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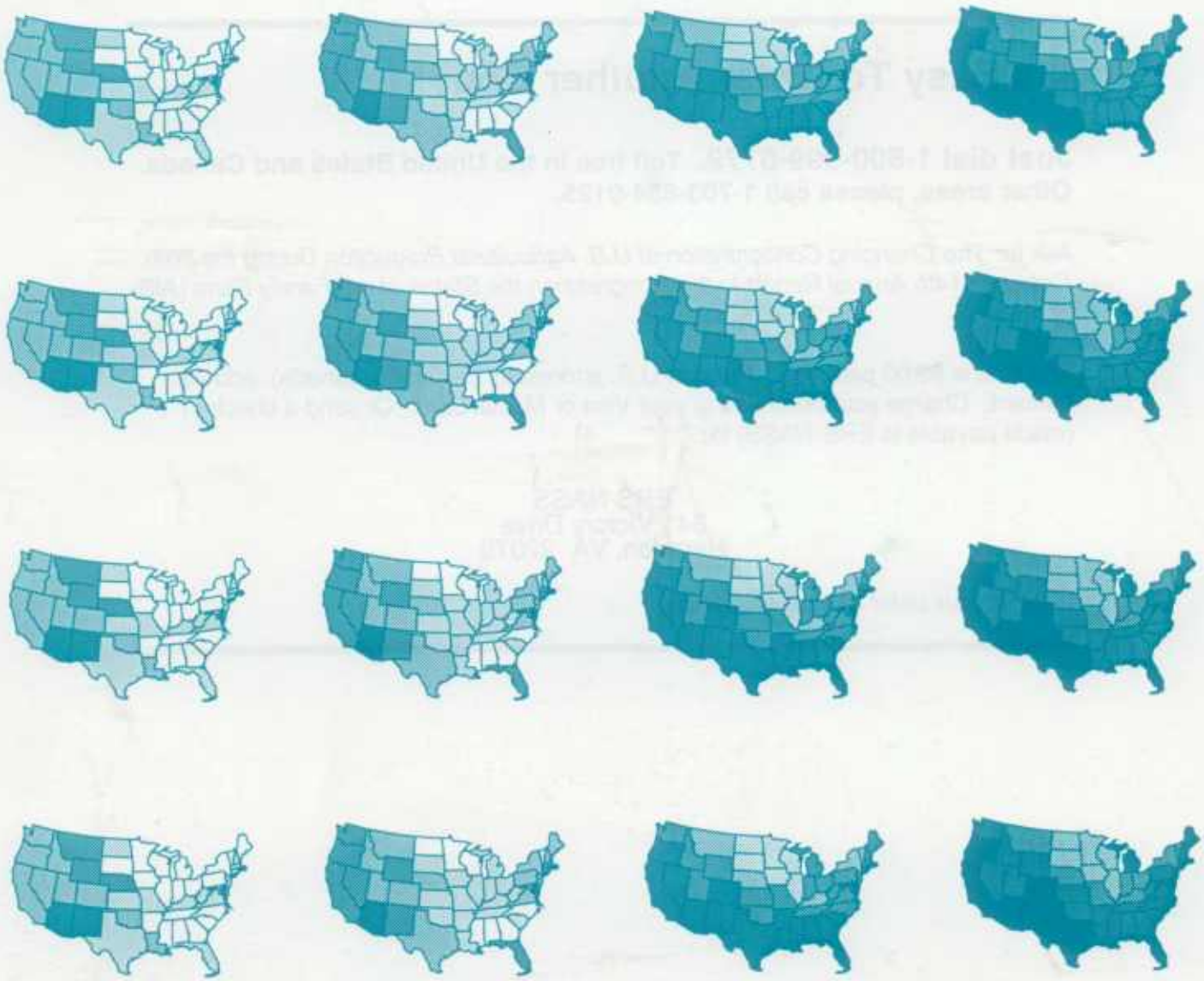
The Changing Concentration of U.S. Agricultural Production During the 20th Century

14th Annual Report to the Congress on the Status of the Family Farm

R. Neal Peterson and Nora L. Brooks



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The Changing Concentration of U.S. Agricultural Production During the 20th Century: 14th Annual Report to the Congress on the Status of the Family Farm. By R. Neal Peterson and Nora L. Brooks, Agriculture and Rural Economy Division, Economic Research Service, U.S. Department of Agriculture. Agriculture Information Bulletin No. 671.

Abstract

Fewer farms account for a larger share of farm production. The rate by which agricultural concentration has increased throughout the 20th century has been relatively steady in terms of sales but slowed markedly for acreage around 1950 to less than half its earlier rate. Every State's agriculture has become increasingly concentrated in the hands of fewer farm operators, although the degree of concentration is not uniform. Farms in the western Corn Belt and northern Plains are less dissimilar in terms of acreage and value of output than are farms in the western, east coast, and Sun Belt regions.

Keywords: Farm concentration, farm structure, farm size, farm sales

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Contents

Summary

Fewer farms account for a larger share of farm production. The rate by which agricultural concentration has increased throughout the 20th century has been relatively steady in terms of sales but slowed markedly for acreage around 1950 to less than half its earlier rate. Every State's agriculture has become increasingly concentrated in the hands of fewer farm operators, although the degree of concentration is not uniform. Farms in the western Corn Belt and northern Plains are less dissimilar in terms of acreage and value of output than are farms in the western, east coast, and Sun Belt regions.

Examining the number of farms that produce half and a third of total farm sales illustrates the degree to which U.S. agriculture has become more concentrated. In 1900, the largest farms that produced half of total output were 17 percent of all farms. By 1987 (the most recent year for which census of agriculture data are available), the proportion producing half of total output had dropped to 3.6 percent. Average sales in real dollars per farm increased 4,858 percent over the period, while average acres per farm increased 756 percent. Despite these increases, the farm sector remains much less concentrated than other sectors of the economy. For example, only 0.1 percent of all U.S. manufacturing firms accounted for 43 percent of the total value of shipments in 1982.

Farm sales concentration has increased during this century at a basically stable rate, despite a series of major social and economic events, such as the Great Depression, World War II, and the farm exodus and consolidation of the 1950's and 1960's. Technology has probably played the major role in fostering concentration, but other factors, such as a growing nonfarm economy and its links to the farm economy, have also contributed to the changes in farm numbers and farm sizes that underlie farm concentration. Although some of the factors that have led to greater concentration have abated, most influences will continue in force into the next century, especially the development of new technologies.

The Changing Concentration of U.S. Agricultural Production During the 20th Century

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R. Neal Peterson and Nora L. Brooks

Introduction

Major changes during the 20th century have transformed the U.S. economy from largely rural and agrarian into predominantly urban and industrial. This economic transformation has its roots in basic, profound changes in transportation, communication, mobility, energy sources, and methods of production that have altered American society. U.S. agriculture has been transformed from a system of relatively diversified, nonintensive production that primarily depended on increased land and labor for expanding output into a much more specialized, technologically innovative, labor-efficient, and capital-intensive system. The process has led to fewer and, on average, larger farms. The attrition in farm numbers has affected all farm sizes and all regions. Many, but not all, of the remaining farms have grown in size. This differential growth and attrition has increased the spread in the distribution of farm sizes.

This distribution of farm sizes from smallest to largest and the shares of production that these different farm sizes represent are reflected in the term "concentration." Average farm size, the total number of farms, and the largeness of the largest farms are important measures of what has been happening to farm sizes. However, analyses of these measures provide only partial understanding of the evolution of the farm sector. Concentration of size distributions has been frequently studied in the context of the manufacturing sector and less often in agriculture. In this report, we analyze farming concentration in U.S. agriculture since 1900 using census of agriculture data with special attention to differences associated with various regions and commodities.

Background

Many of the forces that transformed the U.S. economy and U.S. agriculture during the 20th century were set in motion in the 18th and 19th centuries. These forces include population growth, expansion of educational attainment, developments in science and technology, and the expansion of commerce. The U.S. population grew from 4 million in 1790 to 17 million in 1840 to nearly 76 million in 1900. The U.S. farm population grew from 9 million in 1840 (the first year reported) to about 29 million in 1900. The proportion of people employed in farming was over 90 percent in 1790, but only about 38 percent in 1900. To accommodate the expanding population during the 19th century, the Federal Government encouraged settlement of the western frontier through laws primarily designed to provide cheap or free lands for agricultural settlement.

As the economy expanded and industrialized, functions not directly associated with the biological nature of farming shifted from the farm, first to local blacksmith shops and later into specialized factories. Large investments were necessary for the efficient production of new machinery. As farmers found the new machines to be worth their cost, their need for cash and reliance on markets increased.

Around the time of the Civil War, increased demand for food products led to commercialization of northern agriculture, a temporary diversification of southern agriculture, and substantial shifts of crops from one area to another in the South. By 1880, plow agriculture had extended into the Great Plains, as a result of both population pressure and technical developments such as the windmill and barbed wire.

Infrastructure created by the expanding railroads enabled major food processors, wholesalers, and retailers to expand (Chandler, 1977). By the early 20th century, steam and gasoline power were replacing horsepower, again increasing productivity. A larger share of farm production moved to market. Adoption of mechanical technologies again made farmers more dependent on markets and credit, and concentration increased.

The number of farms fluctuated from the turn of the century until World War II. Land in farms rose almost steadily, except for a slight decline during 1920-25. Because farm numbers varied more than land in farms, average farm size also varied. After 1935, average farm size steadily rose.

Around World War II, farmers intensified their substitution of capital for labor, greatly improving labor efficiency. Nonfarm firms provided machinery, fertilizers and other agrochemicals, petroleum, and finance. Farmers bought more inputs from nonfarm firms, increasing farmers' need for cash and their dependence on markets.

After World War II, the industrial and service sectors expanded, and many new nonfarm jobs attracted people from farms. A major social consequence of these changes was the movement of individuals and families from the countryside and rural America to towns and cities following World War II. The farm population dropped from about 30 million in 1940 to just 5 million in 1987. The proportion employed in agriculture dropped from 18 percent in 1940 to 3 percent in 1987.

Accompanying this occupational change and migration, the remaining farms expanded in size, and the concentration of production increased. Farm numbers fell from 5.9 million in 1945 to 2.3 million in 1974, while average size rose from 195 acres in 1945 to 440 acres in 1974. These trends have since slowed. The 1987 Census of Agriculture reported 2.1 million farms with an average size of 462 acres.

Relevance of Farm Size

Farm size has been an important issue in American political thought and action. The young country rejected hereditary aristocracies, and Jefferson articulated a social philosophy and ideal of the independent farmer that remains an American belief today (Brewster, 1979). Americans have traditionally displayed a strong interest in how income is distributed among U.S. citizens (Blaylock and Blisard, 1990). But, Americans have generally shown more concern about inequality of opportunity, monopoly control, and big business than about income inequality.

"Farm size is clearly a policy issue," Stanton (1978) notes. "At one level the focus of concern is on individual farmers and their welfare. At another, it centers on society as a whole and such questions as who gains and who loses with changes in farm structure over time, and how much power is concentrated in the hands of how many." One example is the size and distribution of farm program benefits. Agricultural subsidies are a small share of total Federal outlays, but these subsidies are highly concentrated among the largest farms, although less concentrated than production of the supported crops (Lin, Johnson, and Calvin, 1981; Carlin, 1990). The cost of food to consumers and the competitiveness of U.S. agricultural commodities in international markets are two other areas where concentration is a relevant issue: competition, market power, and economies of scale are all related to the size and number of farms. The technologies employed in agriculture vary with farm size. Hence, farm size and the distribution of farms are inevitably implicated in issues of a primarily technical nature. Such issues would include water pollution, resource conservation, food safety, and rural and urban development. Despite the uncertainties surrounding notions of inequality, the size of farms, the distribution of sizes, and the concentration of production clearly bear on public policy matters important to our society.

Measuring Size

To measure concentration, one must first measure size. Yet size can mean several things and can be measured in many ways. Production inputs, such as land and labor, are possibilities. The advantage of measuring farm size in terms of acres is that "an acre is an acre is an acre" and, unlike the

dollar, is not subject to inflation or deflation. Even so, changing technology (fertilizer and hybrid crop varieties, in particular) can alter productivity sufficiently that comparison between widely separated years becomes difficult. The disadvantage of acres as a measure of size is that land is only one production input and not necessarily the most vital or most limiting. Moreover, the importance of land to the production process depends on climate, soils, the commodity being grown, and proximity to markets, among other factors. Labor, and input measures of size in general, present similar disadvantages.

Output is a more universal measure of size, although not a perfect one. For instance, output suffers from indexing problems. Indexing of some form is necessary when evaluating output because U.S. agricultural output is composed of thousands of different commodities that are measured in diverse units. The monetary value of output is the most satisfactory method of combining diverse products into a single measure because value is easily indexed for any number of years and can describe production of any number of diverse products.

We have chosen census data for analysis because of their length and comparability. The censuses of agriculture comprise the longest historical record of evolving farm size in the United States. The Bureau of the Census has regularly published information on the distribution of farms by acreage size classes and by State since 1880 and since 1940 on the distribution of farms by value-of-production classes by State with data beginning in 1900.

Increasingly Concentrated Production

Like other industries, food and fiber production has become more concentrated during the 20th century. Most food and fiber is produced on a relatively few large farms. This increasingly concentrated production can be illustrated by examining the characteristics of the minimum number of largest farms required to account for one-half and one-third of all farm sales.[1] Data over the period are not wholly consistent. In all but one instance, the concentration of farm sales was computed from census tables based on fixed farm sales classes. In many years, one could find sales class breaks that approximated 50 percent and 33 percent of total sales, but in other years one could not. Data to analyze the characteristics of the producers of the top third of sales were available for 1940, 1969, and 1987 but lacking for 1900. Data for the top half were available for the years 1900, 1940, 1969, and 1987.[2]

Another problem encountered in this analysis is the effect of price-level changes. The index of prices received by farmers rose from 13 in 1900, to 17 in 1940, to 48 in 1969, and to 100 in 1987. Using these index values, we adjusted the valued items in tables 1 and 2 to constant dollar values. Even after adjusting for the increase in the general price level, we still found substantial increases in the average value per farm of sales, land and buildings, and expenses.

Largest Farms Producing Half of Total Sales

The minimum number of farms required to produce half of all sales dropped from over 983,000 in 1900 to about 76,000 in 1987, and their share of total farm numbers dropped from more than 17 percent to less than 4 percent (fig. 1). The average sales per farm (in constant dollars) on these top-producing farms also increased over 4,800 percent during the period, and expenses (also in constant dollars) over 34,500 percent. However, both the total acres and percentage of total U.S. farmland operated by the largest farms declined over the period.

Although the concentration of production in farming has increased substantially during the 20th century, agriculture remains relatively unconcentrated compared with other sectors of the economy. For example, the 200 largest manufacturing firms (less than 0.1 percent of the 310,341 U.S. manufacturing firms) accounted for 43 percent of the total value of shipments in 1982. And, the 50 largest food processing firms (less than 0.3 percent of the 16,800 U.S. food processing firms) controlled 43 percent of the market (1982 Census of Manufacturers). In contrast, 76,000 farms (3.6 percent of the total) accounted for 50 percent of agricultural production in 1987.

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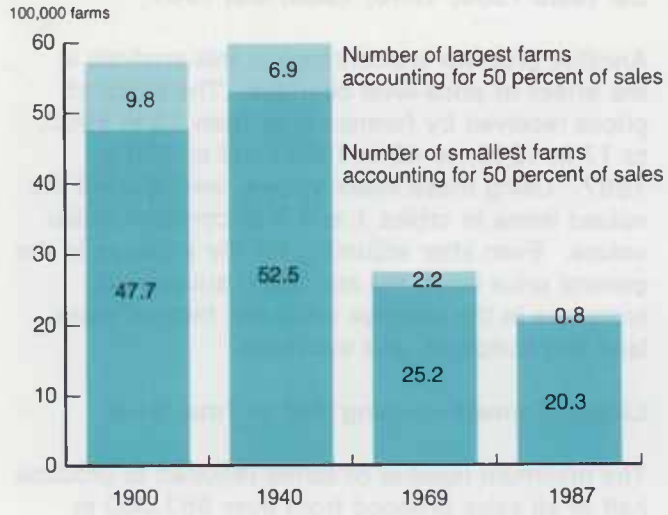
[1] Farm sales are defined as the gross market value before taxes and production expenses of all agricultural products sold or removed from farms. Farm sales include net Commodity Credit Corporation (CCC) loans but exclude direct Government payments and farm-related income.

[2] The 1987 Census of Agriculture included a table on concentration reporting the characteristics of the fewest number of farms accounting for 50 percent of farm sales.

Figure 1

Fewer farms now produce half of farm output

In 1900, 17.1 percent of all farms produced half of all output, but only 3.6 percent produced half in 1987



In 1900, the largest farms that collectively accounted for 50 percent of all farm sales numbered over 983,000 and constituted 17.1 percent of all farms (table 1). They operated 43 percent of all land in farms and accounted for 50 percent of the total value of land and buildings. On average, these farms sold almost $2,500 worth of products ($18,510 in 1987 dollars), incurred expenses of nearly $300 ($2,115 in 1987 dollars), and farmed 369 acres valued at $8,500 ($63,750 in 1987 dollars). The two major commodity specializations of these farms were livestock (excluding dairy) and field crops (including cash grains). These two commodity groups accounted for 76 percent of the largest farms.

By 1940, the largest farms that accounted for 51 percent of the value of all farm products sold numbered under 700,000 and constituted less than 12 percent of all farms. These farms operated 40 percent of all farmland and 40 percent of the total value of land and buildings. On average, they sold almost $6,000 worth of products ($33,335 per farm in 1987 dollars, slightly less than double the 1900 real sales per farm), incurred expenses of about $1,600 ($13,786 in 1987 dollars), and operated 611 acres valued at $20,000 ($115,514 in 1987 dollars). The three most common commodity specialties were field crops (including cash grains), livestock (excluding dairy and poultry), and dairy. These three commodity groups accounted for 88 percent of the top farms.

By 1987, roughly 76,000 farms accounted for 50 percent of all farm product sales. As a share of total farm numbers, their proportion had dropped to less than 4 percent. These farms accounted for only 22 percent of land in farms and 21 percent of the value of land and buildings. On average, they sold almost $900,000 worth of products (almost 27 times the 1940 real sales value), incurred production expenses of about $731,000, and operated 2,792 acres valued at $1.691 million; 26 percent of the acreage was harvested cropland. The three commodity groups most commonly produced were livestock (excluding dairy and poultry), field crops (including cash grains), and poultry. These three production specialties accounted for 70 percent of the top farms.

Largest Farms Producing a Third of Total Sales

Since 1940, the minimum number and proportion of farms required to produce a third of agricultural product sales have declined significantly. While average acres operated by these largest producers increased, total land operated fell. Production significantly shifted from cash grain toward fruits and poultry.

In 1940, slightly more than 300,000 farms (5.2 percent of all farms) accounted for 36 percent of all farm product sales (table 2). These farms accounted for 30 percent of land in farms and 25 percent of the value of land and buildings. On average, they sold almost $9,000 ($51,792 in 1987 dollars), operated 989 acres valued at $28,000 ($165,000 in 1987 dollars), and 20 percent of their acreage was harvested cropland. The three most common commodity specializations of these farms were field crops (including cash grains), livestock (excluding dairy and poultry), and dairy. These three commodity groups accounted for 85 percent of the largest farms.

By 1987, slightly more than 30,000 farms (1.5 percent of all farms) accounted for 38 percent of all farm product sales. These farms had average sales of $1.6 million per farm, about 31 times the real sales value in 1940. On average, these farms operated 3,921 acres, valued at $2.4 million, and 27 percent of their acreage was harvested cropland.

Table 1—Characteristics of the minimum number of largest farms required to produce half of total sales
As their numbers have dropped, these farms have grown tremendously in both physical size and real value of sales

Item	Unit	1900	1940	1969	1987
Farms	*Number*	983,563	688,912	221,690	75,682
Share of all	*Percent*	17.1	11.6	8.1	3.6
Sales	*Million dollars*	2,428	3,973	25,401	68,024
Share of all	*Percent*	50.1	50.9	55.6	50.0
Average per farm	*Dollars*	2,468	5,767	114,579	898,818
Land in farms	*1,000 acres*	362,587	421,217	357,117	211,319
Share of all	*Percent*	43.1	39.7	33.6	21.9
Average per farm	*Acres*	369	611	1,611	2,792
Cropland harvested	*1,000 acres*	NA	NA	85,820	54,523
Value of land and buildings	*Million dollars*	8,360	13,281	66,117	127,983
Share of all	*Percent*	50.1	39.5	32.0	21.2
Average per farm	*Dollars*	8,500	19,984	298,242	1,691,066
Expenses	*Million dollars*	277	1,643	21,505	55,327
Average per farm	*Dollars*	282	2,385	97,005	731,110
Machinery value	*Million dollars*	355	NA	7,151	15,172
Average per farm	*Dollars*	360	NA	32,257	200,466
Operator average age	*Years*	NA	48.3	47.4	49.5
Specialization as a share of all farms:					
Cash grain/field crop	*Percent*	42.8	42.5	21.1	25.3
Vegetable	*do.*	2.8	2.1	2.1	3.1
Fruit	*do.*	2.6	5.3	3.8	9.9
Livestock[1]	*do.*	33.3	26.9	37.6	29.9
Dairy	*do.*	9.2	18.2	15.6	13.4
Poultry	*do.*	*	5.0	12.2	14.7
Miscellaneous	*do.*	9.4	NA	7.6	3.7
Constant dollar values:[2]					
Sales	*Million dollars*	18,210	22,965	53,363	68,024
Average per farm	*Dollars*	18,510	33,335	240,712	898,818
Value of land and buildings	*Million dollars*	62,700	76,769	138,901	127,983
Average per farm	*Dollars*	63,750	115,514	626,559	1,691,066
Expenses	*Million dollars*	2,078	9,497	45,179	55,327
Average per farm	*Dollars*	2,115	13,786	203,972	731,110

Note: 1987 data were compiled from more than one census table.
NA = Not available.
* = Included in livestock.
[1] Excludes dairy and poultry. For 1900, however, excludes only dairy.
[2] 1987 = 100.
Source: U.S. Bureau of the Census, Census of Agriculture.

Table 2—Characteristics of the minimum number of largest farms needed to produce a third of total sales
Average value of land and buildings illustrates the importance of capital to the largest U.S. farms

Item	Unit	1940	1969	1987
Farms	*Number*	312,939	51,995	32,023
Share of all	*Percent*	5.2	1.9	1.5
Sales	*Million dollars*	2,804	15,327	51,952
Share of all	*Percent*	35.9	34.4	38.1
Average per farm	*Dollars*	8,960	294,784	1,622,343
Land in farms	*1,000 acres*	309,479	171,832	125,552
Share of all	*Percent*	29.2	16.2	13.0
Average per farm	*Acres*	989	3,305	3,921
Cropland harvested	*1,000 acres*	NA	36,394	33,765
Value of land and buildings	*Million dollars*	8,491	29,780	77,972
Share of all	*Percent*	25.2	14.4	12.9
Average per farm	*Dollars*	28,558	572,752	2,434,883
Expenses	*Million dollars*	1,179	13,666	42,406
Average per farm	*Dollars*	3,766	26,283	1,324,284
Machinery value	*Million dollars*	NA	2,619	8,759
Average per farm	*Dollars*	NA	5,037	273,510
Operator average age	*Years*	48.5	48.1	50.6
Specialization as a share of all farms:				
Cash grain/field crop	*Percent*	38.3	14.8	17.1
Vegetable	*do.*	2.6	4.1	5.0
Fruit	*do.*	6.8	5.4	14.5
Livestock[1]	*do.*	30.5	40.5	31.8
Dairy	*do.*	16.5	9.6	11.4
Poultry	*do.*	5.3	16.4	16.7
Miscellaneous	*do.*	NA	9.2	3.5
Constant dollar values:[2]				
Sales	*Million dollars*	16,208	32,200	51,952
Average per farm	*Dollars*	51,792	619,294	1,622,343
Value of land and buildings	*Million dollars*	49,081	62,563	77,972
Average per farm	*Dollars*	165,075	1,203,260	2,434,883
Expenses	*Million dollars*	6,815	28,710	42,406
Average per farm	*Dollars*	21,769	55,216	1,324,284

Note: 1987 data were compiled from more than one census table.
NA = Not available.
[1] Excludes dairy and poultry.
[2] 1987 = 100.
Source: U.S. Bureau of the Census, Census of Agriculture.

These farms accounted for 13 percent of land in farms and 13 percent of the value of land and buildings. The three most common commodity types they tended to specialize in were the same as in 1969: livestock (excluding dairy and poultry), poultry, and field crops (including cash grains). These three specialty types accounted for 66 percent of the largest farms.

Measuring Inequality in Farm Size Distribution

Examining the largest producers, although useful, provides only limited information on changes taking place in the distribution of farm size. Such an examination cannot cover change in the entire range of farm sizes and is not an efficient analytical tool for investigating the distribution's dispersion. Methods for measuring dispersion or inequality within distributions are vital for analysis. Numerous measures of inequality exist: the Gini coefficient, the Herfindahl index, Thiel's inequality measure, and Atkinson's inequality measure, among others. Each measure has unique properties and special advantages and disadvantages, but no one measure is universally optimal (Cowell, 1977). All of these measures of inequality simplify reality by reducing complex populations composed of diverse individuals to a single number.

The oldest, best known measure is the Gini coefficient, invented about 1913 by the Italian sociologist Corrado Gini in studying income distribution and inequality. The Gini coefficient is particularly sensitive to changes near the mode (that is, the most frequent class) of the distribution (Kakwana, 1980) and, therefore, is especially appropriate for investigating the U.S. farm size distribution in the late 20th century, a time when most net farm exits were in the small and midsized categories. Because of that property and because of the Gini coefficient's prominence in studies of inequality, we have chosen to use it as our measure of concentration in agriculture. One can calculate the Gini coefficient in many ways, but it is most often defined in terms of the concentration curve (fig. 2).[3]

The concentration curve shows the distribution of a particular attribute across a population. The population is arrayed from least to greatest according to the amount of the attribute each individual possesses, and the concentration curve is obtained by plotting the cumulative percentage of individuals (or units of observation) against the cumulative percentage of the attribute accounted for by those units. If all individuals had identical incomes, the situation of total equality, then the curve would be a diagonal straight line across the diagram. For most attributes, inequality is the rule, and the concentration curve falls below the diagonal. The greater the inequality, the greater is the area between the curve and the diagonal.

In terms of the Lorenz curve, the Gini coefficient is defined as twice the area bounded by the curve and the diagonal. Hence, the Gini coefficient varies between zero and one. Zero corresponds to total equality and is represented by a curve that falls along the diagonal and bounds no area between itself and the diagonal. One corresponds to total inequality with all of the attribute held by one individual and is represented by a curve that is backward L-shaped: the curve follows the horizontal axis along the bottom and ascends the vertical axis along the right side. In the case of real data, neither total equality nor total inequality prevails. The Lorenz curve is at neither extreme, but rather lies between, having a convex shape (fig. 2). The corresponding Gini coefficient is a positive fraction between zero and one.

The Lorenz curves and the Gini coefficients ideally will be computed from data on individuals. Individual data are seldom available, however, and one must make do with grouped data that report values for class intervals. This situation does not prevent the calculation of Lorenz curves and Gini coefficients, but it introduces an element of uncertainty because the distribution of the attribute within classes cannot be known. The calculated curves and coefficients are, thus, estimates of true values. In the case of census of agriculture data, which are grouped, the error of the estimates is believed to be small. For the convenience of exposition, only the mean values of the estimate of the Gini coefficients are reported here.

Inequality at the National Level

Inequality in the size, both in acres and sales, of farms has increased steadily throughout the

[3]Income is the classical attribute studied in this way. The income concentration curve is known as the Lorenz curve, and by extension, concentration curves are often termed "Lorenz curves."

Figure 2

Farm acreage concentration curves

Percentage of total acreage held by increasing shares of total farm numbers

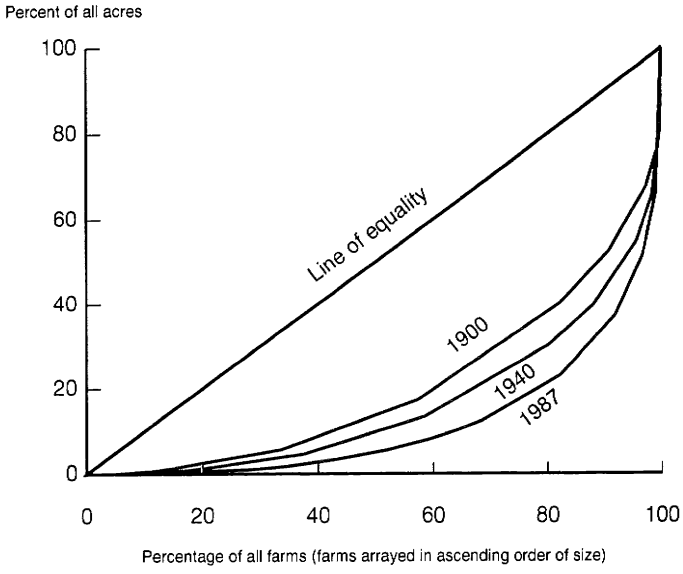
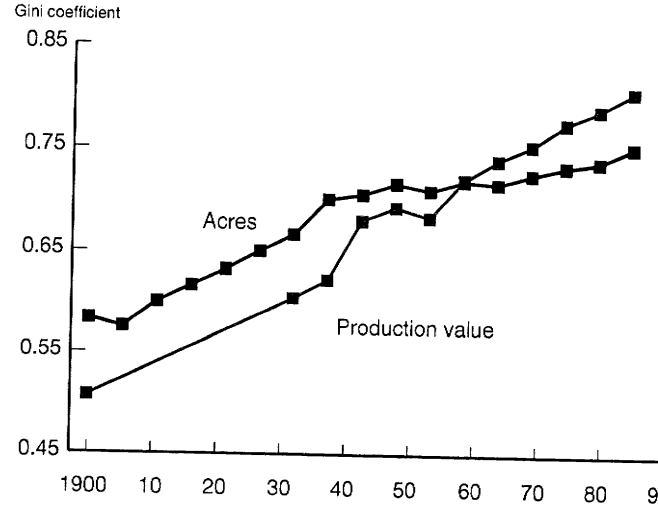


Figure 3

Changing concentration of U.S. farm acreage and product sales

Gini coefficients show that acreage concentration paralleled production concentration until World War II, but slowed thereafter as new technologies substituted for land in the production process



century. During the first 40 years, while farm numbers and land in farms increased, these changes meant that the total number of farm acres was redistributed among farms in an increasingly unequal manner. This greater inequality may be seen by comparing the Lorenz curves for 1900, 1940, and 1987, which are progressively moving further and further away from the line of total equality (fig. 2). Increasing inequality can also be seen for all years for which data are available by inspecting the time-path of the Gini coefficient (fig. 3).

As farm numbers dramatically declined after 1935 and the total amount of land in farms basically stabilized, inequality in farm acreage increased. However, the steady rate of increase in acreage inequality from 1900 to 1945 (as measured by the Gini coefficient) slowed after 1950 to about half its former pace. Between 1900 and 1945, the rate of increase in sales inequality essentially paralleled the rate of increase in acreage inequality.

Although the trend in acreage inequality slowed around 1950, the trend in sales inequality did not (fig. 3). Sales inequality continued to grow at basically the same rate. The comparison of these two trend lines with the flattening out of the acreage concentration line after 1945 reflects the widespread adoption of new technologies around that time. The new technologies included chemical fertilizers, hybrid varieties, self-powered machinery, and chemical pesticides as substitutes for land, human labor, and animal power.

Because the trend toward increasing acreage inequality has considerably slowed, the remainder of our analysis focuses on production output and sales, for which increasing concentration continues.

Regional Patterns of Inequality

The previous section's description of national average change conveys little of the complexity of the farm size distribution across the country during the 20th century. The extent of concentration in the different regions of the country varies greatly, at least as widely as the differences seen at the national level in 87 years. Moreover, different regions of the country have followed different courses of development, although all regions have seen increases in farm sector concentration. Figure 4 shows the spatial patterns of concentration at the State level by sales for 1900, 1940, 1969, and 1987.[4]

Several interesting features of concentration are evident from these maps. The most prominent feature is the change in the Southeast between

[4]The Bureau of the Census did not publish sales class information between 1900 and 1940.

1940 and 1969 where seven States went from being among the least concentrated States to being among the most highly concentrated (table 3). Mississippi went from second least concentrated in 1940 to third most concentrated by 1969.

The rapid increase in concentration in the South during this period is mostly attributable to the change from share-cropping and tenant farming to mechanized, owner-operated farms (Beale, 1979). The loss of many of the smallest farms that were consolidated into larger units explains in large part the increase in concentration in the South.

Another prominent feature in the map for 1987 is a broad band of higher concentration along the country's exterior — west coast, east coast, and Sun Belt — and a center of lesser concentration in the western Corn Belt and northern Plains. This striking pattern of high concentration along the coasts reflects several disparate phenomena. Part-time farming within the commuting area of major cities and rapidly growing cities and the rise of manufacturing in rural areas providing off-farm work to small and part-time farmers have increased inequality through growth at the low end of the farm sales class spectrum. These cities are concentrated in the Northeast, the Sun Belt, and the west coast regions.

Another factor that has accentuated inequality is the growth at the high end of the farm sales class distribution. This growth among large farms has accompanied the expansion of irrigation and double-cropping, especially in the West and South.

Rural communities in the western Corn Belt and northern Plains have been less successful than the rest of the country in diversifying their local economies, and major cities in those regions are further apart than in the coastal regions. Thus, the options for part-time farming are fewer in the western Corn Belt and northern Plains. While there is relatively less inequality in these areas, farms there are, on average, larger.

Commodity Inequality

We have looked at concentration at the national and regional levels and in terms of acres and sales. Concentration by commodity is another facet of concentration, and one that helps explain some of the regional patterns observed earlier. For example, some commodities tend to be grown in particular regions. If such a commodity is highly concentrated, then the region where that commodity is primarily grown is also likely to be highly concentrated.

Table 3—Increase in concentration rank, selected States
Concentration dramatically increased in Southeast

State	1940 rank[1]	1969 rank[1]	Difference
Mississippi	47	3	44
Alabama	44	8	36
South Carolina	41	9	32
Georgia	43	15	28
Louisiana	35	10	25
Arkansas	38	14	24
North Carolina	46	24	22

[1]The higher the rank, the lower the level of concentration.

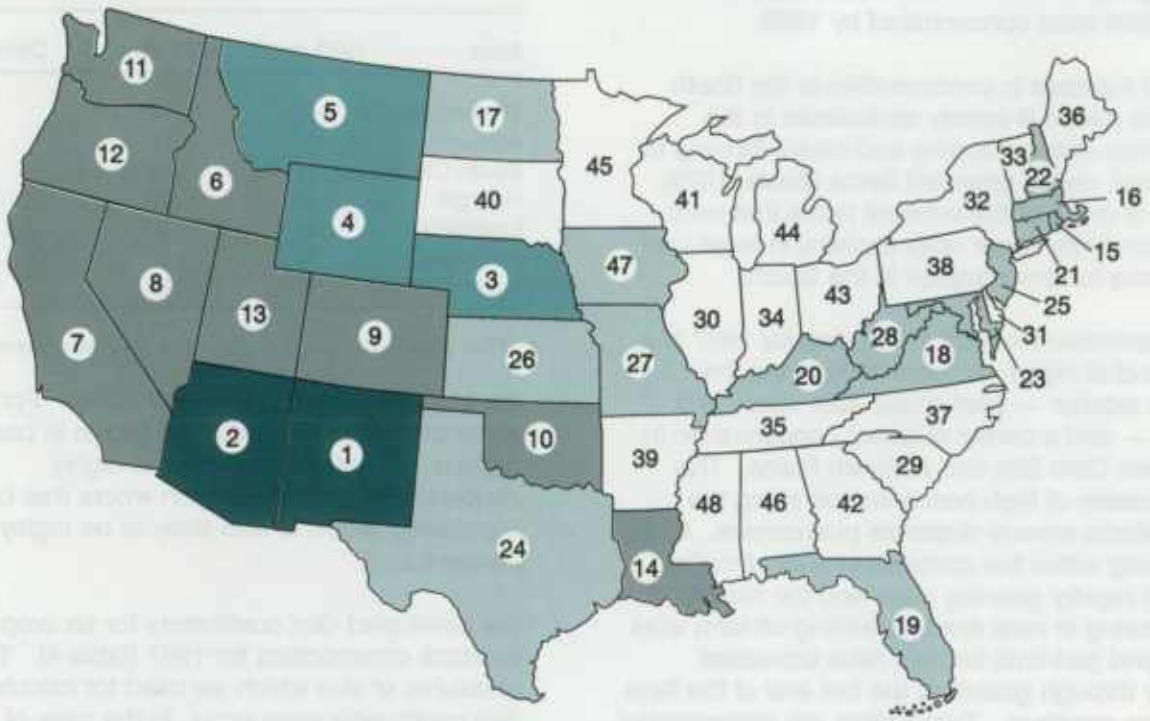
We developed Gini coefficients for six crop and five livestock commodities for 1987 (table 4). The measures of size which we used for calculating the Gini coefficients were acres, in the case of crops, and inventory, in the case of livestock (except broilers, for which we used number sold). Similarities in level of concentration do not imply similarities in the respective industries, however. For example, corn and broilers had roughly equal concentration ratios, yet corn and broilers are starkly different industries. Most poultry farms produce broilers under contract to large processing companies who play a major role in determining farm size and management. In contrast, corn farmers produce relatively little corn under contract and control most of their management decisions.

Soybeans were the least concentrated of the six crops studied, probably because they are grown primarily as a secondary crop in rotation with other crops such as corn, wheat, and cotton. Compared with wheat and corn, there are fewer specialized soybean farms, and overall the diversity of acreage devoted to soybeans is less. Hay and corn were more concentrated than soybeans, and wheat was even more concentrated. But the production of fruits and vegetables was the most concentrated of the crops analyzed. Fruits and vegetables are grown on widely varying sizes of acreage, from very large specialized farms in California and Florida to

Figure 4

The increasing concentration of U.S. agricultural product sales

In 1900, farms were relatively equal in size, especially in the East



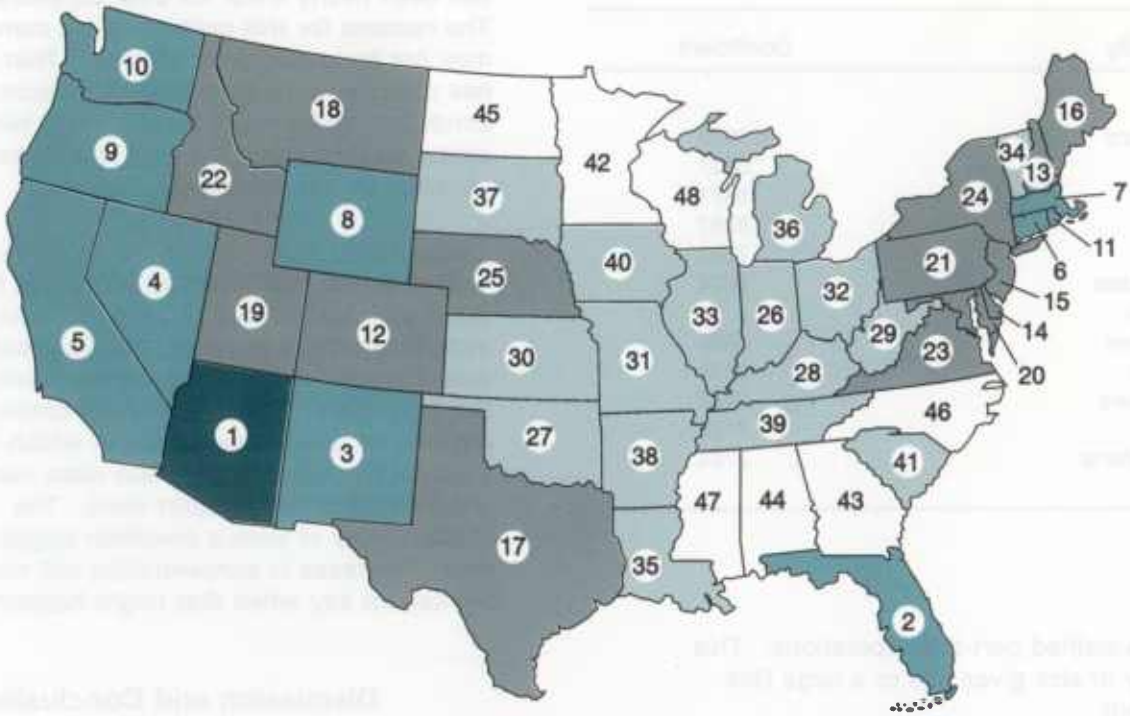
By 1969, concentration had increased in many States, but no other increases were so dramatic as those in the South

Gini coefficient ranges

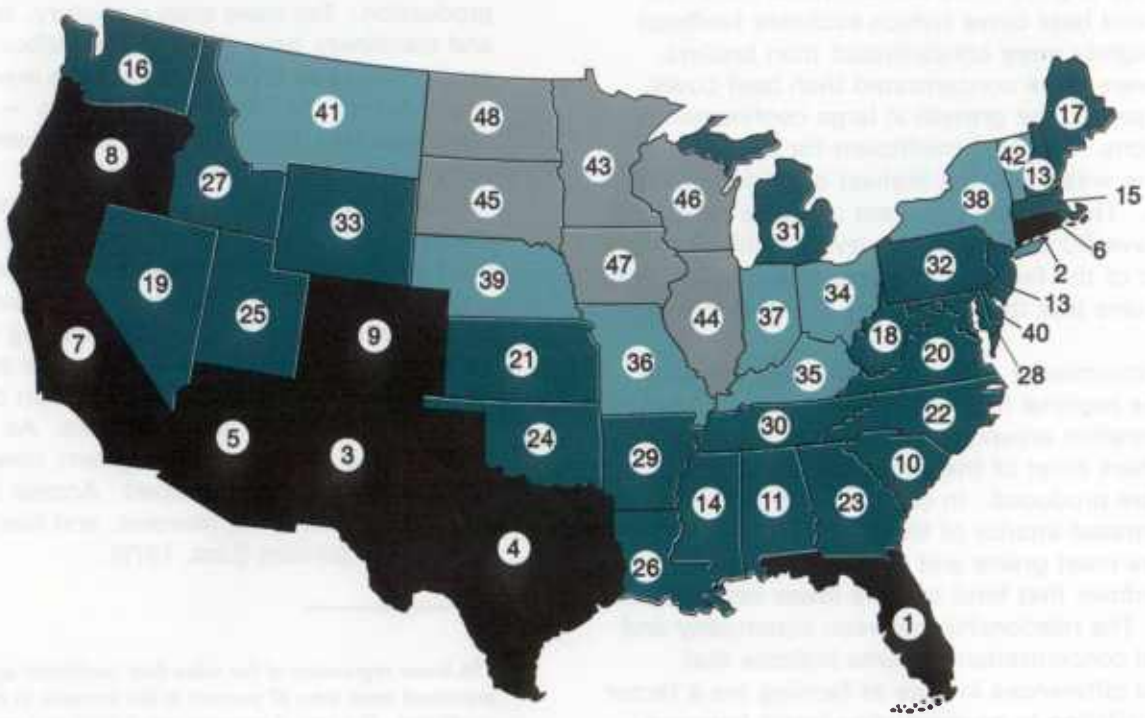
0.35 to 0.45 | 0.45 to 0.55 | 0.55 to 0.65 | 0.65 to 0.75 | 0.75 to 0.85 | 0.85 to 0.95

Least concentrated — Most concentrated

By 1940, concentration had increased somewhat, particularly in the Midwest and Northeast



By 1987, inequality in farm sizes continued to increase, especially in the West and South



Numbers within States indicate ranking from most concentrated (1) to least concentrated (48).

Table 4—Ginicoefficients by commodity, 1987
Relatively few very large farms produce much of the Nation's fruit, vegetables, and eggs

Commodity	Coefficient
Crops:	
Soybeans	0.5589
Corn	.5927
Hay	.5971
Wheat	.6587
Fruits	.7830
Vegetables	.8088
Livestock:	
Milk cows	.5669
Broilers	.5731
Beef cows	.6447
Hogs	.7179
Laying hens	.9794

small diversified part-time operations. This disparity of size gives rise to a large Gini coefficient.

Of the livestock commodities analyzed, milk cows were the least concentrated. Broiler chickens were only slightly more concentrated than milk cows, and beef cows (which excludes feedlots) were slightly more concentrated than broilers. Hogs were more concentrated than beef cows, due in part to the growth in large confinement operations. The Gini coefficient for laying chickens was 0.98, the highest of all commodity groups. The largest 1 percent of farms producing eggs have 60 percent of the layers, while 87 percent of the farms with layers (the smallest flock sizes) have less than 1 percent of the chickens.

These commodity concentration ratios correlate with the regional findings we observed. The high concentration around the exterior of the country is also where most of the vegetable and orchard crops are produced. In contrast, the lesser concentrated interior of the country (the Midwest) is where most grains and cattle are produced, commodities that tend to have lower concentration levels. The relationship between commodity and regional concentration patterns indicate that regional differences in type of farming are a factor in the variation in concentration levels between regions.

Projections to the Year 2000 and Beyond

The increase in the Gini coefficient for farm sales has been nearly linear for over 80 years (fig. 3). The reasons for this constancy are complex and may not be immediately obvious. That this trend has persisted through extremes in economic conditions and a major restructuring within the sector suggests that the past rate of increase will continue for the foreseeable future.

Extrapolating from historic trends gives an expected Gini coefficient of 0.8475 in the year 2000 and 0.9196 in 2020 (fig. 5).[5] At the estimated rate of increase, the Gini coefficient would attain 1.00, the maximum possible value, in the year 2044. This result is not credible, as it requires an agricultural sector in which only the farms in the single largest size class report sales while all other farms report none. The implausibility of such a condition suggests that the rate of increase in concentration will moderate, but we cannot say when that might happen.

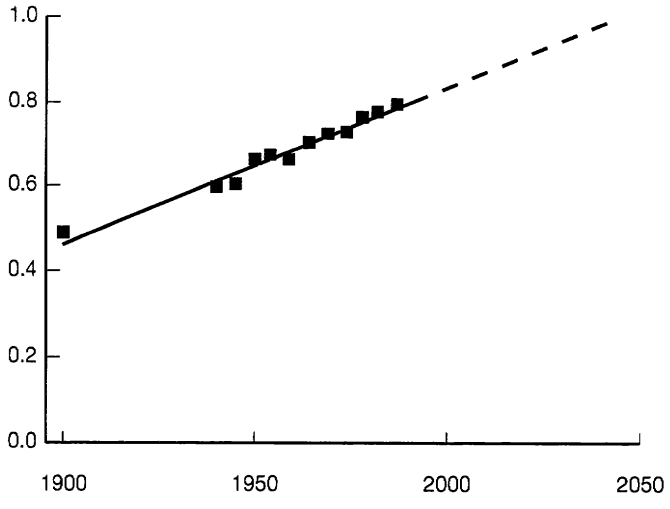
Discussion and Conclusions

A number of forces have contributed directly to increases in the size of U.S. farms and indirectly to the increasing concentration of agricultural production. For more than a century, new tools and machinery have strengthened labor productivity and enabled farmers to manage ever-larger operations. New technologies — especially plant breeding, fertilizer, and other chemicals — have helped improve land productivity. Improved means of transportation have made distant markets accessible, and improved communications have simplified the coordination of large organizations. The development and expansion of farm inputs, processing, and marketing industries have afforded farms new opportunities and choices. New Federal farm programs have been developed during the century to assist farmers. As reliance on credit by the farm sector has grown, new institutions of credit have been developed. Access to credit has not been uniform, however, and has tended to favor larger farmers (Lins, 1979).

[5]A linear regression of the sales Gini coefficient against the year explained more than 97 percent of the increase in the Gini coefficient. The rate of increase was 0.0036 and was significant at the 0.001 level.

Figure 5

Increasing concentration of agricultural product sales
The best-fit trend line of Gini coefficients suggests concentration will continue to increase



Few of these innovations, which led to greater farm sizes, would have also led to greater concentration without the presence of some additional factors. Most important of these factors is the process whereby innovations are adopted and diffused throughout the farm sector. The adoption/diffusion process inevitably entails lags in the timing of adoption by different farmers in different places. As the advantages of innovations accrue mostly to the early adopters, and because larger wealthier farmers are better positioned to adopt new methods and ideas and tools, the process of adoption of innovation has enlarged the production of early adopters while later adopters have lagged behind. The gap between large and small producers has increased in the process and, consequently, concentration has increased. (For a more detailed discussion, see Cochrane and Runge, 1992.)

The extent to which the smallest producers have exited farming disproportionately, such as during the 1950's and 1960's, has tended to offset increases in concentration. But the major reasons for leaving in the past have changed considerably in recent decades. Expanding nonfarm employment opportunities in rural communities have enabled families operating small farms to improve their incomes while continuing to farm. The elimination of substantial differences in the standard of living between urban and rural America has also enticed some to remain on their farms. Although the strength of some of the above-named forces may have abated recently, none are apt to reverse in the near future. These forces, taken together, will continue to move the farm sector in the direction of greater concentration for the remainder of this century and early into the next.

References

Beale, Calvin L. 1979. "Demographic Aspects of Agricultural Structure," *Structure Issues of American Agriculture*. AER-438. U.S. Dept. Agr., Econ. Stat. Coop. Serv.

Blaylock, James R., and William N. Blisard. 1990. *Economic Well-Being and Household Size*. AER-640. U.S. Dept. Agr., Econ. Res. Serv.

Brewster, David. 1979. "Historical Notes on Agricultural Structure" and "The Family Farm: A Changing Concept," *Structure Issues of American Agriculture*. AER-438. U.S. Dept. Agr., Econ. Stat. Coop. Serv.

Carlin, Thomas A. 1990. "Federal Commodity Programs," *The U.S. Farming Sector Entering the 1990's: Twelfth Annual Report on the Status of Family Farms*. AIB-587. U.S. Dept. Agr., Econ. Res. Serv.

Chandler, Alfred D. 1977. *The Invisible Hand*. Cambridge, MA: The Belknap Press of Harvard University.

Cochrane, Willard W., and C. Ford Runge. 1992. *Reforming Farm Policy: Toward a National Agenda*. Ames, IA: Iowa State University Press.

Cowell, Frank A. 1977. *Measuring Inequality*. Oxford, U.K.: Philip Allan Pub. Ltd.

Kakwana, Nanak C. 1980. *Income Inequality and Poverty: Methods of Estimation and Policy Implications*. New York: Oxford University Press.

Lin, William, James Johnson, and Linda Calvin. 1981. *Farm Commodity Programs: Who Participates and Who Benefits*? AER-474. U.S. Dept. Agr., Econ. Res. Serv.

Lins, David A. 1979. "Credit Availability Effects on the Structure of Farming," *Structure Issues of American Agriculture*. AER-438. U.S. Dept. Agr., Econ. Stat. Coop. Serv.

Stanton, B. F. 1978. "Perspectives on Farm Size," *American Journal of Agricultural Economics*, 60(5): 727-37.

U.S. Department of Agriculture, Economic Research Service. 1991. *Economic Indicators of the Farm Sector: Production and Efficiency, 1989*. ECIFS 9-4.

U.S. Department of Agriculture. 1989. *Agricultural Statistics, 1989*.

U.S. Department of Commerce, Bureau of the Census. 1989 (and earlier issues). *1987 Census of Agriculture*.

U.S. Department of Commerce, Bureau of the Census. 1986. *1982 Census of Manufacturers*.