Chapter 4

Commodity Program Payments and the Concentration of Cropland

To focus more clearly on the impact of payments on crop producers, cropland (versus farmland) is used to characterize land concentration at the local (ZIP Code) level. Weighted-median cropland is constructed in the same way as weighted-median farmland in the previous chapter (cropland excludes pasture, range, woodland, and other minor uses).[8] The analysis includes almost all farms and ZIP Codes in the census of agriculture.

First, the study compares percentage changes in cropland concentration between consecutive census periods of ZIP Codes having different levels of payments. This indicates whether concentration increased more in regions having higher average payments per acre than in regions with lower average payments. Even if programs target farms that happen to be larger due to the nature of the crops they grow (that is, some crops are land-intensive), there is no apparent reason to expect programs to target farm types more inclined to grow in size over time. And, by examining percentage changes, growth is scaled relative to initial concentration levels.

Although a comparison of changes can control for many factors, the approach is not infallible. It might be that corn, wheat, cotton, and other crop farms traditionally targeted by programs have grown more concentrated for reasons other than government programs. To address this concern, the study controls for initial farm size and for ZIP Code location. This approach restricts comparisons to those between ZIP Codes with similar initial farm sizes that are close to each other geographically, and thus likely to have similar climate, soils, and crop types.

It is possible that areas with high yields, and hence higher payments, also have better land quality (flatter, more fertile soil, etc.). If scale-enhancing technological change favored higher quality land over lower quality land for the same crop, this could explain a correlation between payments and subsequent growth in land concentration. To account for variation in land quality, the study controls for initial crop sales per acre and the share of all land in crops.

If it were participation in farm commodity programs and not the payment levels associated with participation that drove farm size changes, one might expect a similar change in farm size between crops with higher and lower payment levels. For example, payments (per acre) tied to cotton production tend to be higher than those tied to corn, while corn payments tend to be higher than for wheat. Examining farm growth rates over a range of payment levels demonstrates that concentration growth steadily increases with steadily increasing payment levels.

Of course, other factors cause payment levels to differ across ZIP Codes (see box, "Defining Commodity Program Payments"). One source of variation in payment levels stems from regional differences in crop mix. Of particular importance is farmers' planting decisions and yield outcomes. Yields between 1981 and 1985 determined 1985 base acres and program crop yields. Particularly high or low yields in those years because of weather variation would have longrun consequences in terms of payment

[8]An analysis using farmland instead of cropland produced qualitatively similar results.

Zip Code Data

The data used for this analysis include all ZIP Codes recorded in the census of agriculture that had at least three farms in each of the four census years examined (1987, 1992, 1997, and 2002). The analysis begins in 1987, the first year for which farm-specific data on commodity program payments are available. The study examines ZIP Code areas because they are the smallest geographic unit where farms can be located with the data. This provides more observations and more variability in the concentration and payment measures than a county-level analysis would. Local variation in payment levels and concentration growth is important when attempting to identify the effect of payments on concentration while controlling for factors that vary geographically.

ZIP Code areas, like counties, vary markedly in size, with rural ZIP Codes generally larger than urban ZIP Codes and Western ZIP Codes generally larger than those farther east. To account for this variation, the study examines payments per acre of cropland rather than total payments. This standardization makes the payments measure insensitive to the size of ZIP Code areas. The concentration measure is not sensitive to the land area of the ZIP Code and therefore does not require standardization.

ZIP Codes can change over time. Most changes have occurred in more urban areas undergoing rapid population growth and where agriculture is less prevalent, which mitigates the issue for this analysis. When ZIP Codes do change, it is usually because one ZIP Code is split into two or more ZIP Codes, with one area retaining the old ZIP Code and the other(s) assigned a new code. Sometimes individual ZIP Codes are assigned to universities or large companies, and this can also change over time. Because the study restricts the analysis to ZIP Codes appearing in all four censuses, all farms in areas with new ZIP Codes are omitted. However, there are a few ZIP Codes that decreased in size between 1987 and 2002, with part of the earlier ZIP Code area split off into new ZIP Codes that were dropped. These changes, however, would not be expected to be systematically related to payments per acre or concentration measures.

Another consideration is that many farms likely straddle ZIP Codes. This issue is not likely to cause significant bias in this analysis because the ZIP Code associated with any particular farm is unlikely to change from one census to the next. Measurement issues may arise when farms with different ZIP Codes consolidate, causing reassignment of land from one ZIP Code to another. Such changes may create more variability in the concentration measure over time for ZIP Codes affected by consolidation, but there is no reason to expect this variability to be associated with commodity program payments per acre or other determinants of farm size.[1]

The census of agriculture reported farms in 32,959 ZIP Codes in 1987, 34,202 in 1992, 34,408 in 1997, and 33,548 in 2002; 23,293 ZIP Codes had 3 or more farms reporting in all censuses.[2] Of these 23,293 ZIP Codes, observations with undefined variables or extreme outliers are dropped, resulting in 21,524 ZIP Codes. Although the sample drops about a third of all U.S. ZIP Codes containing farms, it drops a much smaller share of total farms. The sample includes 1,716,814; 1,524,783; 1,541,547; and 1,341,306 farms in the 4 census years, compared with 1,799,926; 1,621,263; 1,653,098; and 1,486,895 farms in the raw census files.[3]

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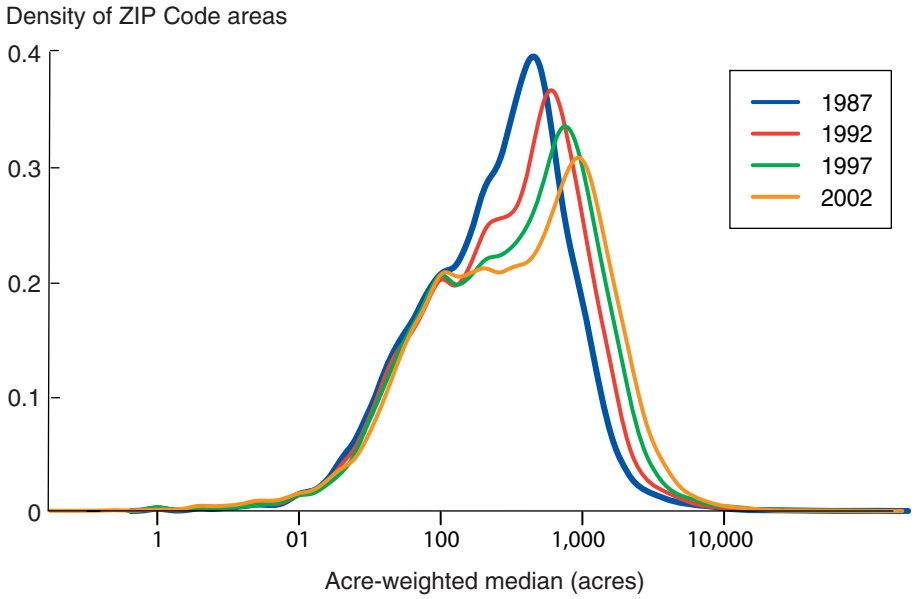
[1] Only a small portion of farms are dropped from the analysis because their ZIP codes were dropped. This suggests most farms are in areas relatively unaffected by changes in ZIP Codes. And the farms dropped are predominantly very small farms, which have little influence on the weighted-median farm size.

[2] These counts compare to a nationwide total of about 43,000 ZIP Codes currently in the United States.

[3] These numbers refer to actual census observations. Published census estimates of farm numbers are higher to account for nonresponse probabilities. Nonresponse weights were used in computing tables 2-4.

Figure 4
Distribution of cropland concentration across ZIP Codes, 1987-2002



Note: Data are from census of agriculture 1987, 1992, 1997, and 2002. Sample includes all ZIP Codes with at least three farm operations reporting in each year.

levels. Similarly, because base acres were fixed in 1996, cropping decisions prior to 1996 affected payment levels for many years.

Another factor driving variation in payments is historical participation in government farm programs. In the late 1980s, agricultural program restrictions may have discouraged some farmers from participating. Participation required farmers to limit their plantings to a share of acres historically planted and required that a certain portion be idled (called the Acreage Reduction Program). Farmers with environmentally fragile land (e.g., highly erodible) were also required to follow certain practices to limit environmental damages stemming from the cropping activities.[9] These costly participation restrictions probably limited program participation.[10]

For each ZIP Code region, the study estimates concentration using the acre-weighted median cropland area. This measure is the farm size at which half the cropland in the ZIP Code is operated by farms with more cropland and half the cropland is operated by farms with less cropland.

Figure 4 illustrates how the distribution of farm sizes has changed since 1987. The figure shows the frequency distributions of cropland concentration in the census years from 1987 to 2002. The horizontal axis is concentration, plotted on a logarithmic scale, and the vertical axis measures the frequency of ZIP Codes at each concentration level. The area under each curve equals one, by definition, so the area beneath the curve between any two points represents the share of ZIP Codes that are in the size range. The horizontal axis is plotted on a logarithmic scale where each step represents a ten-fold increase in farm size (rather than an increase of 10 units). Because there are relatively few ZIP Code areas with very high levels of concentration (the distribution is highly skewed), the logarithmic scale allows for a clearer representation of the whole distribution and more clearly illustrates

[9] See Claasen et al. for a description of cross-compliance provisions.

[10] Prior to 1996, between 15 and 40 percent of eligible cropland was not enrolled in a Federal program (USDA, various years).

the continuous temporal shift. The figure shows cropland distributions shifting markedly to the right: the share of ZIP Codes with weighted-median farm size above 600 acres increased every census from 1987 to 2002, indicating a relative increase in cropland controlled by larger farms.

Descriptive Statistics for ZIP Codes

The empirical approach is to compare how cropland concentration changes for ZIP Codes with different initial commodity program payments per acre (total commodity program payments divided by total cropland). The study measures changes in concentration over the three 5-year periods between censuses (1987-92, 1992-97, and 1997-2002). For example, it measures how payments per acre in 1987 correlate with changes in concentration from 1987 to 1992. It also measures the longrun relationship between payments per acre in 1987 and total percentage growth in concentration from 1987 to 2002.

For 1987, 1992, and 1997, ZIP Codes are sorted into six groups: the first group includes those ZIP Codes with zero program payments; the remaining ZIP Codes are sorted into five quintiles according to their level of payments per acre, with each quintile having the same number of ZIP Codes. There are two advantages to examining payment quintiles rather than estimating a linear or continuous relationship between payments per acre and concentration growth. First, estimating separate concentration measures for each quintile allows for the identification of nonlinear relationships between payment levels and concentration, if they exist. Second, pooling many observations into discrete categories of equal size greatly reduces the influence of miscoded or anomalous data.

For each of the six payment groups, table 5 reports summary statistics for the proportion of ZIP Codes, farms, and cropland; crop sales per acre; share of cropland in program crops and soybeans (a common rotation crop); and cropland concentration (weighted-median cropland), all for the beginning year of each census panel. The payment levels that divide quintiles change from one census year to the next as the general level of payments varies, mainly due to changing commodity prices and target prices set by farm policy.

As one would expect, the share of cropland in program crops increases with payment levels. With the exception of the no-payment group, typical farm size (initial concentration) is not markedly different between the payment groups in the initial year, but grows more for the higher payment groups in the more recent panels. Figure 5 maps ZIP Codes according to the cropland payment groups used for the longrun analysis.

Table 5

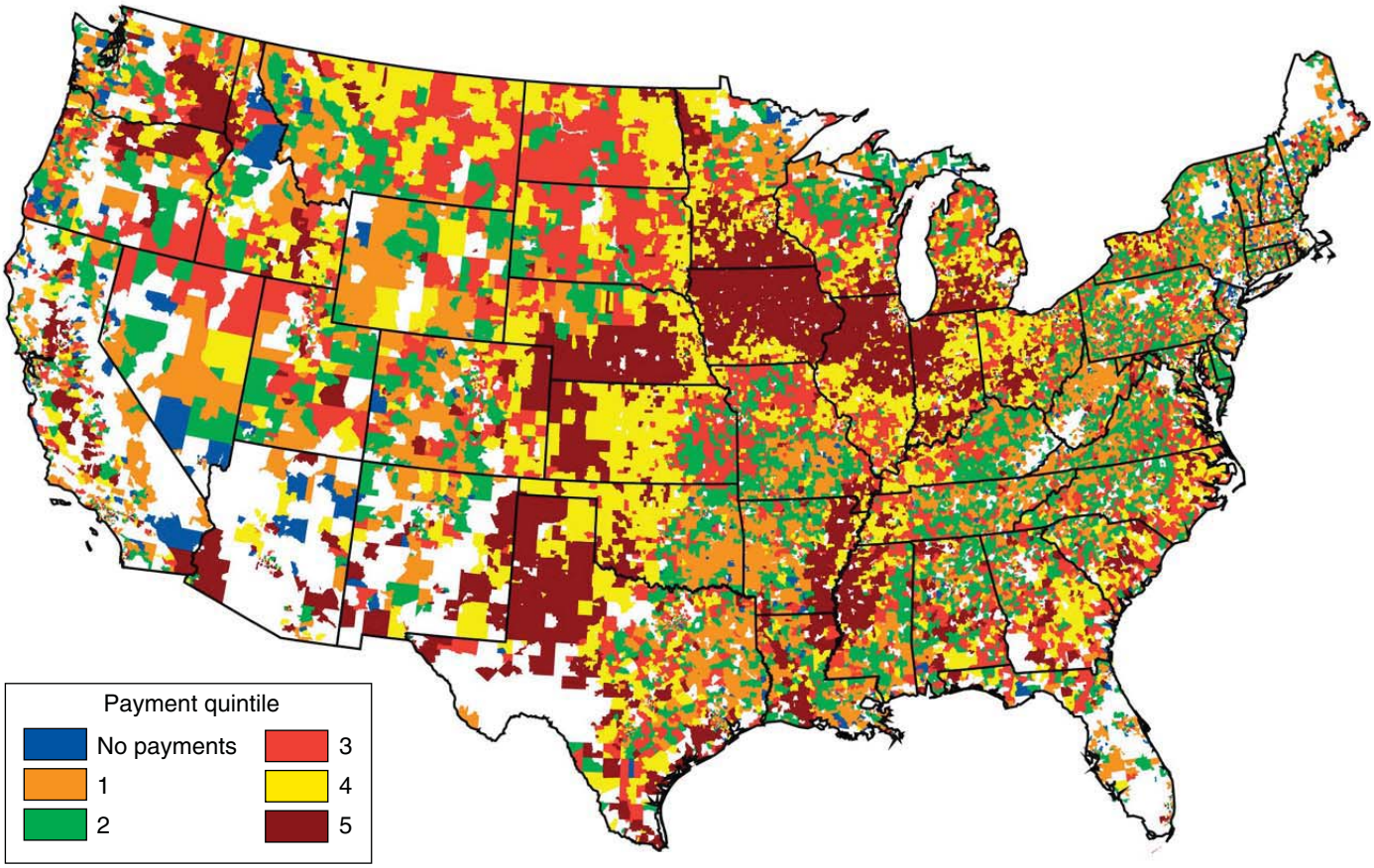
Summary statistics for each payments-per-acre category

Years of analyses		Payments per acre of cropland in beginning year					
		No payments	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1987-1992	Payments per acre in 1987 ($)	0	0.01-7.49	7.49-20.08	20.08-35.11	35.11-53.11	>53.11
	% of ZIP Codes	10.7	17.9	17.8	17.8	17.8	17.9
	% of farms 1987	2.3	15.0	20.4	20.5	20.8	21.0
	% of cropland 1987	0.5	5.0	10.1	21.5	29.7	33.2
	Crop sales per acre 1987 ($)	406.4	287.5	156.0	136.0	154.3	204.0
	% of cropland acres in program crops in 1987	9.6	18.5	41.2	65.8	80.6	75.1
	Weighted-median cropland acres in 1987	1,127.7	809.7	611.1	748.1	734.9	607.3
1992-1997	Payments per acre in 1992 ($)	0	0.01-3.62	3.62-7.79	7.79-12.34	12.34-18.32	>18.32
	% of ZIP Codes	12.1	17.6	17.6	17.6	17.6	17.6
	% of farms 1992	2.7	17.6	20.6	21.0	20.1	17.9
	% of cropland 1992	0.5	5.8	11.7	23.0	30.2	28.7
	Crop sales per acre in 1992 ($)	582.3	325.6	207.5	171.9	178.2	233.8
	% of cropland acres in program crops in 1992	15.7	25.2	52.7	72	80.6	75.1
	Weighted-median cropland acres in 1992	2161.1	780.6	717.3	835.7	882.6	993.6
1997-2002	Payments per acre in 1997 ($)	0	0.01-3.01	3.01-6.72	6.72-10.19	10.19-14.24	>14.24
	% of ZIP Codes	10.6	17.9	17.9	17.9	17.9	17.9
	% of farms 1997	2.3	17.0	20.4	20.8	21.0	18.4
	% of cropland 1997	0.4	5.0	12.3	23.8	30.2	28.3
	Crop sales per acre in 1997 ($)	724.9	416.1	214.6	206.9	230.7	304.6
	% of cropland acres in program crops in 1997	7.4	12.7	47.3	69.7	78.7	80
	Weighted-median cropland acres in 1997	1,198.6	984.8	1,124.1	1,185.6	1,040.2	1,011.9

Notes: Data from census of agriculture 1987, 1992, 1997, and 2002. Sample includes all ZIP Codes with at least three operations reporting in every year. All statistics correspond to the first year of each panel. Typical cropland acres are acre-weighted median. All payments are adjusted to 1997 dollars using the Consumer Price Index.

Figure 5

Mean payments per cropland acre by ZIP Code, 1987-1997



Note: Data from census of agriculture 1987, 1992, and 1997. Sample includes all ZIP Codes with at least three operations reporting in every year. White areas were dropped from the analysis due to extreme values or little data.

Land Concentration Change by Payment Category

Average growth rates in concentration for all payment groups are reported in table 6. Figure 6 displays the same statistics graphically. Each 5-year panel generally displays increasing concentration growth for higher payment levels, and the relationship is strongest and clearest in the cumulative 15-year panel.

Table 7 reports estimated differences in concentration growth rates for the same panels and groups as table 6, except the estimates include controls for beginning-year concentration levels, sales per acre of cropland (a proxy for land quality), cropland density (the ratio of cropland to land area in the ZIP Code), and location. These estimates are derived by restricting comparisons between ZIP Codes that have similar initial concentration rates, crop sales per acre, and ratios of cropland to ZIP Code area. Location is critically important because it controls for the effects of climate, soils, distance to markets, and other local economic factors that may influence changes in concentration. Controlling for the location of the ZIP Code areas reduces the chance that the effect of payments is confounded by these and other

Table 6

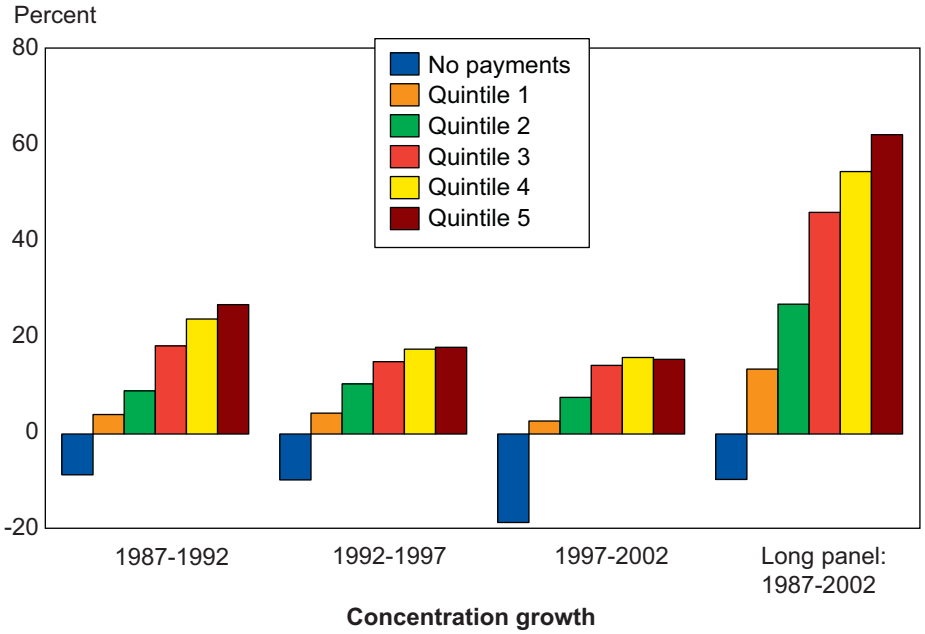
Percentage change in concentration by payments-per-acre quintile

Years	No payments	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
	Percentage change in concentration of cropland (Standard error)					
1987-92	-8.8 (1.7)	4.2 (0.8)	9.3 (0.7)	19 (0.5)	24.8 (0.4)	27.9 (0.4)
1992-97	-9.9 (1.5)	4.5 (0.8)	10.8 (0.6)	15.6 (0.5)	18.3 (0.4)	18.7 (0.4)
1997-2002	-21.2 (2.0)	2.8 (0.9)	7.9 (0.7)	14.8 (0.6)	16.5 (0.5)	16.1 (0.5)
Long panel 1987-2002	-9.8 (2.0)	14.0 (1.1)	28.0 (0.9)	47.8 (0.7)	56.6 (0.6)	61.4 (0.5)

Notes: Concentration is defined as the cropland-weighted median farm size in each ZIP Code. See appendix for details. Data are from census of agriculture 1987, 1992, 1997, and 2002. Sample includes all ZIP Codes with at least three farm operations reporting in every year.

Figure 6

Change in ZIP Code farm size (weighted-median cropland) by payments-per-acre group, 1987-2002 (no controls)

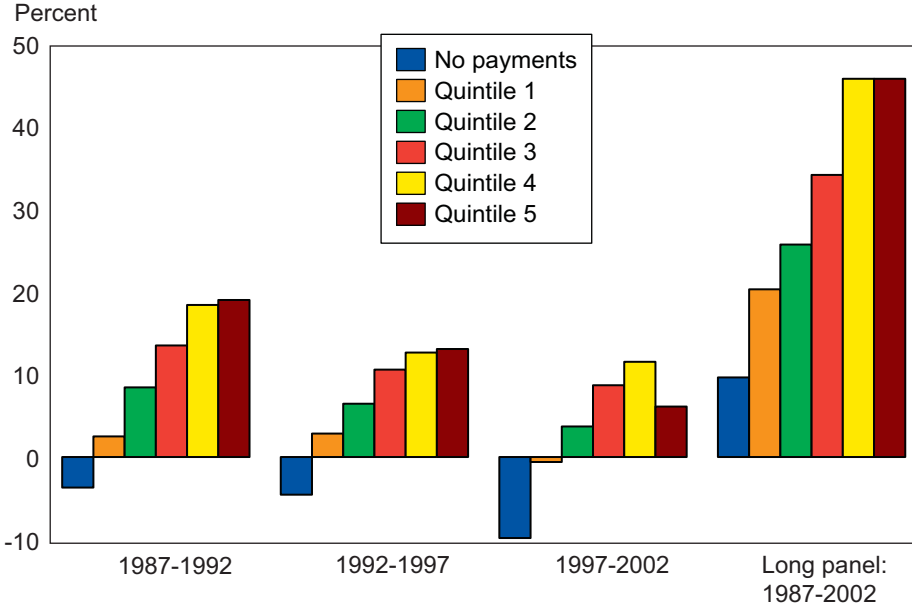


Note: Data from census of agriculture 1987, 1992, 1997, and 2002. Sample includes all ZIP Codes with at least three operations reporting in every year. Payment quintiles are derived by sorting ZIP Codes by payment per cropland acre in the beginning year of each panel and choosing an equal number of ZIP Codes for each quintile.

factors varying geographically with payments. Beginning-year concentration measures capture the degree to which there is remaining scope for further concentration. Initial crop sales per acre and share of ZIP Code land in crops serve as further controls for land quality. The effects of all the controls are accounted for using a flexible semi-parametric regression model (see appendix). In comparison to standard regression techniques, the semi-

Figure 7

Change in ZIP Code farm size (weighted-median cropland) by payments-per-acre group, 1987-2002 (with controls)



Note: Data are from census of agriculture 1987, 1992, 1997, and 2002. Sample includes all ZIP Codes with at least three farm operations reporting in each year.

parametric model requires fewer assumptions about the way these control variables influence concentration growth.

The addition of controls (table 7) changes the estimated values somewhat, but a similar pattern across payment categories remains. For the long panel, the estimated difference in cropland concentration growth between the highest and lowest payment categories is 71.2 percentage points without controls (table 6) and 35.1 percentage points with controls (table 7). Figure 7 displays the adjusted growth rates associated with each panel.

What might the statistics imply in terms of the size of the relationship between cropland concentration and payments from agricultural programs? The estimates in table 7 can be compared to the average predicted cropland concentration growth between 1987 and 2002. The estimate of 11.2 percent for the zero-payments category is substantially lower than the average predicted growth rate of 41.5 percent.[11] This comparison may overstate the effect of payments on concentration, however, because there are few ZIP Codes with no payments and these ZIP Codes are likely quite different from those with modest payments.

An alternative way to estimate concentration growth in the absence of payments is to use the growth predicted for the first payment quintile (23.6 percent) rather than the zero-payments group. This alternative comparison suggests that about 43 percent of growth in cropland concentration between 1987 and 2002 is associated with commodity program payments (23.6 percent with low payments versus 41.5 percent with average payments).

[11] Because the regression model is nonlinear, the average fitted growth rate does not equal the average observed growth rate, which was 50.1 percent (the weighted average of the last row in table 6).

Table 7

Percentage change in ZIP Code farm size (weighted-median cropland) by payments-per-acre quintitle group, with controls

Years	No payments	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
	Percentage change in concentration of cropland (Standard error)					
1987-92	-4.3 (1.7)	2.9 (1.8)	9.8 (1.8)	15.7 (1.8)	21.4 (1.8)	22.1 (1.8)
1992-97	-5.3 (1.7)	3.3 (1.8)	7.5 (1.8)	12.3 (1.8)	14.7 (1.8)	15.2 (1.8)
1997-2002	-11.4 (1.7)	-0.7 (1.8)	4.3 (1.8)	10.1 (1.8)	13.4 (1.8)	7.1 (1.8)
Long panel 1987-2002	11.2 (1.8)	23.6 (2.0)	29.9 (2.0)	39.7 (2.3)	46.3 (2.3)	46.3 (2.4)

Notes: This table reports estimated effects of the payment quintiles on concentration growth after controlling for location and concentration, sales per acre of cropland, and the ratio of cropland to area in each ZIP Code in the beginning year of each panel. Effects were estimated using a semi-parametric generalized additive regression model. Concentration is defined as the weighted-median farm size in each ZIP Code. For the long panel, quintiles are calculated using payments per acre in 1987. An appendix provides more detail about the methods used. Data are from census of agriculture 1987, 1992, 1997, and 2002. Sample includes all ZIP Codes with at least three farm operations reporting in every year. Extreme outliers were dropped from the analysis, as described in the appendix.