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# Determinants of Farm Size and Structure

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## RECENT CHANGES IN SIZE AND STRUCTURE OF NORTH CENTRAL AGRICULTURE: A STUDY OF SELECTED STATES IN THE NORTH CENTRAL REGION

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The changing structure of American Agriculture has long been an issue discussed by agricultural policy analysts. Structural changes affect opportunities for beginning farmers, the viability of many existing farms, sociological aspects of the rural community, and the cost and availability of food to consumers.

A major change in farm structure began with the end of World War II as many new technologies were used in agriculture. Farmers moved from horsepower to tractor power, and used more hybrid seeds, fertilizers, chemicals, irrigation and more productive livestock. It was expected that there would be fewer farms after the war, but farmers expanded their operations to make the best use of new technologies and farm numbers decreased even more than expected.

In 1979, Secretary of Agriculture Bob Bergland renewed interest in the structure subject by holding nationwide hearings. The event prompted additional studies of the factors affecting the structure of agriculture and the type of structure that might exist in the future. There was support from across the nation for the "family farm."

According to Stanton, structural change during the 1970s and 1980s was still an important issue, but concern was for the proportions of agricultural output that would be produced by different economic classes of farms rather than the decline in farm numbers. Lin, Coffman and Penn illustrate these ideas with the following statistics. In 1969, 80% of the total agricultural output was produced by approximately 655,000 farms (the largest 24%). By 1974, 493,000 farms (the largest 20%) produced the same amount. They estimate that by the year 2000, the 50,000 largest U.S. farms will produce two-thirds of all agricultural output and half of the total agricultural output will come from the largest 1% of the farms.

To examine the factors affecting the structure of agriculture, Baab identified five dimensions of structure. These dimensions are: number and size of farms, specialization, owner control, entry barriers and socioeconomic characteristics. Stanton cites two commonly

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used variables used in studying agricultural structure changes: 1) status of the operator, measured in terms of tenancy (e.g., full-owner, part-owner or tenant) or type of business organization (e.g., family farm or sole proprietor, partnership, or corporation) and 2) farm size distribution measured in terms of acreage or output. Both distribution measures have limitations, but the acreage criterion still indicates the direction of agricultural structure and the sales measurement is largely accepted for the sake of convenience. The U.S. Census of Agriculture provides farm sales figures for the entire U.S. In addition, sales of agricultural output reflects the combined productivity of all factors of production used in farming.

Farm size is commonly measured in acreage and/or value of sales. This dimension can be used to describe the proportion and distribution of all farms within a geographic region. A number of factors influencing farm size are: technology, economies of size, variations in input prices, variations in commodity prices, risk and expectations, price-cost margin, capital requirements, goals of the farmer, managerial ability, foreign demand and exchange rates, and government fiscal and monetary policy.

In this chapter, changes in farm size and structure from 1978 to 1987 are examined for the following eight states in the North Central region: North Dakota, Kansas, Iowa, Illinois, Wisconsin, Michigan, Indiana and Ohio. Distributions of farms by size and structure categories were obtained from the 1978, 1982 and 1987 U. S. Census of Agriculture.

Three definitions of farm size were chosen for examining the size distributions of farms in the selected states. The size definitions include gross value of sales, acreage and market value of machinery and equipment. The U.S. Census categories are summarized in five classes for each size definition as depicted in Table 1. The gross value of sales includes the gross values of all crops, animal and poultry and specialty products sold.

The number of farms in each size category is also shown in Table 1. Based on the sales definition of farm size, the absolute number of farms decreased in each category from 1982 to 1987. However, between 1978 and 1987, the percentage of farms in S2 and S3 decreased, while categories S4 and S5 increased. Likewise, using the acreage definition, the percentage of farms in the largest two categories has increased, but the absolute numbers have only increased for farms larger than 1000 acres. Within the North Central region, the proportions of the smallest farms, based on sales and acreage, has not decreased, while the absolute number has declined.

The only absolute increases in farm numbers, as classified by machinery investment, occurred in the largest two categories between 1978 and 1982. The only proportional increase from 1982 to 1987 was in M2.

Table 1.

**Size Categories and Number of Farms in Eight Selected States  
in the North Central Region.<sup>1</sup>**

	S1	S2	S3	S4	S5
Sales	1 - 10	10 - 20	20 - 100	100 - 250	250+
1978	297.1	113.8	146.5	61.6	13.3
1982	253.7	89.7	136.0	84.9	25.1
1987	237.3	81.0	114.1	77.8	24.1
	A1	A2	A3	A4	A5
Acreage	1 - 100	100 - 220	220 - 500	500 - 1000	1000+
1978	213.3	165.2	167.4	74.6	38.3
1982	221.7	145.1	147.7	73.2	42.0
1987	198.0	127.8	130.8	70.7	45.8
	M1	M2	M3	M4	M5
Mach Inv	1 - 20	20 - 50	50 - 100	100 - 200	200+
1978	282.8	170.9	120.7	67.7	17.2
1982	245.2	153.5	118.3	80.0	30.7
1987	222.2	148.1	106.3	69.0	26.4

<sup>1</sup>All dollar values and number of farms are in 1000s.

Moreover, agriculture's structure does not appear to be moving toward the "bimodal" distribution of farms that was anticipated (McDonald et al.). Tweeten adds that the distribution of farms is skewed and has led to a dual agriculture--a few large farms that account for most of the agricultural output and part-time small operations that account for most of the farms. The size distributions here indicate that while the proportion of very small part-time farms remains constant, there exists a natural growth in the distributions from small to medium to larger farms.

Inappropriate interpretations of changes in farm size and structure may occur if policy makers rely solely on aggregate information. Many of the important changes within regions, states and counties are lost in the national average statistics. To examine changes at the state level, number of farms and size statistics for the eight states are reported in Table 2.

Table 3 includes the percentages of farms raising major grain and livestock products. These statistics indicate the percentage of farm operators who reported raising corn, soybeans, wheat, cattle, dairy cows, beef cows and/or hogs. Information on the business organization and tenure of farms in the eight states is reported in Table 4. Farms are classified as *full owners* if the operator farms only land he/she owns, *part owners* if the farm

includes owned land and rented land and *tenants* if all land is rented or the operator works on shares.

Table 2.

## Total Number and Average Size of Farms for Eight Selected States.

	1978	1982	1987
North Dakota			
number	40,357	36,431	35,289
average acres	1,033	1,104	1,143
Kansas			
number	74,171	73,315	68,579
average acres	640	642	680
Iowa			
number	121,339	115,413	105,180
average acres	274	211	229
Illinois			
number	104,690	98,483	88,786
average acres	282	292	321
Wisconsin			
number	86,505	82,199	75,131
average acres	206	210	221
Michigan			
number	60,426	58,661	51,172
average acres	183	187	202
Indiana			
number	82,483	77,180	70,506
average acres	204	211	229
Ohio			
number	89,131	86,934	79,277
average acres	177	177	189

**Table 3.**  
**Percentage of Farms in Selected North Central**  
**States Producing Grain and Livestock**

	Grain			Livestock			
	Corn	Wheat	Soybeans	Cattle	Dairy	Beef	Hogs
<b>North Dakota</b>							
1978		85		51	12	43	9
1982		80		51	10	43	7
1987		80		49	8	41	7
<b>Kansas</b>							
1978	14	62	22	54	3	42	9
1982	11	67	23	50	2	37	5
1987	13	56	28	47	1	34	5
<b>Iowa</b>							
1978	83	1	65	57	10	37	47
1982	80	2	63	54	9	36	40
1987	79	1	65	47	7	31	35
<b>Illinois</b>							
1978	75	21	70	44	7	30	27
1982	75	29	68	42	6	29	19
1987	75	24	69	38	5	26	19
<b>Wisconsin</b>							
1978	65		5	74	53	18	18
1982	64		7	76	54	18	15
1987	65		7	71	50	14	12
<b>Michigan</b>							
1978	56	23	23	42	16	18	14
1982	52	26	25	44	16	18	13
1987	49	20	25	38	13	16	11
<b>Indiana</b>							
1978	68	24	56	47	9	30	27
1982	65	31	55	48	9	30	23
1983	64	26	57	43	7	27	21
<b>Ohio</b>							
1978	62	36	50	48	14	27	20
1982	61	38	45	49	13	27	16
1987	58	33	46	44	12	24	14

Three types of business organizations are reported in Table 4. *Individual or family operations* are defined as those organizations controlled and operated by an individual. *Partnerships* are only those operations in which an agreement to the shares of contribution and income has been made by two or more partners. *Family corporations* are those corporations in which more than 50% of the stock is owned by related persons. Any other business forms constitute the residual percentage.

The following sections include a discussion of the size distributions of farms in each state and type of farm information. Distributions of farms by size categories are depicted in Figures 1 to 8.

### North Dakota

As shown in Figure 1, 36% of the farms in North Dakota in 1978 had gross sales between \$1,000 and \$10,000. By 1987, only 30% of the farms remained in this smallest sales category. The proportion of farms declined in both S1 and S2 from 1978 to 1982. The increases in sales categories also took place between 1978 and 1982. The \$100,000 to \$250,000 class increased from 7% to 14%, and the \$250,000 and above class from 1% to 3%. Very little change occurred in the sales distribution between the 1982 and 1987 census.

The acreage distribution of farms in North Dakota is uncharacteristic of farms within the North Central region of the U.S. Around 40% of the farms in the state are larger than 1000 acres. This category of farms increased from 38% in 1978 to 43% by 1987. The only other acreage class of farms to increase in size during the nine-year period was A1 (100 to 220 acres).

North Dakota also has a larger percentage of farms with higher levels of investment in machinery and equipment than most other states in the region. More than 50% of the farms have more than \$50,000 invested in machinery and equipment, and about 30% exceed an investment level of \$100,000.

As indicated in Table 3, about 80% of the farms in North Dakota produce wheat and half feed cattle. Most of the farms are individual operations (84% in 1987) while 14% are partnerships. Many of the partnerships include family-operated partnerships. More than 30% of the farms are fully owned by the operator and about 17% are tenant farms. The 50% part-owned farms operate about two-thirds of the acreage.



**Table 4.**  
**Ownership and Tenure of Farms in the Eight North Central States**

	Farms			Proportion of Acres		
	1978	1982	1987	1978	1982	1987
<b>North Dakota</b>						
Full Owner	34	34	32	23	24	19
Part Owner	49	49	50	65	66	67
Tenant	17	17	18	12	11	13
Individual	88	87	88	79	78	78
Partnership	12	12	10	15	14	13
Family Corp.	0	0	1	1	1	1
<b>Kansas</b>						
Full Owner	41	43	44	19	22	19
Part Owner	43	41	41	67	65	66
Tenant	17	16	16	14	13	15
Individual	88	88	88	80	78	78
Partnership	10	9	9	14	13	13
Family Corp.	2	2	3	5	7	7
<b>Iowa</b>						
Full Owner	46	46	46	29	29	25
Part Owner	32	33	33	50	52	55
Tenant	22	21	21	21	19	20
Individual	86	85	85	80	78	79
Partnership	12	11	11	14	13	12
Family Corp.	2	3	4	5	7	7
<b>Illinois</b>						
Full Owner	42	44	44	21	22	19
Part Owner	36	36	37	57	59	60
Tenant	22	20	19	22	20	20
Individual	86	85	85	79	78	78
Partnership	13	12	12	17	16	16
Family Corp.	1	2	2	3	4	5

**Table 4.**  
**Ownership and Tenure of Farms in the Eight North Central States**  
**(continued)**

	Farms			Proportion of Acres		
	1978	1982	1987	1978	1982	1987
<b>Wisconsin</b>						
Full Owner	62	59	58	47	43	41
Part Owner	31	32	33	46	49	51
Tenant	7	9	8	7	7	7
Individual	88	86	86	81	77	77
Partnership	10	11	11	13	15	15
Family Corp.	2	2	3	5	7	8
<b>Michigan</b>						
Full Owner	61	60	61	39	36	34
Part Owner	32	33	33	56	59	61
Tenant	6	6	6	6	5	5
Individual	89	89	88	80	77	76
Partnership	9	9	9	16	17	18
Family Corp.	1	1	2	3	4	5
<b>Indiana</b>						
Full Owner	57	57	58	31	30	28
Part Owner	31	32	31	57	59	60
Tenant	12	11	11	13	11	12
Individual	86	85	85	77	75	75
Partnership	12	12	11	17	16	15
Family Corp.	2	3	4	6	8	9
<b>Ohio</b>						
Full Owner	59	60	59	37	36	34
Part Owner	29	29	29	51	53	55
Tenant	12	11	11	12	11	12
Individual	86	86	86	79	77	77
Partnership	12	12	11	17	17	17
Family Corp.	1	2	2	3	4	5

## North Dakota

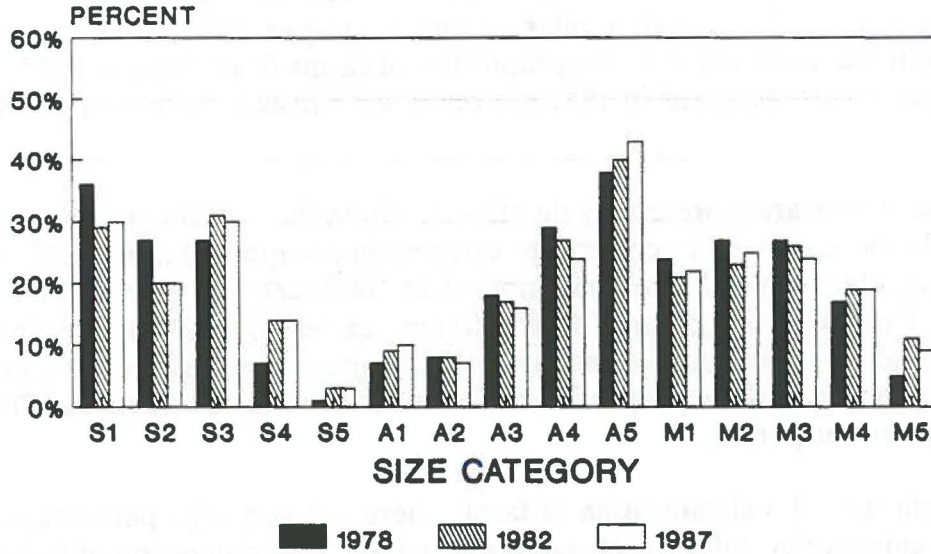


Figure 1. Distribution of farms in North Dakota by gross value of sales, acreage and value of machinery and equipment size categories.

## Kansas

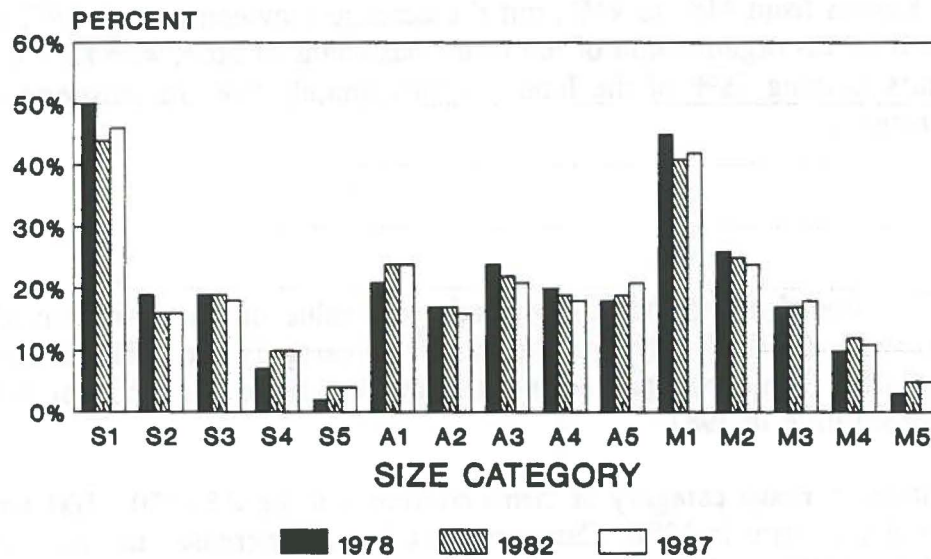


Figure 2. Distribution of farms in Kansas by gross value of sales, acreage and value of machinery and equipment size categories.

**Kansas**

The distribution of farms in Kansas (Figure 2) is characterized by approximately 45% of the farms in the smallest sales category (\$1,000 - \$10,000). In 1987, 15, 18, 10 and 4% of the farms were in the next four sales categories, respectively. Only the smallest sales category exhibited an increase in the proportion of farms from 1982 to 1987. The largest two sales size groups increased in 1982 but remained constant between the 1982 and 1987 census.

Kansas farms are more evenly distributed within the acreage size classes than farms in most of the other states. Each acreage category holds approximately 20% of the farms. Only farms smaller than 100 acres and larger than 1000 acres have increased in proportion since 1978. The proportion of small farms (S1) increased from 21% to 23% between 1978 and 1982, while the percentage of the largest farms grew from 18% to 21% between 1978 and 1987. Reductions in the proportion of farms occurred in the three middle size classes during the nine-year period.

As with the sales classification of farms, there is a very high percentage of farms in the smallest category by dollars invested in machinery. The proportion of farms in the two smallest categories (M1 and M2) decreased 2 to 3%, while the percentages in the three largest categories increased 2 to 3% from 1978 to 1987.

The predominate crop grown on Kansas farms is wheat, while the number of farms growing soybeans has increased from 22% to 28% since 1978. The number of farms which produce livestock has declined. In 1978, 54% fed cattle, down to 47% in 1987. Likewise, beef cow farms have diminished from 42% to 34%. The percentage of fully owned farms increased in Kansas from 41% to 44%, but the acreage they control was 19% of the total in 1987. The business organization of the farms has changed little, with 88% organized as individual units farming 78% of the land. Approximately 9% are partnerships and 3% family corporations.

**Iowa**

In 1978, 31% of the farms in Iowa had gross value of sales between \$20,000 and \$100,000 (Figure 3). By 1987, only 25% were in the S3 category and 30% had sales between \$1,000 and \$10,000. The two largest sales categories increased in proportion from 1978 to 1982, but changed little in 1987.

The largest acreage category of farms continues to be A3 (220 - 500 acres), which included 31% of the farms in 1987. Categories A4 and A5 increased in size, while A2 and A3 decreased from 1976 to 1987. Between 1982 and 1987, all but the smallest two classes of farms, by value of machinery and equipment, decreased in size. In these latter five years, there seems to be a decreased investment in machinery.

### Iowa

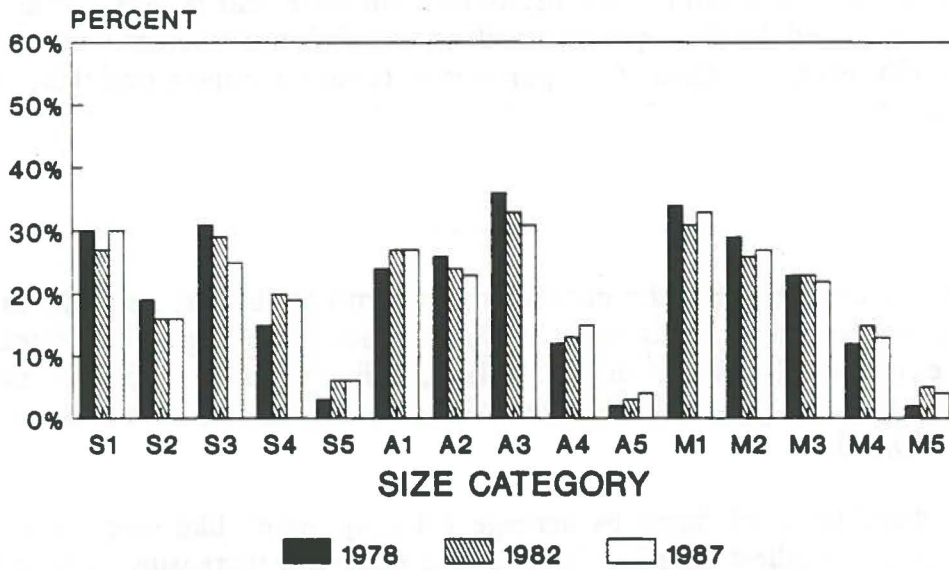


Figure 3. Distribution of farms in Iowa by gross value of sales, acreage and value of machinery and equipment size categories.

### Illinois

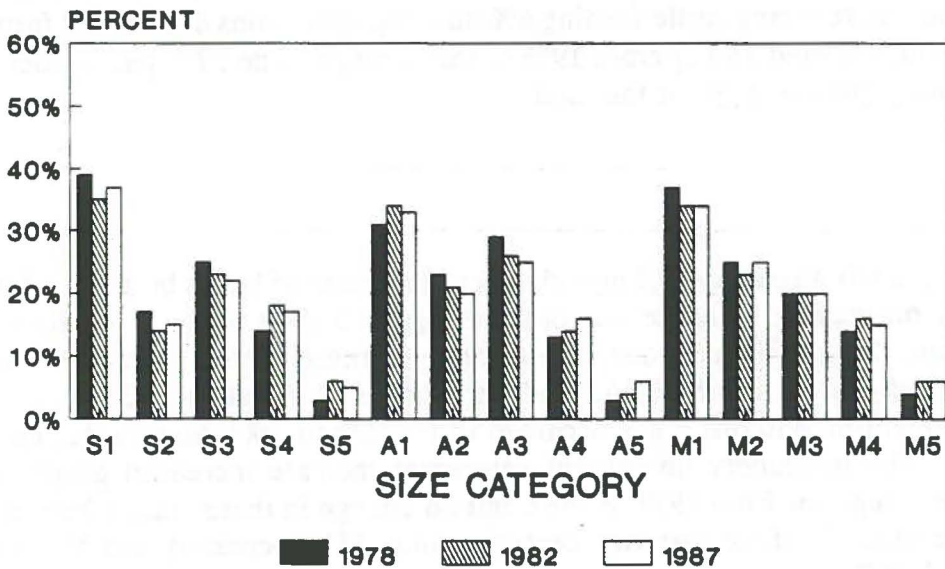


Figure 4. Distribution of farms in Illinois by gross value of sales, acreage and value of machinery and equipment size categories.

Corn and soybean farms predominate in Iowa. The proportion of farms producing livestock has decreased significantly since 1978. The tenure and business organization of farms in Iowa have remained fairly constant over the nine-year period. Of all Iowa farms, 45% are fully owned by the operator and about 85% are operated as sole individual businesses. However, one-third of the part owner farms have increased their share of land from 50% to 55%.

### **Illinois**

Figure 4 indicates that the distribution of farms in Illinois is similar to Iowa's, but with a larger percentage of farms in the smallest classes. Like most other states, the S1 and S2 categories increased in size from 1982 to 1987, while groups S3 to S5 decreased. In 1987, 37% of the farms had gross sales less than \$10,000, and for 4% of the farms, gross sales exceeded \$250,000.

The distribution of farms by acreage category, much like sales, includes a large proportion of the smallest farms (~32%) and a small but increasing proportion of large farms. As in Iowa, the two largest categories are increasing in size and categories A2 and A3 are decreasing.

The proportion of farms in M2 increased by 4% and M4 decreased by 4% from 1982 to 1987. All other machinery investment categories remained constant in the two most recent years.

Illinois farms remain primarily corn and soybean production units, with about 25% of the farms also producing wheat. More and more Illinois farms are also specializing in grain production, reducing cattle feeding 6% and hog operations 8%. Of all farms, 44% are classified as fully owned and operate 19% of the acreage. The 37% part owner farms have increased their share to 60% of the land.

### **Wisconsin**

Wisconsin is an example of how changes in number of farms by gross sales categories can be very misleading. The census data in Figure 5 show large reductions in the two smallest farm classes (S1 and S2) and a large increase in S4. However, the acreage distribution indicates a decline in A2 and only modest increases in A3 and A4 from 1978 to 1982. Growth in Wisconsin has occurred in the 220 to 1000-acre range, but not above 1000 acres. The machinery investment categories indicate increased proportions in the largest three categories from 1978 to 1982, but no change in these classes between the 1982 and 1987 census. In these last two census counts, M1 decreased and M2 increased by approximately 2%.

## Wisconsin

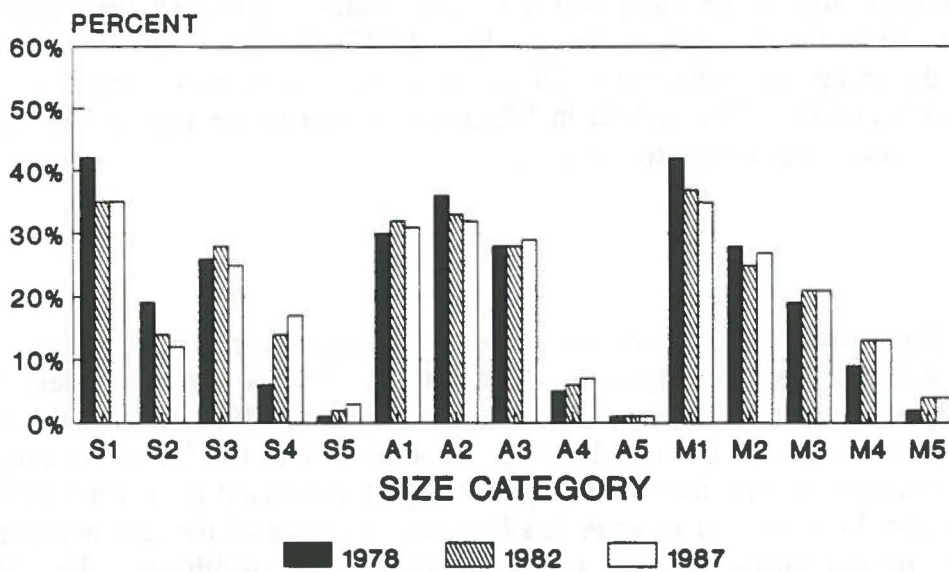


Figure 5. Distribution of farms in Wisconsin by gross value of sales, acreage and value of machinery and equipment size categories.

## Michigan

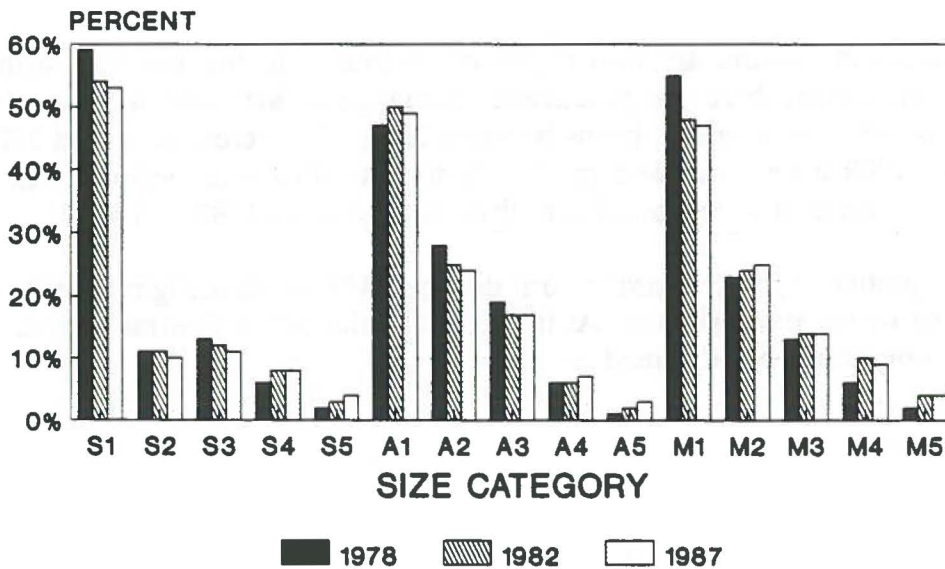


Figure 6. Distribution of farms in Michigan by gross value of sales, acreage and value of machinery and equipment size categories.

Of the three major crops listed in Table 3, corn is produced on 65% of the Wisconsin farms and soybeans on only 7%. The proportion of farms producing livestock in Wisconsin is the highest of any of the eight North Central states. Although the percentages have declined, in 1987 71% of the farms fed cattle and 50% produced milk. Wisconsin also has a high but declining ownership rate. Of all farms, 62% were fully owned in 1978, 59% in 1982 and 58% in 1987. The growth in Wisconsin is also in the part owner farms with an increase in acreage from 46% to 51%.

### **Michigan**

Michigan has the highest concentration of farms in the smallest categories S1, A1 and M1 of any of the eight states (Figure 6). Of all farms, 53% had gross sales less than \$10,000 in 1987 and just fewer than 50% were less than 100 acres. In 1978, 58% of the census farms had gross sales between \$1,000 and \$10,000. Around 20% of the farms were in the \$10,000 to \$100,000 categories and the \$250,000 plus category increased from 2% to 4%. Only the largest category by sales and acreage has increased in each of the last two census counts. About 50% of the farms invested less than \$20,000 in machinery. The M1 category decreased 8% during the nine years, whereas M2 through M5 increased.

In 1987, about half of the Michigan farms produced corn, 20% produced wheat and 25% produced soybeans. Michigan has the highest full ownership and the lowest tenant rates at 61% and 6% respectively in 1987. However, in 1987 61% of the land was controlled by part owners.

### **Indiana**

Numbers in Indiana are also highly concentrated in the smallest farm categories (Figure 7). Moreover, there was practically no change in farm size, by sales classification, from 1982 to 1987. By acreage, farms between 220 to 500 acres decreased 2% and farms greater than 1000 acres increased by 2% during the nine-year period. The machinery investment categories also exhibited very little change from 1982 to 1987.

The number of farms growing corn declined 4%, while a slightly larger percentage are producing wheat and soybeans. As in the rest of the North Central region, the number of livestock operations has declined.



## Indiana

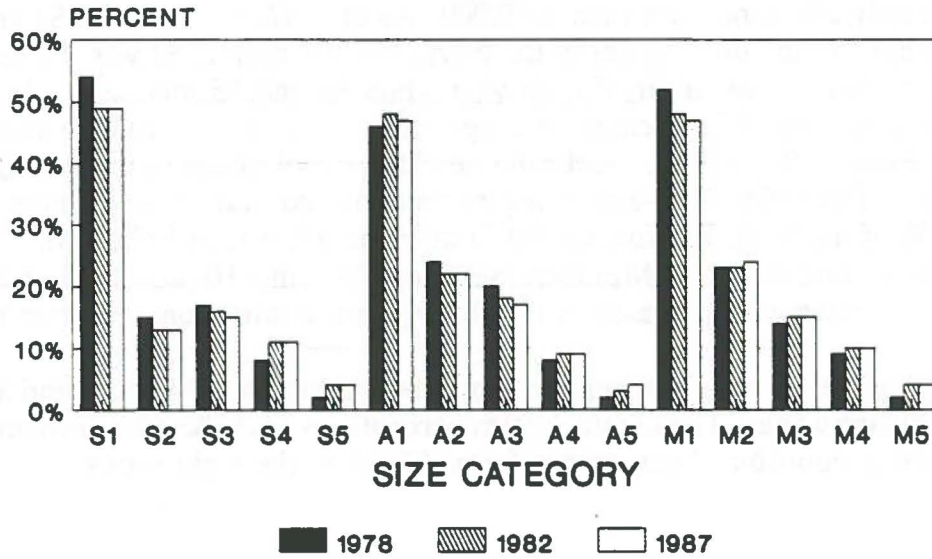


Figure 7. Distribution of farms in Indiana by gross value of sales, acreage and value of machinery and equipment size categories.

## Ohio

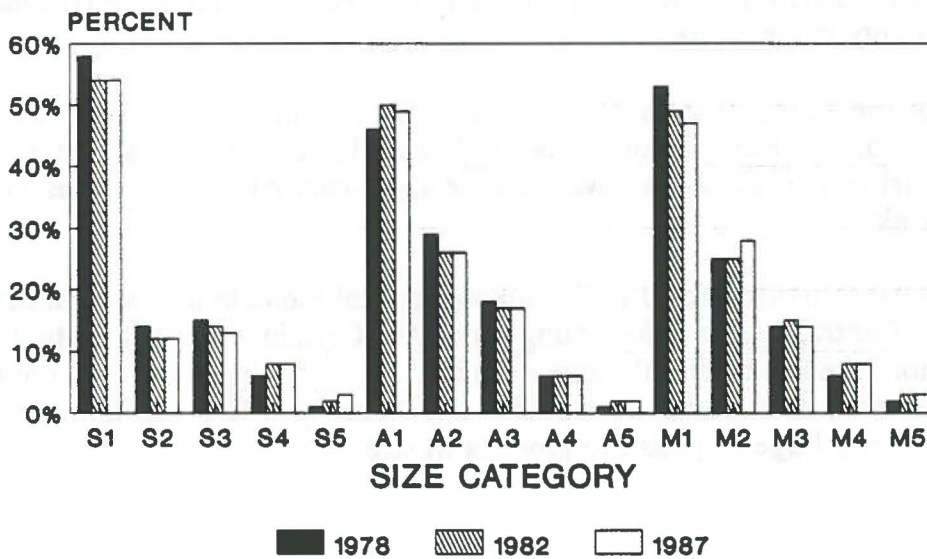


Figure 8. Distribution of farms in Ohio by gross value of sales, acreage and value of machinery and equipment size categories.

## Ohio

As shown in Figure 8, 57% of the farms in Ohio in 1978 had gross sales less than \$10,000 and only 2% were more than \$250,000. As of 1987, 54% were in S1 and 4% in S5. As noted in most of the other states in the North Central region, S3 was the second largest sales category, but S3 has declined each year while S4 and S5 increased. In the acreage classifications, A1 and A5 increased in proportion, from 1976 to 1982, while A2 and A3 decreased. From 1982 to 1987, practically no change took place in the acreage classifications of farms. The 500 to 1000-acre category remained constant over the nine-year period. In Ohio, 53% of the farms had investment in machinery less than \$20,000 in 1978 and 47% in 1987. The second category (M2) increased from 24% in 1978 and 1982 to 27% in 1987. The two largest categories increased in 1982 but remained fairly constant from 1982 to 1987.

Ohio has seen a 4% reduction in farms growing corn and soybeans and a 3% decline in those producing wheat. The livestock farm percentages have likewise declined. Ohio also has the lowest proportion of part owner farms (29%) in the eight states.

## Conclusions

The size of farms and structure of agriculture varies somewhat from state-to-state. North Dakota has the largest farms, as classified by acreage and Ohio the smallest. The acreage distribution of farms in North Dakota is skewed to the left while the distribution of farms based on value of machinery and investment has changed toward a uniform distribution. In contrast, all of the size distributions in Ohio are skewed to the right and the number of small part-time farms has changed little while the largest farms have grown in number at a very modest rate.

All of the states have exhibited a disinvestment in livestock diversification as the proportion of farms which produce livestock has declined in each year. Increases in acres farmed by part owner operators have increase significantly in all the states except Kansas and North Dakota.

The distribution depicted in the chapter do not indicate that agriculture's structure in the North Central region is becoming bimodal. Certainly the distribution of output is becoming more skewed in that the largest farms are producing a larger percentage of that output. However, that would be true for any industry where the number of plants is decreasing but the largest plants are growing in size.

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