Chapter 3
Rapid Growth in Land Concentration

This chapter uses statistics from the census of agriculture to show how different land-based measures of farm size and concentration have changed over time. Taken together, the measures indicate large structural changes over the past quarter century. The weighted-median farm size is chosen as a measure of concentration because it provides a clearer indication of concentration change than median or mean farm size.[5]

Many different variables can be used to measure farm size, including farmland or cropland acreage, sales, value of production, and net returns. The focus of this study is on the effects of commodity program payments. To minimize the influence of changes in the size of noncrop enterprises, particularly livestock, the empirical analyses in this and the next chapter use farmland and cropland acreage to measure farm size. Acreage is less likely to be related to changes in past payments than are measures based on sales, value of production, and net returns, which depend on prices and yields and could be correlated with commodity program payments. For example, if payments were correlated with prices or yields, then even though past payments are exogenous to current sales, past payments would not be exogenous to past sales and this could cause a spurious correlation between past payments and the change in sales. Acreage-based measures, unlike sales-based measures, do not need to be deflated for changes in prices in order to make comparisons over time. Also, using land-based measures avoids ambiguity about how to compare prices (e.g., producer price index versus consumer price index).[6] Land-based measures of size do miss farm size growth occurring on livestock farms, some of which have grown markedly in animals managed without simultaneously increasing acreage. But since our primary focus is on farms receiving commodity payments, this actually clarifies the analysis.

This chapter provides a broad overview of structural change for all farms, so farmland is used as the variable of analysis. In the next chapter, which examines the correlation between payments and land concentration, cropland is used rather than farmland because cropland does not include pasture and rangeland and better corresponds to the land targeted by program payments.

Between 1982 and 2002, farms operating at least 1,000 acres of farmland and farms operating fewer than 50 acres increased in number, while farms operating 50 to 999 acres declined in number (table 2).[7] Most of the shifts in land were from farms operating 150-999 acres to farms operating 1,000-9,999 acres. Farms operating 1,000-9,999 acres increased their share of total farmland from 34.0 to 41.8 percent. The expansion of these large farms contrasts with farms operating 150-499 acres, whose share of total farmland declined by 4.5 percentage points, and with farms operating 500-999 acres, whose share declined by 2.5 percentage points.

Using harvested acreage instead of total farmland illustrates how production has become concentrated on large farms for seven major field crops. For every major field crop in every census year from 1987 to 2002, the share of land harvested by farms harvesting more than 1,000 acres increased (fig. 1). For example, in 1987, 4.6 percent of land harvested in corn was harvested

[5] In this study, the term concentration refers to the phenomenon of agricultural production or land shifting to fewer and larger operations—the term should not be confused with the concept of oligopoly or market power, where a few large firms are able to influence the market price. The measure of land concentration (the weighted-median land size) is distinct from the USDA-NASS (National Agricultural Statistics Service) concentration measure: the percent of farms that, when ordered from largest to smallest, cumulatively account for 50 percent of sales.

[6] Prices for agricultural inputs and commodities have not increased as much as consumer prices. The share of sales going to farmers' out-of-pocket production costs may be best deflated by producer prices, while farmers' wages (returns net of costs) may be best deflated by the consumer price index. It is difficult to determine the appropriate share of sales that should be deflated by producer versus consumer price indices. Difficulties are compounded by the fact that producer and consumer prices vary over location, time, and type of operation, and tend to be poorly measured for small geographic areas.

[7] Farmland is defined by the census as the quantity of farmland owned plus farmland rented in minus farmland rented out.

Table 2
Farmland operated and number of farms by farm size, 1982-2002

Farm size	1982	1987	1992	1997	2002	Change 1982-2002
0-49 acres						*Percent*
Farmland (million acres)	12.70	11.61	10.87	11.46	15.52	22.1
(Percent of total)	(1.33)	(1.25)	(1.19)	(1.27)	(1.66)	24.4
Farms	629,962	588,632	546,955	556,330	738,113	17.2
(Percent of total)	(28.45)	(28.57)	(28.81)	(29.54)	(34.77)	22.2
50-149 acres						
Farmland (million acres)	52.38	47.49	43.14	43.92	49.18	-6.1
(Percent of total)	(5.49)	(5.10)	(4.73)	(4.88)	(5.25)	-4.4
Farms	571,330	517,388	470,880	482,340	548,062	-4.1
(Percent of total)	(25.81)	(25.11)	(24.81)	(25.61)	(25.82)	0.0
150-499 acres						
Farmland (million acres)	179.05	162.62	144.85	136.33	133.45	-25.5
(Percent of total)	(18.78)	(17.47)	(15.88)	(15.16)	(14.26)	-24.1
Farms	656,800	595,808	530,961	502,820	498,524	-24.1
(Percent of total)	(29.67)	(28.91)	(27.97)	(26.69)	(23.48)	-20.8
500-999 acres						
Farmland (million acres)	138.12	136.15	126.99	119.93	112.38	-18.6
(Percent of total)	(14.48)	(14.63)	(13.93)	(13.34)	(12.00)	-17.1
Farms	200,601	196,705	183,207	172,660	161,450	-19.5
(Percent of total)	(9.06)	(9.55)	(9.65)	(9.17)	(7.60)	-16.1
1,000-9,999 acres						
Farmland (million acres)	324.04	335.80	349.88	365.12	390.88	20.6
(Percent of total)	(33.98)	(36.08)	(38.37)	(40.61)	(41.76)	22.9
Farms	147,615	154,535	158,492	162,223	168,730	14.3
(Percent of total)	(6.67)	(7.50)	(8.35)	(8.61)	(7.95)	19.2
10,000+ acres						
Farmland (million acres)	247.27	237.13	236.16	222.41	234.68	-5.1
(Percent of total)	(25.93)	(25.48)	(25.90)	(24.73)	(25.07)	-3.3
Farms	7,641	7,492	7,739	7,218	8,096	6.0
(Percent of total)	(0.35)	(0.36)	(0.41)	(0.38)	(0.38)	10.5
Total farmland (million acres)	953.56	930.80	911.87	899.16	936.08	-1.8
Total farms	2,213,949	2,060,560	1,898,234	1,883,591	2,122,975	-4.1

Source: Census of agriculture. Farmland is defined in the census as the quantity of land owned plus land rented in minus land rented out.

Table 3
**Representative farm size, various measures, 1982-2002**

Measure	1982	1987	1992	1997	2002	Change 1982-2002
			Acres			*Percent*
All farms						
Mean	430.7	451.7	480.4	477.4	440.9	2.4
Median	122	125	125	120	95	-22.1
Weighted mean	48,955	46,998	51,742	95,482	95,945	96.0
Weighted median	1,620	1,700	1,925	2,000	2,190	35.2
Farms < 10,000 acres						
Mean	321.4	339.3	359.5	362.5	333.7	3.9
Median	121	125	125	120	94	-22.3
Weighted mean	1,776.8	1,831.5	1,957.6	2,035.9	2,144.8	20.7
Weighted median	864	954	1054	1143	1225	41.8

Source: Census of agriculture.

Figure 1
**Share of harvested acreage in large farms
(at least 1,000 harvested acres of commodity)**

Percent of harvested acreage
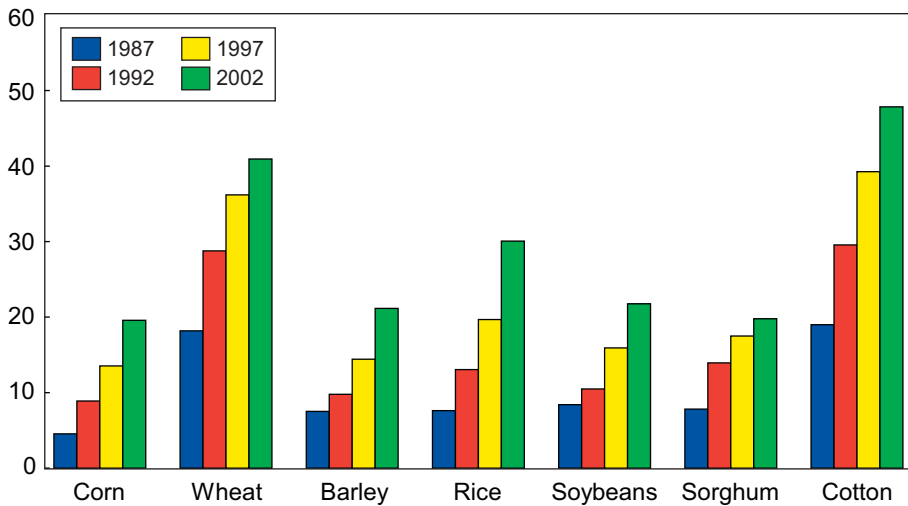
by these large farms, increasing to 9.0 percent in 1992, 13.7 percent in 1997, and 19.8 percent in 2002.

Mean and median farm size can be misleading indicators of concentration when the distribution of farm size is heavily skewed. This is illustrated in table 3, which presents four measures of average farm size by farmland size category from 1982 to 2002. To illustrate the influence on the statistics of very large operations, the table presents these statistics both for all farms (top half of the table) and for farms with fewer than 10,000 acres (bottom half of table). For all farms, the mean farm size increased slightly from 430.7 acres in 1982 to 440.9 acres in 2002. However, the median farm dropped from 122 to 95 acres of farmland, reflecting an increase in the number of small farms.

To characterize land concentration, the acre-weighted mean and acre-weighted median have advantages over the mean or median (see box, "Measures of Land Concentration"). The acre-weighted mean farm size averages farm sizes over acres rather than over farms. The acre-weighted median is the size of a farm such that half of all farmland is operated by larger farms and half by smaller farms. The weighted mean and weighted median are much larger than the unweighted averages, reflecting the fact that large farms operate most of the farmland. For all farms, the weighted mean almost doubled between 1982 and 2002, while the weighted median increased by 35 percent. The weighted median indicates that in 1982, half of all farmland was operated by farms larger than 1,620 acres. By 2002, half of all farmland was operated by farms having at least 2,190 acres.

Farms with more than 10,000 acres operate about 25 percent of U.S. farmland but represent only 0.4 percent of all farms. Most land on farms with more than 10,000 acres is range, pasture, and woodland, and generally of much lower quality than land on farms with less than 10,000 acres. Separate measures for farms with less than 10,000 acres (the bottom half of table 3)

Mean and median farm size can be poor indicators of agricultural concentration. To see why, consider the hypothetical example illustrated below. Suppose there are initially four medium-sized farms and two of these farms consolidate to make one farm equal in size to the two former farms. And suppose that one medium-sized farm is simultaneously split into two smaller farms. In the left panel, before the change, each of four farms cultivates 10 acres; in the right panel, the largest farm operates 20 acres and the smallest two operate 5 acres each.
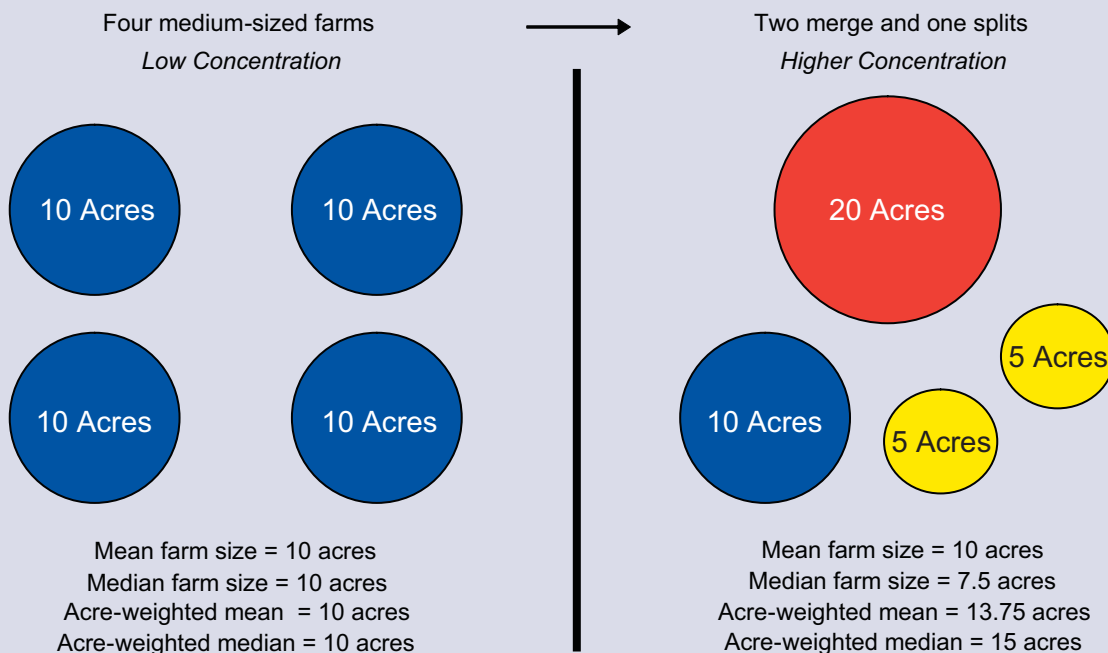
Now consider the different ways one might measure the size of a typical farm in each panel. The mean farm size is 10 acres in both panels: each has a total of 40 acres divided by 4 farms. The median farm is the farm for which half are smaller and half are larger. In the first panel, median farm size is 10 acres, because all farms are that size. In the second panel, half the farms are 10 acres or larger and half are 5 acres or smaller so the median farm is 7.5 acres. These measures seem to belie the rather large change that has taken place. One of four farms controls half the land in the second panel, whereas it is equally divided in the first panel. Land concentration, if not median or mean farm size, would seem to have increased.

Now consider the acre-weighted median. This measure is calculated by ordering farms from smallest to largest and picking the farm size at the middle acre (unlike the regular, unweighted median, which is the middle farm). In the second panel, half the acres are on a 20-acre farm and half are on farms 10 acres or less, so the acre-weighted median is the farm size in-between 10 and 20, or 15 acres. The increase in the acre-weighted median from 10 to 15 acres better reflects the increase in concentration taking place between the first and second panels of the figure than does the mean or median. The acre-weighted median is used in the ZIP Code analysis (next chapter) in this report.
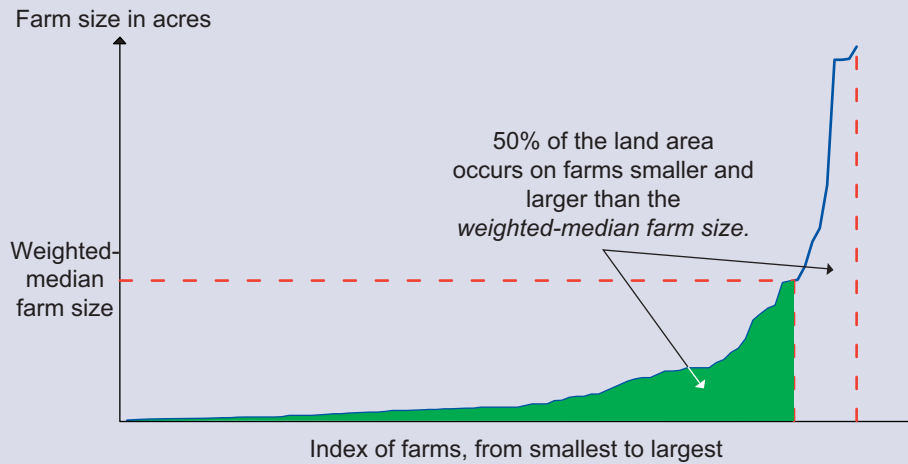
This simple example is similar to what has actually occurred in U.S. agriculture. Production has shifted to larger farms, while the relative number of small farms has increased at the same time. The observed increase in the number of small farms can be partly attributed to how a farm is defined. The definition of a farm plays an important role in determining the mean and median farm size, as well as the number of farms.

The USDA defines a farm as "any place from which $1,000 or more of agricultural products (crops and livestock) were sold or normally would have been sold during the year under consideration" (USDA, 1997).

Measures of land concentration

Four medium-sized farms
Low Concentration

Two merge and one splits
Higher Concentration

Mean farm size = 10 acres
Median farm size = 10 acres
Acre-weighted mean = 10 acres
Acre-weighted median = 10 acres

Mean farm size = 10 acres
Median farm size = 7.5 acres
Acre-weighted mean = 13.75 acres
Acre-weighted median = 15 acres

Weighted-median farm size

Farm size in acres

50% of the land area occurs on farms smaller and larger than the *weighted-median farm size.*

Weighted-median farm size

Index of farms, from smallest to largest

Note: The farms depicted are 100 farms chosen randomly from the 2002 Census of Agriculture to illustrate the acre-weighted median farm size.

This definition includes many small operations for which farming contributes only a small share of farm household income. The $1,000 figure has remained unchanged since the 1974 census, so inflation has effectively increased the number of small operations that qualify as farms. Other changes in the definition may have also increased the count of small farms.[1]

The concentration measure used in this study, the acre-weighted median, is less sensitive to how a farm is defined than is the mean or median. This is because adding or dropping a large number of very small farms changes the total number of acres by only a small amount. Hence, the farm size associated with the "middle acre" changes very little.

Another possible measure is the acre-weighted mean farm size, which effectively averages farm sizes over acres rather than over farms. It can be interpreted as the farm size associated with an "average" acre. In the first panel of the example, this measure also equals 10 acres, but is 13.75 acres in the second panel.[2] Like the acre-weighted median, this statistic is more representative of the farm size associated with a typical acre farmed, and is less susceptible to changes in the number of very small farms caused by changes in the definition of a farm or enumeration techniques.

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[2]In calculating the standard mean, each farm is weighted equally (in this example each farm has a weight of ¼), so mean = 5*1/4 + 5*1/4 + 10*1/4 + 20*1/4 = 10. For the weighted mean, each farm is weighted by its share of land in total acres, so weighted mean = 5*5/40 + 5*5/40 + 10*10/40 + 20*20/40 = 13.75.

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[1]Beginning in 1997, maple syrup and Christmas tree sales qualified as part of the $1,000 sales threshold. For details on these changes, see http://agcensus.mannlib.cornell.edu/general.php.

show similar patterns for the mean, median, and weighted-median measures, but the weighted mean, which is more sensitive to outliers, differs from the trend for all farms. For farms with less than 10,000 acres, the weighted mean increased by 20.7 percent between 1982 and 2002.

How Have Commodity Program Payments Changed Over Time?

Commodity program payments (see box, "Defining Commodity Program Payments") per farm are closely associated with farm size in all census years from 1987 to 2002. Mean program payments per farm increase with farm size class up to 10,000 acres of farmland (table 4). In 2002, the median payment for farms operating 1,000-10,000 acres was $9,738— almost three times the median payment for farms operating 500-1,000 acres, and about 200 times the median payment for farms with 150 to 500 acres of farmland. For some census years, very large farms operating more than 10,000 acres actually received lower program payments per farm than farms operating 1,000-10,000 acres. A smaller portion of land managed by these very large farms is cultivated with crops normally targeted by commodity programs. Farmland as defined by the census includes pasture, range, woodland, and other land, some of which is not actively used in farm production activities.

Large farms receive an increasingly large share of program payments. The share of payments going to farms with 1,000-10,000 acres increased from 41.1 percent of all payments in 1987 to 49.5 percent in 2002. During the same period, farms with 150-1,000 acres received a smaller share of total payments, while farms with fewer than 150 acres received an increasing share (from 4.1 percent to 7.6 percent in 2002), reflecting their growing numbers. Still, over half of all farms with less than 150 acres receive no commodity program payments—a fact that has not changed since 1987. The share of payments going to farms operating more than 10,000 acres also increased over time (table 4).

Table 4
Commodity program payments by farm size category, 1987-2002

Farm size and payments	1987	1992	1997	2002	Change 1987-2002
0-50 acres					*Percent*
Mean payments ($)	182	108	183	227	24.4
Median payments ($)	0	0	0	0	0.0
Total payments ($ million)	107	59	102	127	18.6
(Percent of total)	(0.7)	(0.9)	(1.8)	(1.9)	171.6
50-150 acres					
Mean payments ($)	981	438	632	812	-17.2
Median payments ($)	0	0	0	0	0.0
Total payments ($ million)	508	206	305	373	-26.6
(Percent of total)	(3.4)	(3.2)	(5.5)	(5.7)	68.2
150-500 acres					
Mean payments ($)	6,262	2,389	2,390	2,904	-53.6
Median payments ($)	0	0	0	43	-
Total payments ($ million)	3,731	1,269	1,202	1,330	-64.4
(Percent of total)	(24.9)	(19.4)	(21.7)	(20.3)	-18.4
500-1,000 acres					
Mean payments ($)	21,676	8,553	7,403	8,062	-62.8
Median payments ($)	12,831	4,464	4,284	3,500	-72.7
Total payments ($ million)	4,264	1,567	1,278	1,255	-70.6
(Percent of total)	(28.5)	(24.0)	(23.1)	(19.2)	-32.6
1,000-10,000 acres					
Mean payments ($)	39,840	20,589	15,665	19,331	-51.5
Median payments ($)	23,469	11,540	9,206	9,738	-58.5
Total payments ($ million)	6,157	3,263	2,541	3,237	-47.4
(Percent of total)	(41.1)	(50.0)	(45.9)	(49.5)	20.4
10,000+ acres					
Mean payments ($)	28,605	21,355	14,636	27,481	-3.9
Median payments ($)	0	0	0	4,000	-
Total payments ($ million)	214	165	106	222	3.6
(Percent of total)	(1.4)	(2.5)	(1.9)	(3.4)	137.3
Total payments ($ million)	14,981	6,529	5,533	6,543	-56.3

Note: Payments are in 2002 dollars deflated using the Consumer Price Index. Farm program payments are defined as total payments received for participation in Federal farm programs (including CRP/WRP), not including government CCC loans.

Source: Census of Agriculture.

Defining Commodity Program Payments

Although the Federal Government has provided payments to farmers since the Great Depression, the programs that provide payments have changed markedly over time. In recent decades, most payments have been tied to a farm's "base acres," a measure of historical plantings of program crops, and to historical program crop yields. Program yields were fixed in 1985 (at an average of 1981-85 yields) until 2002. Base acres were fixed under the 1996 Farm Act (production flexibility contract acreage). Until 2002, program crops included barley, corn, cotton, oats, rice, sorghum, and wheat.

Payments tied to base acres have fluctuated over time, depending on whether and to what extent market prices fell below program-set target prices. In 1987 and 1992, participation in government programs also required farms to idle a share of their base. In these years farmers may have chosen not to participate in government programs in order to avoid annual acreage reduction requirements. By 1992, farmers could plant nonbase or other base crops on their base acres in accordance with flexibility rules, which changed over time. By 1997, annual acreage reduction programs were eliminated and farmers were given almost complete flexibility in planting.

In addition to payments tied to base acres, farmers have also received loan deficiency payments from the marketing loan program. These payments depend on current production, not base acres, and the payment amount depends on the difference between market prices and loan rates set by the program. Marketing loan payments were available for soybeans and minor oilseeds in addition to program crops that receive payments tied to base acres. Some kinds of marketing loan benefits are not included in our data because the census of agriculture does collect information about them.

The census of agriculture does not classify payments according to type beyond distinguishing payments from the Conservation Reserve Program (CRP) and

Wetland Reserve Program (WRP). This study considers total payments net of CRP and WRP payments because these program payments are generally small and likely influence concentration growth differently than other kinds of payments. Data on payments were available starting in 1987. For the 1987, 1992, and 1997 censuses, respondents were asked for (1) "the amount received from CCC loans" by crop, (2) "total amount received for participation in Federal farm programs (do not include CCC loans)," and (3) "of the total amount [in 2] how much was received for participation in the CRP and WRP?" For 1987, 1992, and 1997, the value from (2) minus the value from (3) was used in the analysis, except for table 4.

In 2002, respondents were asked for (1) "total amount received in 2002 from Government CCC loans for all crops," (2) "how much was received for participation in the Conservation Reserve Program and Wetlands Reserve Program (CRP and WRP)" and (3) "amount received from other participation in other Federal farm programs (include loan deficiency payments)." For 2002, the value in (3) would be the appropriate measure of payments, but 2002 payments were not used in the analysis linking payments to concentration because we use past payments to observe subsequent growth.

Total commodity program payments recorded by the census are substantially below the net outlays to farmers reported by the USDA. For example, in 2002, census respondents reported commodity program payments net of Commodity Credit Corporation (CCC) loans and CRP and WRP payments totaling $5.2 billion. In contrast, the Farm Service Agency budget reports that total direct cash payments excluding conservation payments totaled $9.7 billion (USDA/ERS, 2007). Part of this discrepancy could be explained by the fact that landlords received a substantial portion of commodity program payments, and many landlords were not operators, so they were not included in the census of agriculture.