the period from 1978 to 1992.

The Changing Concentration of Livestock Production

Concentration refers to the inequality in which a particular characteristic or attribute is distributed among members of a group or a population. Inequality of an attribute is often expressed with the concentration curve, commonly called the “Lorenz curve.” The Lorenz curve shows the distribution of a particular attribute—in this case livestock production—across the population. First, the population is ordered from smallest to largest. The cumulative percentage of individuals (or unit of individuals) is then plotted

²The analysis in this report is limited only to the 48 continental States. Alaska and Hawaii are excluded because of consistency problems in the county definition in each census of agriculture from 1969 to 1992. Alaska and Hawaii contribute a very small portion of production of these livestock commodities and, in some cases, none of the production.

³The census of agriculture refers to fed or feedlot cattle as cattle fattened on grains and concentrates.

against the cumulative percentage of production accounted for by those units. If all individuals have identical production, or total equality, the curve is a straight line through the diagonal (line of equality). However, the inequality of most attributes, including livestock production, causes the concentration curve to fall below the line of equality. The greater the inequality, the greater the area between the curve and the line of equality. In this analysis, Lorenz curves for livestock production are plotted and compared for each industry in both 1969 and 1992.

The Gini coefficient (see appendix) is related to the Lorenz curve. One of the oldest measures of inequality, the Gini coefficient is popular because it provides a way of simplifying reality by reducing the complex population composed of diverse individuals to a single number. In relation to the Lorenz curve, the Gini coefficient is defined as the area between the Lorenz curve and the line of equality, expressed as a proportion of the total area under the line of equality. Hence, the Gini coefficient is a positive fraction between zero and one. With respect to livestock production, a Gini value of one means that all of production is concentrated in one individual (or unit of individuals), while a Gini value of zero indicates that all in the population produce an equal share of production. Gini coefficients are estimated for livestock production in each sector during years of the census of agriculture from 1969 to 1992.

Comparing deciles, quartiles, or quintiles of the size distribution is another method of measuring the concentration of production. Size is ranked from largest to smallest to form a cumulative distribution of production, and the number of units required to produce various levels of aggregate output are determined. In this report, livestock production in each county is ordered from largest to smallest and the minimum number of counties with 25 and 50 percent of the production units are identified in 1969 and in 1992. Using county data in this analysis allows a visual representation of concentration and the identification of geographic patterns of change between the years.

Lorenz curves, Gini coefficients, and size distributions are most often computed from data on each individual or a sample of individuals from the population. However, for this report the production data are not for individual farms but rather are aggregated to the county level. This situation does not prevent the calculation of Gini coefficients, Lorenz curves, and size

distributions, but it does affect their interpretation.⁴ Thus, concentration is not measured in terms of farms, but rather in terms of geography.⁵ Shifts in the location of the most concentrated areas of animal production between 1969 and 1992 identify changes in geographic concentration.

Lorenz Curves and Gini Coefficients

Figure 3 includes Lorenz curves plotted for each livestock commodity in 1969 and 1992, except for fed cattle where data were not available prior to 1978. The greater the area between the Lorenz curve and the line of equality, the greater the degree of geographic concentration. To compare industry concentration in 1969 and 1992, the percent of production units provided by the top 10 percent of U.S. counties is identified in each year.

The greatest change in geographic concentration was in egg production where the top 10 percent of producing counties had 94 percent of the total layer hen and pullet inventory in 1992, up from 61 percent in 1969. In contrast, concentration changed little in feeder cattle production where the top 10 percent of counties had 34 percent of the total beef cow inventory in 1992, and 32 percent in 1969. Levels of geographic concentration and the change between 1969 and 1992 were much the same for hog and milk production. The top 10 percent of counties had 55 percent of hog sales and 55 percent of the milk cow inventory in 1969, but increased to about 65 percent in both industries by 1992. Only for broiler sales did geographic

concentration decline during the study period. The top 10 percent of counties accounted for 83 percent of broiler sales in 1969, but only 66 percent in 1992.

Table 1 includes estimated Gini coefficients for each livestock commodity for each census year during the 1969-92 period. Data on cattle feedlots and head are available only from 1978 to 1992. Higher values for the Gini coefficients indicate greater geographic concentration of production for a commodity. Lower values indicate less geographic concentration. To illustrate change during the study period, the estimated Gini coefficients are plotted in figure 4.

According to the analysis of Gini coefficients, the poultry industry included the most geographically concentrated livestock commodities in 1992. Gini coefficients for broiler and egg production are about 0.95. Broiler production was most geographically concentrated throughout the entire study period, with little variation in the estimated Gini. In contrast, the growth of geographic concentration in egg production was much higher from 1969 to 1978 than in any other industry. The estimated Gini for egg production increased from 0.74 in 1969 to 0.93 in 1978, but changed little from 1978 to 1992. Following egg and broiler production, concentration was next highest for fed cattle production with an estimated Gini of about 0.90 in 1992, up from 0.86 in 1978.

Geographic concentration in the other livestock industries is not as high as for poultry and fed cattle production, but the rate of increase during the study period was substantial. Gini coefficient estimates for hog and milk production are nearly identical throughout the study period, increasing steadily from about 0.70 in 1969 to 0.80 in 1992. Concentration of the beef cow inventory is well below the other livestock sectors, but change during the study period was toward

⁴Lorenz curves and Gini coefficients calculated on a different basis, such as for the farm population or a sample of farms, should not be directly compared with those based on aggregate groups.

⁵Different geographic sizes of counties cause some additional problems of interpretation since smaller counties predominate in the East and South, and larger counties in the West.

Table 1—Estimated Gini coefficients for the geography of major livestock commodities, 1969-92

Commodity	1969	1974	1978	1982	1987	1992
	Coefficient					
Hog and pig sales	0.7260	0.7366	0.7351	0.7653	0.7817	0.8081
Milk cow inventory	0.6926	0.7259	0.7511	0.7654	0.7917	0.8071
Fed cattle sales	na	na	0.8631	0.8639	0.8760	0.8955
Beef cow inventory	0.5091	0.4980	0.5299	0.5417	0.5745	0.5847
Broiler sales	0.9483	0.9521	0.9519	0.9527	0.9528	0.9475
Layer hen and pullet inventory	0.7421	0.8191	0.9302	0.9428	0.9675	0.9501

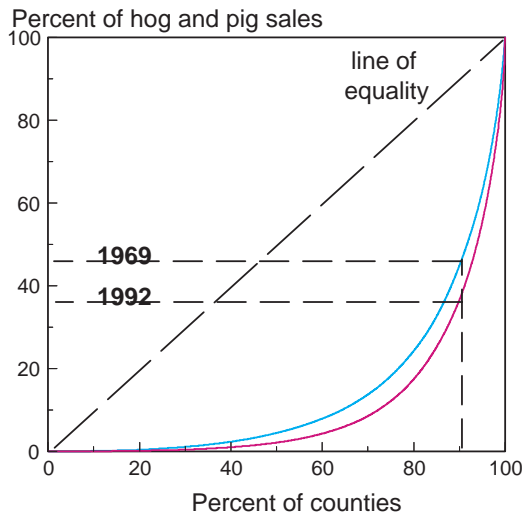
na=Not available.

Source: Compiled by ERS using census of agriculture data.

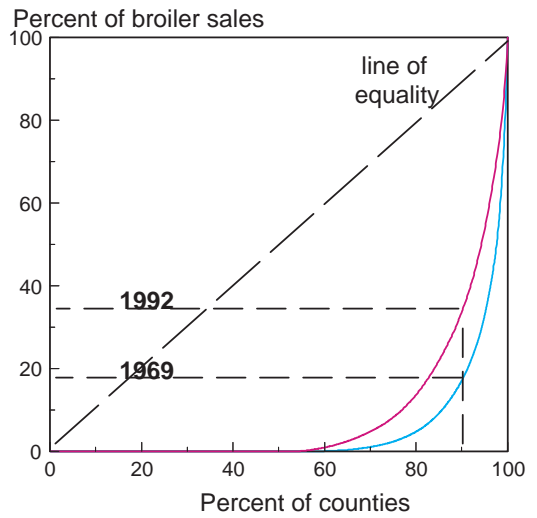
Figure 3

Lorenz curves for the geography of major livestock commodities, 1969 and 1992

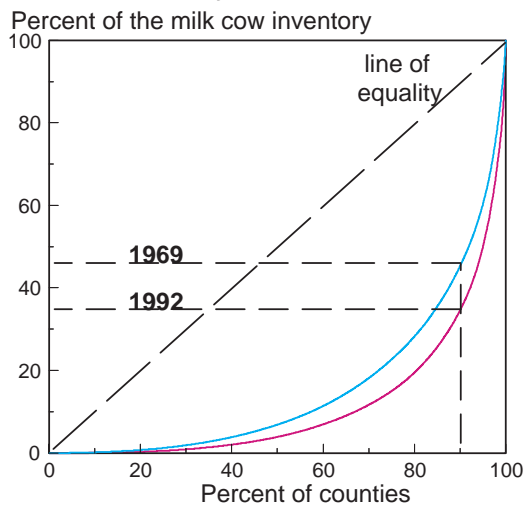
Hog and pig sales



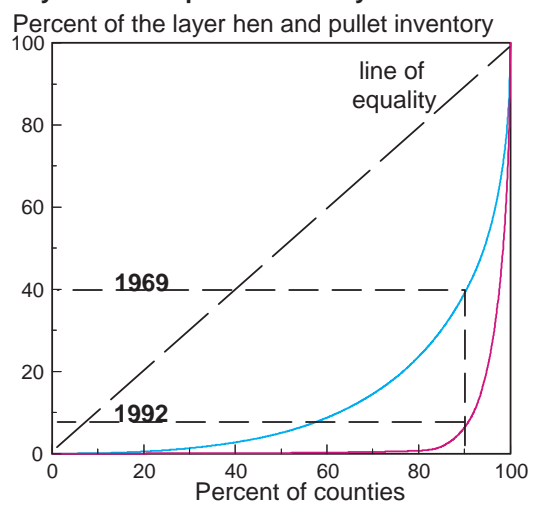
Broiler sales



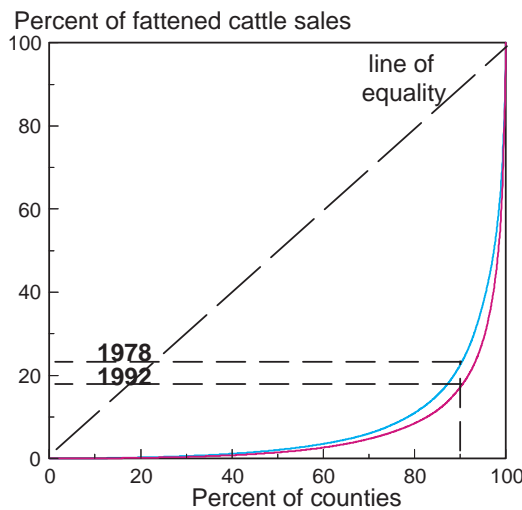
Milk cow inventory



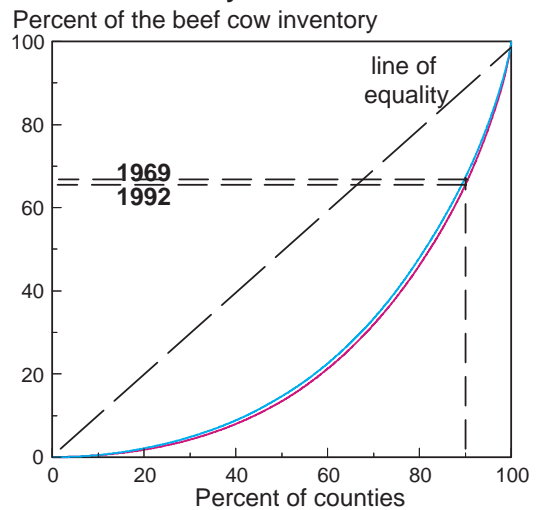
Layer hen and pullet inventory



Fattened cattle sales 1/



Beef cow inventory

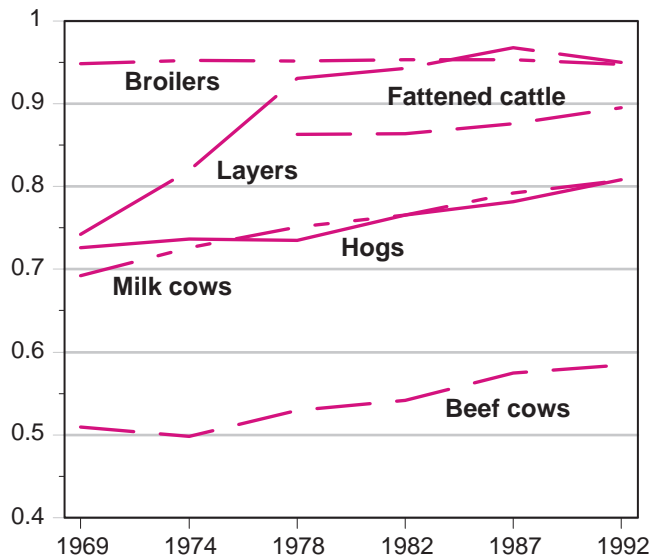


1/ Data on fattened cattle farms and head sold were available from only 1978 to 1992.
Source: Compiled by ERS using census of agriculture data.

Figure 4

Estimated Gini coefficients for the geography of major livestock commodities, 1969-92

Gini



Source: Compiled by ERS using census of agriculture data.

greater concentration. The estimated Gini is only 0.51 for beef cows in 1969, but up to 0.58 in 1992.

The Geographic Distribution of Production

The geographic distribution of production for each livestock commodity is illustrated with the maps shown in figures 5-10. Data presented in the figures are cumulative. The fewest counties with 25 percent of sales (inventory) are shown in the dark shade, while the fewest counties with 50 percent of sales (inventory) include both the dark and medium shades. All shaded counties comprise 100 percent of sales (inventory). A summary of the county data is presented in table 2, while the number and land area of counties for each of the groups shown in figures 5-10 are included in table 3.

The number of farms with hog sales declined by about 70 percent between 1969 and 1992 from more than 600,000 to less than 200,000, while total hog sales increased by more than 20 percent (table 2). Average sales per farm in 1992, at 588 head, was more than four times greater than in 1969. The number of hog-producing counties contributing half of total sales dropped to 168 in 1992, down from 251 in 1969 (table 3). Fifty-one counties contributed a quarter of hog sales in 1992. The combined land area in these 51 counties covers an area only slightly larger than

Table 2—Number of farms, head of production, and per farm production for major livestock commodities, 1969-92¹

Commodity	Farms	Head	Head per farm
Hog and pig sales:			
1969	644,882	89,296,278	138
1974	449,266	79,664,655	177
1978	422,873	90,530,088	214
1982	312,924	93,998,044	300
1987	236,973	95,595,391	403
1992	186,627	109,775,439	588
Milk cow inventory:			
1969	567,786	11,168,207	20
1974	403,600	10,647,475	26
1978	310,884	10,168,378	33
1982	276,332	10,780,610	39
1987	200,554	10,006,103	50
1992	153,945	9,407,190	61
Fed cattle sales:			
1969	na	na	na
1974	na	na	na
1978	243,417	25,755,779	106
1982	234,750	22,869,398	97
1987	186,411	22,939,061	123
1992	144,303	22,186,662	154
Beef cow inventory:			
1969	845,514	34,281,198	41
1974	1,024,180	41,170,021	40
1978	942,226	33,415,205	35
1982	940,395	33,213,020	35
1987	810,494	29,963,442	37
1992	767,919	30,540,647	40
Broiler sales:			
1969	33,221	2,351,979,300	70,798
1974	33,486	2,484,037,900	74,181
1978	28,988	3,008,971,000	103,801
1982	27,444	3,446,919,300	125,598
1987	25,222	4,250,689,255	168,531
1992	21,777	5,174,690,477	237,622
Layer inventory:			
1969	470,832	297,387,187	632
1974	304,738	269,623,558	885
1978	161,817	186,368,665	1,152
1982	146,957	171,364,812	1,166
1987	89,922	167,390,165	1,862
1992	70,623	210,808,487	2,985

na=Not available.

¹Summarized county data in each year. Total may not equal published estimates because of farms omitted from the county file to avoid data disclosure.

Source: Compiled by ERS using census of agriculture data.

that of Indiana, an area 30 percent smaller than in 1969. Iowa was the largest hog-producing State in both 1969 and 1992, but North Carolina moved from 11th to 2nd, surpassing such traditional hog-producing States as Illinois, Minnesota, Indiana, Nebraska, and Missouri. Changes in the geographic concentration of

Table 3—Number of counties and land area in the areas of greatest concentration for major livestock commodities, 1969 and 1992

Commodity	Number of counties		Land area in square miles	
	1969 ¹	1992	1969 ¹	1992
Fewest counties with:				
25 percent of hog and pig sales	83	51	553,850	383,420
50 percent of hog and pig sales	251	168	1,550,480	1,151,410
100 percent of hog and pig sales	3,015	2,722	29,147,100	26,047,800
Fewest counties with:				
25 percent of the milk cow inventory	71	34	1,151,070	784,780
50 percent of the milk cow inventory	247	130	2,619,030	1,879,960
100 percent of the milk cow inventory	3,032	2,583	29,351,510	25,617,670
Fewest counties with:				
25 percent of fed cattle sales	17	13	324,310	193,870
50 percent of fed cattle sales	73	44	1,237,450	672,310
100 percent of fed cattle sales	2,756	2,652	25,285,300	25,117,590
Fewest counties with:				
25 percent of the beef cow inventory	210	171	5,060,920	4,089,310
50 percent of the beef cow inventory	573	476	10,072,600	8,931,990
100 percent of the beef cow inventory	3,046	2,683	29,519,290	26,254,670
Fewest counties with:				
25 percent of broiler sales	12	17	94,760	171,370
50 percent of broiler sales	37	51	251,470	389,170
100 percent of broiler sales	1,534	886	13,120,440	7,442,290
Fewest counties with:				
25 percent of the layer inventory	34	10	564,150	188,850
50 percent of the layer inventory	174	39	1,868,410	620,700
100 percent of the layer inventory	3,038	2,413	29,377,400	24,272,440

¹1978 for fed cattle sales.

Source: Compiled by ERS using census of agriculture data on animals sales and inventories, and census of population and housing data on land area.

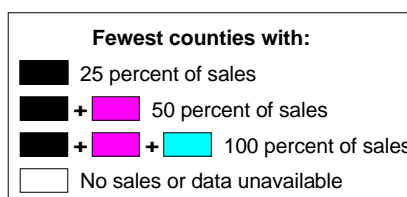
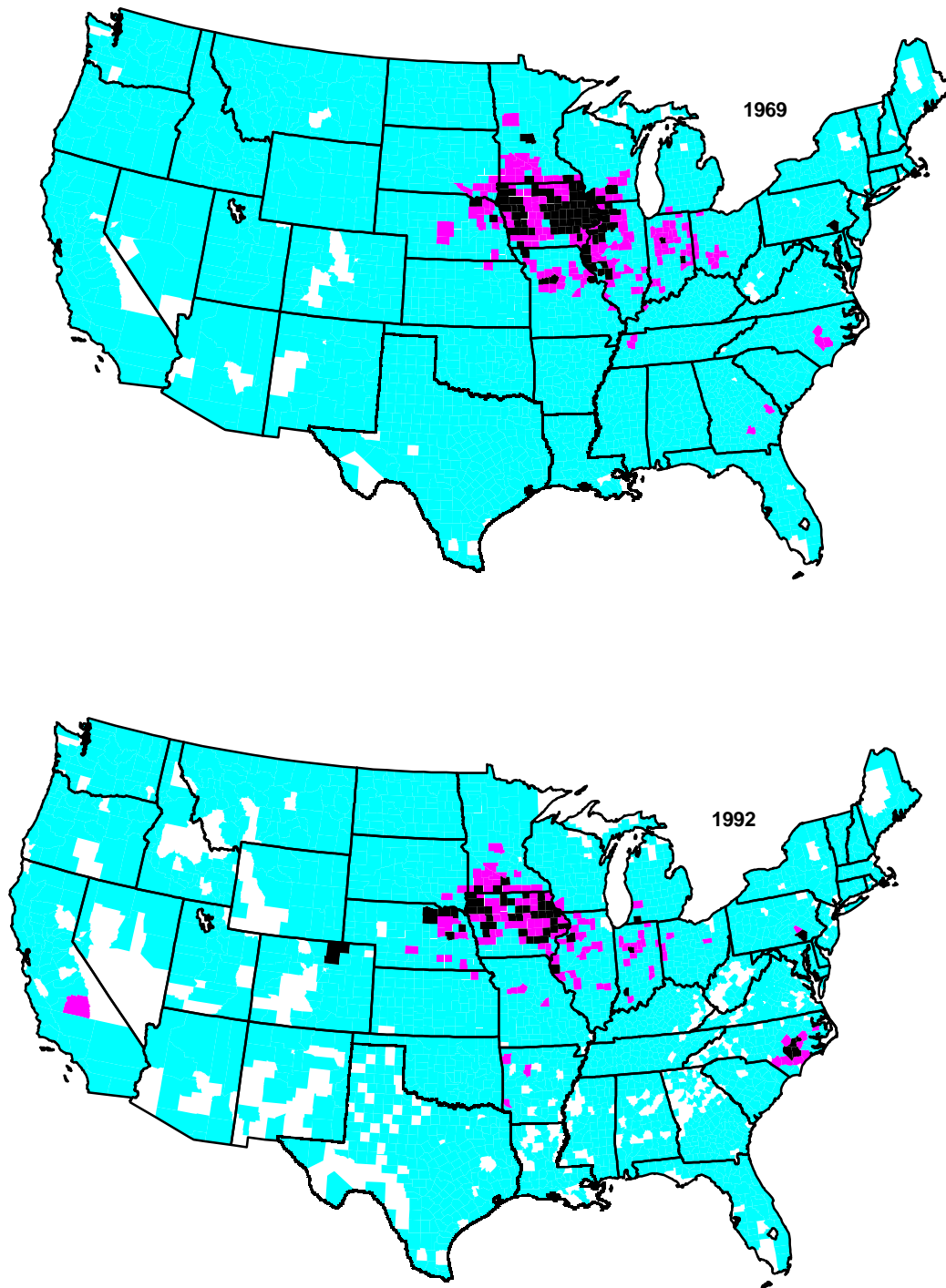
production between 1969 and 1992 resulted in fewer counties in Iowa, Illinois, and Indiana being among the fewest counties with 25 and 50 percent of sales (fig. 5). More counties from nontraditional hog production areas, primarily North Carolina, but also Arkansas, Colorado, and California, became part of the most concentrated areas of hog production. Overall, hog production became increasingly concentrated among fewer counties during the 1969-92 period and new production areas increased in importance relative to traditional areas.

Much like the hog industry, the number of farms with a milk cow inventory declined by more than 70 percent between 1969 and 1992, from more than 560,000 to about 150,000 (table 2). The national milk cow inventory declined during this period, but substantial growth in productivity increased aggregate milk production (Perez). The average milk cow inventory per farm tripled from 20 to 61. Half of the 1992 milk cow inventory was included in 130 counties, down from 247 counties in 1969 (table 3). A quarter of the

1992 milk cow inventory was in only 34 counties, but these are relatively large counties that have a combined land area nearly the size of Minnesota. Wisconsin was the largest milk-producing State in both 1969 and 1992. However, growth in the California dairy industry was most dramatic during this period, moving from the fifth largest inventory in 1969 to the second largest in 1992, surpassing New York, Minnesota, and Pennsylvania, and nearly equaling Wisconsin.⁶ Changes in geographic concentration between 1969 and 1992 reflected this regional shift (fig. 6). Fewer counties in the Upper Midwest and Northeast were among the most concentrated production areas. Leading milk-producing counties in California gained in importance, along with counties in other Western States, particularly New Mexico. Milk production became increasingly concentrated during the 1969-92 period, with significant regional shifts in production.

⁶While the milk cow inventory in California remains below that in Wisconsin, total milk production in California has surpassed that of Wisconsin in each year since 1993 due to greater production per cow (USDA/ERS, 1995a).

Figure 5
Concentration of hog and pig sales, 1969 and 1992



Source: Compiled by ERS using census of agriculture data.