Measuring the Impact of Direct Government Payments on the Value of Midwest Cropland

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The market for United States farmland operates subject to the influences of a complex and extensive policy structure created by local, state and federal laws. In particular, since the 1930s, federal policy has exerted significant indirect influence on cropland values through the capitalization of commodity price and income support programs. In any given year, programs have provided guaranteed minimum income levels, and therefore eliminated downside risk, but allowed payments to increase as yields increase.

More than three decades ago, Floyd used economic theory to deduce that increases in cropland values created by acreage control programs could account for between 5 percent and 55 percent of cropland value, depending on the particular form of control adopted. Since that time, a number of studies have used a variety of approaches and disparate data to provide limited quantitative estimates of the extent to which federal farm program payments are capitalized into cropland values (e.g., Herriges et al.; Duffy et al.; Just and Miranowski; Goodwin and Ortalo−Magne ; and Shoemaker et al.). The question continues to be pertinent at this time, especially given the enactment of the most recent farm legislation, under which all federal commodity program payments have been decoupled from current year production as a precursor to a planned elimination of all federal commodity programs at the end of 2002.

Most observers agree that a dismantling of the traditional commodity programs will allow United States producers to be more responsive to market signals, which will result in increased returns from the market. Some have argued that this increased income will approach the loss in income from federal subsidies. Of course, as the government withdraws its involvement from agriculture, additional factors come into play, such as a loss in income stability and an increase in financial risk. Furthermore, the effects of the reduction in subsidies on cropland prices will vary considerably over geographic space. Predictions about the short−run and long−run net effects of the elimination of federal commodity programs will continue to be debated. However, an understanding of how much direct government payments were capitalized into cropland values immediately preceding the passage of the 1996 Farm Bill will surely inform the debate.

The purpose of this paper is to measure the recent impact of direct government payments on the value of cropland in the Midwest, where program commodities occupy a high percentage of total cropland. In addition, the analysis will focus on the interregional variation of cropland values and government program effects. The exact amount by which cropland values might change subsequent to 2002, however, is an empirical question for which our analysis does not provide a definitive answer. Recent experience, though, could be viewed as an indicator of the amount by which cropland values could fall in the short−run (i.e., prior to major adjustments to production by farmland owners in response to greater planting flexibility). The analysis employs micro−level cropland values data from the newly redesigned U.S. Department of Agriculture farmland values data collection effort and uses two related, but quite different, regression−based approaches. One is the standard linear (parametric) estimator and the other is a nonparametric estimator. The empirical results will be preceded by a brief discussion of the current policy setting and past research on the role of government payments in determining farmland prices.

Policy Context[1]

Much of the United State's agricultural commodity policy grew out of efforts to promote economic recovery and development following the Depression and World War II. The intent of the programs was to stabilize farm commodity prices and augment farm income.[2] For major food and feed grains, these intentions were accomplished using nonrecourse loans and target prices (to determine direct payments to producers) in conjunction with land retirement, set−aside or acreage diversion (to control production). Though not discussed here, government programs also include indirect price supports for peanuts, sugar, dairy and a few other commodities.

Since the 1985 Farm Bill, federal commodity programs have moved toward greater market orientation, reducing the influence that traditional commodity programs have had on the agricultural sector. That trend was furthered by the 1990 legislation, and then greatly accelerated by the Federal Agricultural Improvement and Reform Act of 1996, which decoupled agricultural production from the influence of commodity programs. FAIR, which provides agricultural sector law for 1996 to 2002, fundamentally redesigns current programs and totally phases out most programs by 2002.

The FAIR Act discontinues supply management provisions and replaces an income support system based on deficiency payments (difference between a pre−set target price and the market price) with a system of fixed payments called Production Flexibility Contract Payments. The link between direct government payments and planting decisions is thus severed for wheat, corn, grain sorghum, barley, oats, rice and cotton. Producers are no longer locked into production of specific crops through historically−established base acreage. Producers must, however, still comply with conservation and wetlands provisions and keep the land in agricultural use.[3]

These legislated changes in FAIR will impact farmers immediately by altering the amount of direct payments received and by changing the decision criteria for which crop to plant. Ultimately, when most programs are phased out after 2002, the benefits of access to government commodity programs afforded by previous law will be gone. Presumably, there will be no programs, no acreage or other access restrictions and no benefits to be partially capitalized.

Over the past decade alone, federal commodity program outlays have ranged from $26 billion in fiscal year 1986 to $7 billion in fiscal year 1995. Figure 1 shows outlays for deficiency payments from 1986 to 1995 and legislatively−fixed production flexibility contract payments for 1996 to 2002. Deficiency payments (now recast by current legislation as production flexibility contract payments) constitute, by far, the largest form of direct government payments. Figure 2, showing the distribution of deficiency payments among crops, indicates that corn and wheat received the bulk of those payments. The corresponding distribution of production flexibility contract payments is nearly the same. Nearly 45 percent of these payments go to landowners and producers in the Corn Belt, Northern Plains and lake regions. These three regions account for more than 70 percent of the combined United States acres planted in corn, soybeans and wheat.

Government Payments and Cropland Values

The current market value of an asset is determined by the discounted (or capitalized) value of the income flows expected to be generated over the remaining life of the asset. There are, of course, a myriad of factors that influence both current and future income flows to cropland. Some of the most important factors affecting farmland values include: soil productivity, climate, location relative to markets and services, government payments and demand for cropland from competing nonagricultural uses. Government payments and nonagricultural influences are of particular interest at this conference.

United States farm programs have existed, at least partially, to raise producer incomes above levels that would have occurred in the absence of program payments. Such increased income to the agricultural sector necessarily implies artificially higher net returns to farm assets, primarily cropland. Theoretically, the higher net returns will be capitalized into cropland values (at least partially) if the direct payments associated with commodity programs are expected to continue indefinitely. Given that farm programs have existed for more than six decades, it is likely that landowners have come to expect continued receipt of payments. Consequently, it is widely believed that direct government payments have caused increases in cropland values above what they would have been in the absence of government programs.

Government programs have also contributed indirectly to higher cropland values through stabilization of farm income. Commodity programs have not only provided an annual supplement to farm income, but have reduced the variance in that income, making agricultural production a less risky enterprise. The risk reduction associated with this implicit income insurance is effectively a lowering of the discount rate, which has the effect of enhancing cropland values.

Economists do not expect that every dollar of direct government payments is capitalized into cropland values. First, receipt of direct government payments through commodity programs is not without cost to producers. To gain access to the payments, producers must comply with the program provisions, which generally means removal of some land from production. Expenses for maintenance and reduced potential revenues from such land diversions partially offset benefits received through the direct government payments. Second, the extent to which direct government payments are capitalized is spatially variable, meaning that some areas will experience greater effects than others, partially depending upon whether the dominant crop is wheat or corn/soybean rotation. Gertel, for instance, concluded that the short−term effect of farm−program elimination in 1986 would have been a more severe downward impact on the value of land producing wheat than on the value of land producing corn and soybeans.

Several studies have examined the extent to which government payments are capitalized into cropland values. Most of these studies have analyzed limited geographic areas or addressed the issue from the perspective of a single commodity. In other cases, aggregate national data have been used. Featherstone and Baker employed an econometric simulation to analyze the distribution of cropland prices for an Indiana county under two scenarios, one assuming existence of the 1985 programs and the other assuming that all programs were eliminated. They estimated that over a four year period, elimination of the 1985 programs would have resulted in a 13 percent reduction in cropland values. Herriges et al., used a hedonic pricing approach and rent data for 12 counties from the Iowa Rent Survey to estimate that an acre of Iowa cropland base was worth 11 percent to 14 percent more than a similar non−base acre. They cite other work (Feinerman, Herriges and Holtcamp), based on quadratic risk programming models, that indicated a 35 percent premium for base acres. Herriges et al., state that QRP models are expected to produce estimates that are high because the model assumes full capitalization.

Duffy et al., used mixed integer and dynamic programming models to estimate the value of cotton base while accounting for the opportunity cost of creating cotton base on cropland without current base acres. Using Duffy et al.'s, estimates of the opportunity value of cotton base acres and the value of bare cropland in Alabama from an extension service publication (Prevatt), we place the opportunity cost of cotton base acres at between 7 percent and 12 percent of cropland value. Goodwin and Ortalo−Magne' used regression models to analyze cropland values in wheat areas of the United States, Canada and France. Based on state−level time series data over the period 1979 to 1989, they found that a 1 percent increase in expected per−acre subsidies (measured by Producer Subsidy Equivalents) led to a 0.38 percent increase in cropland values.

Other studies have taken a more long−run perspective, attempting to measure the change in cropland values after producers have had time to adjust inputs, outputs and technology. Most often, this analysis has been done through the use of computable general equilibrium modeling. Kilkenny, for instance, found that termination of federal farm subsidies would lead to lower real household income in rural areas. Shoemaker, Anderson and Hrubovcak specifically addressed the issue of cropland values in the absence of government payments. Their research indicated that in the absence of farm programs, long−run equilibrium cropland values would be 15 percent to 20 percent lower.

Empirical Analysis and Results

If the extent to which direct government payments are currently capitalized into cropland values can be isolated, then we can provide estimates of the amount by which cropland values could fall in the short run when such payments are fully eliminated. Our analysis uses two different regression−based approaches to address the question of how much impact government commodity programs currently have on the value of cropland via capitalization of direct government payments. The first approach uses ordinary least squares to estimate the percentage of Midwestern cropland value that is accounted for by farm program payments. The second approach uses a nonparametric estimator. The tract−specific data on cropland values permits the analysis to be conducted for very small geographic areas, while the 12 state study area provides the opportunity to examine the effects of direct government payments in the context of multiple program crops. This broad perspective on the impact of direct government payments is not available from other studies.

Decades of income support programs, built upon the concept of base acreage for each commodity, have "locked in" historical cropping patterns, creating inefficiencies in the United State's farm economy. Eliminating the programs and allowing complete planting flexibility should eliminate inefficiencies, allowing increased productivity and increased net returns to cropland relative to what would have occurred under continuation of previous farm programs. This hypothesized increase in productivity might partially offset (some would argue, fully offset) the downward pressure on cropland values caused by eventual elimination of commodity support. Such issues can be more appropriately addressed in the context of CGE models (Kilkenny).

Regression analysis has often been used in the analysis of urban housing markets to examine the value of dwelling characteristics, including structural features such as fireplaces and neighborhood amenities such as school quality, all of which are implicit in the sale prices of residential dwellings. The approach also has been used in several contexts to examine the value of characteristics associated with rural land parcels. Attributes examined include site specific characteristics such as soil productivity (Miranowski and Hammes, Gardner and Barrows, and Palmquist and Danielson) and nonmarket ambient characteristics such as air quality (Brookshire et al.) and water quality (Michael, Boyle and Bouchard; Edwards and Anderson).

The land value equation used in this analysis relates the value per acre of cropland to a vector of cropland characteristics that measure agricultural productivity, climate, direct government payments, urban influence and state−specific institutional environments. Mathematically, the equation estimated in this analysis can be expressed as:

$$V_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_K X_{Ki} + \varepsilon_i \qquad i = 1, \ldots, n, \qquad (1)$$

where V_i is the value per acre of cropland, the X_k are a set of characteristics whose implicit values are hypothesized to be capitalized into cropland value, α is a constant, the β_k's are coefficients to be estimated, ϵ is the error term and *n* is the number of observations. The marginal implicit value of a given characteristic is the partial derivative ($\partial V / \partial X_k$ for the kth characteristic) of equation (1) with respect to that characteristic, which is equal to β_k. The regression coefficient is therefore interpreted as a measure of the additional amount that a purchaser must pay to include one more unit of that characteristic in the bundle of characteristics being purchased as a parcel of cropland, with everything else remaining the same.

A linear regression estimator, usually Ordinary Least Squares, has been the standard approach in the economic literature to estimating farmland value equations. While linear regression results provide useful information, especially for confirmation of previous estimates, such estimates only represent average effects for an entire region.[4] In fact, the effect of program payment elimination on cropland values is expected to vary spatially within the region, based partially on program differences for the dominant crop grown (which varies spatially) and partially on variation in the agronomic flexibility that producers in specific subregions have to grow alternative crops.

The nonparametric approach was used because it has the advantage of providing estimates of the effects of government payments that have much greater spatial detail and enables display of those estimates on spatially continuous maps. Until recently, the less restrictive nonparametric estimator was too expensive to compute in practice. Enhanced computing capabilities, coupled with statistical advances (Scott and Whittaker), have made the implementation of nonparametric estimation possible on standard desktop computers. By linking the nonparametric regressions to Geographic Information System mapping capabilities, we are able to provide a unique perspective on the spatial distribution of potential decreases in cropland values across the 12 states in the Corn Belt, Northern Plains and lake regions. A limitation of nonparametric regression is that the number of independent variables that can be incorporated is severely limited by the extensive additional data requirements necessary for each additional variable. It is also important to recognize that the linear estimator is a special case of the less restrictive nonparametric estimator.

Discussion of Data

Specification of the regression equation begins with definition of the dependent variable, which in this analysis is the per−acre values of nonirrigated cropland in the Corn Belt, Northern Plains and lake regions. The observations, representing farmers' reports of the current market value of specific tracts they operate, were collected by the National Agricultural Statistics Service on the June Agricultural

Survey (Barnard and Westenbarger).

The June Agricultural Survey is a probability survey based on a land area frame that is divided into "segments" representative of land uses across the nation. Segments represent approximately 1 percent of the total land area with 20 percent of segments replaced each year. Within these segments, enumerators identify "tracts," which represent a particular farm operator's acreage within the segment. Farm operators then provide estimates of the value per acre for any irrigated and nonirrigated cropland, grazing land and woodland within the tract boundaries. For the 12 state study area, 3,830 segments were sampled for 1996. Within these segments, enumerators identified 14,406 agricultural tracts. Information on nonirrigated cropland is analyzed here, as it constitutes the major land−use in the area, and, in contrast to grazing land and woodland, its value is directly influenced by government payments. A high percentage of cropland in the region is planted to program crops, including wheat and feed grains. In addition, a high percentage of producers participate in federal commodity support programs.

Table 1 describes the independent variables used in the OLS or nonparametric regressions. The mean and standard deviation of each variable are presented. Two of these variables are of primary interest at this conference: 1) the amount of government payments and 2) the degree of urban influence. Government payments are measured as county−level averages of the annual amount of direct government payments received per acre as published in the 1992 Census of Agriculture (U.S. Department of Commerce). The sign of the estimated government payments parameter is expected to be positive: to the extent that government payments increase the discounted stream of residual net returns to cropland, higher levels of government payments imply higher cropland values.

In some previous work, measures of urban influence, including population, population density and extent of off−farm employment, have often been found to have large, positive and statistically significant effects on farmland values. In other cases, distance from parcels to the center of the nearest major metro area (or other local population concentration) has also been used successfully (e.g., Kennedy et al.).

Larger urban populations surrounding a parcel and a parcel's location closer to population centers both imply increased demand for cropland for use as rural residences, commercial businesses and industrial sites. Access to larger population concentrations generally implies more off−farm employment opportunities, activating demand from part−time and hobby farmers. Such nonagricultural demands often outbid agriculture for use of farmland near urban areas. In general, measures of urban influence are proxies for access to social services, recreational facilities, commercial areas and quality−of−life aspects of metro areas.

A preferred measure of urban influence is the "gravity" measure of accessibility, which accounts for both the size of nearby population centers and distance from the center. The obvious analogy is the pull of gravity, which is determined by both the mass of the gravitational source (size of the population center) and distance from the source to the object of study (parcel). The POPACCESS variable, as generated by a function in ARC/INFO (a GIS system), is the sum of all populations within 1 kilometer grids over a 200 mile radius of the parcel, with each grid population weighted by the inverse of distance from the parcel to each grid. Mathematically:

$$POPACCESS_i = POP_0 + \sum_{i=1}^{n} \left(\frac{1}{D_i} * POP_i\right), \qquad (2)$$

where POP_0 is the population of the grid cell containing the parcel, POP_i is population of the ith grid cell, D_i is the distance from the parcel grid cell to the ith grid cell and n is the number of grid cells. Larger index numbers for POPACCESS imply greater population influence and therefore a positive effect on cropland values is hypothesized. A particular advantage of the gravity measure is that it simultaneously accounts for the influence of multiple centers.

Various measures have been used in the literature to represent agricultural productivity. In this analysis, we generally follow techniques that Mendelsohn et al., used in model specification. We include five independent variables, which, taken together, represent the basic agricultural productivity of parcels used for nonirrigated crop production. Conceptually, agricultural productivity is viewed as the result of complex interactions between soil quality, topography and climate (temperature and rainfall), which determines the agricultural−income producing capabilities of the parcel. Variation in the overall economic potential of the parcel for crop production is represented in the empirical model by SRPG, RAIN, RAINSQ, LATITUDE and LONGITUDE.

Soil quality is measured by SRPG, the Soil Relative Productivity Index developed and used by the Natural Resources and Conservation Service for county−level soil analysis. Rainfall enters the equation in quadratic form. RAIN, the linear term, is the 30 year average rainfall for the county containing the parcel. The parameter estimate for RAIN should capture the marginal effect of rainfall at the regional mean. The quadratic term, RAINSQ, is the square of RAIN, and provides for a nonlinear effect. When interpreting the results, the parameter estimate for RAINSQ shows how the marginal effect of RAIN will change as one moves away from the regional mean. Temperature, amount and intensity of sunshine, and other extraneous factors associated with climate are captured by the inclusion of LATITUDE and LONGITUDE, which adds a spatial dimension to the analysis. (As discussed below, the spatial dimensions of latitude and longitude can be more appropriately and clearly captured via the nonparametric analysis.) Although these variables are crude individually, taken together, they serve as proxies for the agricultural value of cropland. In particular, LATITUDE and LONGITUDE, in and of themselves, do not have a causal relationship to cropland value. Instead, they are intended to control for variation in climate, which across this 12 state region varies both by latitude and longitude.

The OLS model also includes a set of 11 dummy variables, one for each state, excluding Ohio. These state effects represent any systematic influences on the price of cropland that are common only to all observations in a specific state, but that are not represented by the other regressor variables. State property tax laws, environmental laws and restriction on corporate or foreign ownership of farmland come to mind as policies that restrict farm operation or landownership, and vary by state.

Linear Estimation and Empirical Results

The log−linear functional form was chosen, based on unpublished analysis of 1994 JAS data for the Corn Belt (Roka and Palmquist). The estimated regression coefficients are given in Table 2. Parameter estimates from the linear−in−logs specification can be interpreted directly as elasticities. Thus a 1 percent increase in any of the continuous independent variables corresponds to an increase in cropland values of greater or less than 1 percent depending upon whether the respective parameter estimate is greater or less than 1.0. All of the continuous variables have the expected sign and are statistically significant at a 1 percent confidence level. The estimated model carries an adjusted R^2 of 66 percent, explaining a quite large percentage of cropland price variation given the cross−sectional nature of the data and the heterogeneity of the region. Due to space limitations, only the government payments coefficient will be discussed.

An increase of 1 percent in direct government payments is estimated to increase cropland values by 0.19 of 1 percent, with a highly significant t−statistic. This coefficient can be used to estimate the effect that total elimination of direct government payments could have on the value of Midwest cropland value. The effect can be seen by considering the following example, based on the means reported in Table 1. First, a 100 percent elimination of direct government payments implies a reduction of $12.39 per acre (mean of GOVPMTS from Table 1). Using the 0.19 coefficient estimated for GOVPMTS in the regression, a 100 percent decrease in direct government payments implies a 19 percent (.19 times 100) decrease in average Midwest cropland values. Based on a mean of $1,287.37 per acre, this implies a $245 per acre reduction in value.

Nonparametric Regression Estimation and Results

Nonparametric regression has been known in statistics for at least 30 years, but only recently has entered the mainstream of statistical research. Other disciplines are only starting to take advantage of the method. Parametric regression forces the analyst to make assumptions about the functional form of the data and the distribution of the errors from the fitted model. The nonparametric regression methods do not require assumptions about functional form or distribution. This type of model is said to be "data driven" in the sense that the estimated relationships among variables are determined by the observed probability density of the data rather than the assumptions of the analyst.

The nonparametric method we chose is the average shifted histogram. This estimator is based on the observation by Scott that if one takes a number of histograms of the same data starting at different origins, then takes the mean of histograms, the result is a density estimator. To apply the ASH, one first bins the data into a rectangular grid, a step similar to calculating a two dimension histogram. The nonparametric regression estimator is applied to the binned data. More formally: let K be a symmetric kernel function with support on (−1,1) satisfying $\int K(t)dt = 1$. Given a positive smoothing parameter *h* (referred to as the bandwidth in most literature), define the scaled kernel function by:

$$K_h(t) = \frac{1}{h}K\left(\frac{t}{h}\right). \qquad (3)$$

The Nadaraya−Watson bivariate regression estimator was derived from the kernel density estimator, and is defined:

$$\hat{m}(x,y) = \frac{\sum_{i=1}^{n} z_i K_h(x - x_i)K_h(y - y_i)}{\sum_{i=1}^{n} K_h(x - x_i)K_h(y - y_i)}, \qquad (4)$$

where z_i is the dependent variable and xi and yi are the independent variables. The trivariate estimator is given by:

$$\hat{m}(x,y) = \frac{\sum_{i=1}^{n} z_i K_h(x - x_i)K_h(y - y_i)Kh(z' - z'_i)}{\sum_{i=1}^{n} K_h(x - x_i)K_h(y - y_i)Kh(z' - z'_i)}, \qquad (5)$$

where z' is an additional independent variable, and similarly for additional dimensions.

Now consider the results of estimating the value of cropland using the ASH estimator. Figure 3 shows the estimate of per acre cropland value as a function of longitude and latitude. This regression clearly shows the influence of urban centers on cropland values, with high values at the locations of major cities, especially the Chicago area. The sensitivity to the estimator is such that even some relatively small towns identifiable from the accompanying population density graphic (Figure 4) can be located in Figure 3 by examining the variation in estimated cropland values. The clear implication is that urban population is an important determinant of cropland values that should be accounted for in any model of cropland values.

Through nonparametric regression, we can estimate the value of cropland in the absence of urban population. This is done by estimating cropland value with population held constant. In this case, we hold population constant at a very low level, desiring only to remove the influence of urban population, not rural population.[5] Figure 5 is an estimate of cropland value as a function of latitude, longitude and low population density. The most noticeable feature of Figure 5 is a decrease of estimated cropland value in the Chicago area by about $4,000 dollars per acre. The cropland value in the Detroit area also shows a large decrease.

There are two interesting differences in the results obtained by nonparametric regression compared to parametric methods. First, variation in the location and effect of population on cropland values is easily visualized. Second, the relation of population and cropland values is not required to be the same at every location. Concepts underlying the nonparametric model permit the functional form and any implied parameters to differ throughout the data area. This can be seen by examining the Chicago and Minneapolis areas. A comparison of the population density visualized in Figure 4 with the relative changes in cropland values between Figure 3 and Figure 5 reveals that the relation of population density to cropland value is clearly different in the Minneapolis area, and is not nearly as strong as the effect in the Chicago area.

As a prelude to including the amount of government payments per acre in the model, we estimated direct government payments per acre as a function only of latitude and longitude. The results of this estimation are visualized in Figure 6.

Estimates of the proportional effects of direct government payments on cropland values are displayed in Figure 7. To calculate this surface, we first estimated a nonparametric regression with cropland values as the dependent variable and four independent variables: latitude, longitude, population density divided into two levels (greater or lesser than 1,500 people per square mile) and direct government payments, also divided into two levels (greater or lesser than $.90 per acre). Splitting direct government payments in this manner effectively divided all observations into two groups, one which received direct government payments and one which did not. Second, the predicted cropland value surface conditioned on receiving direct government payments was subtracted from the surface predicted without payments. The difference was divided by the surface predicted in the presence of government payments. The results are the proportions mapped in Figure 7, showing the percentage difference between cropland values (surface) predicted with and without government payments.[6]

For the region as a whole, the effect of eliminating the influence of government payments is to reduce cropland values by 11 percent. Differences between this estimate and the 19 percent OLS estimate are possibly attributable to differences in variables used. Inclusion of additional variables in the nonparametric regression is precluded by extensive data requirements. But, the restrictive, unchanging linear assumptions underlying the OLS model could also account for the difference.

The strength of the nonparametric regression, though, is the regional specificity of the estimates it provides relative to OLS. From Figure 7 one can see that the highest degree of capitalization of direct program payments is 22 percent. Much of this peak area is located in the vicinity of the Red River Valley. For the Corn Belt, the estimates indicated that only about 5 percent of cropland value is accounted for by direct government payments. The lowest elasticities between government payments and cropland values appear in areas of Ohio and Indiana.

The most notable feature of a comparison between Figure 6 and Figure 7 is that direct government payments are capitalized into cropland values at comparatively low rates in those areas that receive the highest levels of direct government payments per acre. The highest rate of capitalization occurs in the Northern Plains, particularly in the area of the Red River Valley. We speculate that this is due in part because government payments constitute a larger proportion of the gross income from an acre in the Northern Plains than in the Corn Belt, even though government payments per acre are higher in the Corn Belt. In addition, choices of alternative crops are more limited in the Northern Plains; production is limited principally to barley and wheat, both program crops. The Corn Belt will support a wider variety of crops, including some major crops that are ineligible for deficiency payments.

Conclusions

Existing research provides limited information on the extent to which direct government payments are capitalized into cropland values. Our estimates, providing confirmation, are well within the range of estimates found by others using disparate techniques and data. Consequently, eventual elimination of all commodity support programs could not be expected to reduce Midwest cropland values by more than 20 percent in the most impacted areas. But, there are several conditions that make it possible that an absolute decline in cropland values may never occur as the result of planned elimination of commodity support programs. Between now and 2002, any changes in values and underlying expectations are likely to be gradual because the payments are being gradually phased out. It is even possible that producers will develop the belief that government programs will not end, and instead that they will be resurrected in some form before they expire. That belief may be fostered by the current outlays for production flexibility contract payments, which are greater than projected outlays in the form of deficiency payments would have been under previous law (see Figure 8). Beyond 2002, major changes in the historical relationship between government and agriculture in the United States must be considered. Complete elimination of farm programs signals not a marginal change in production and price relationships, but a major structural change. Increased efficiency as the result of new planting flexibility granted by the FAIR Act may offset some of the potential decline. Other factors in the cropland market may further offset any potential reductions. These include continued urbanization, productivity gains and strong export demand.

The use of nonparametric regression techniques has allowed us to look at the effects of government payments on a geographic scale that is probably unprecedented. The estimates clearly indicate that wide spatial variability exists in the percentage of direct government payments that are capitalized into cropland values. From a policy perspective, this means that the effects of program elimination will vary across the Midwest, partially depending upon whether the dominant crop is wheat or corn. Our estimates indicate that the largest changes could occur in the Northern Plains. For much of the Corn Belt, only small percentages of direct government payments have been capitalized, so any potential reductions in cropland value should be small.

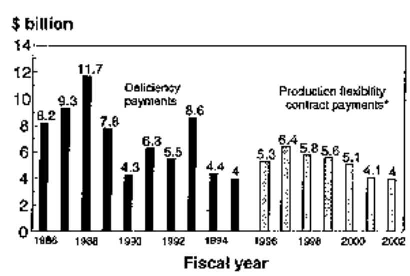
This information should be especially useful in the formation of rural development policy. The role of federal farm programs in shaping the economic structure and population of communities in farming−dependent areas continues to be debated. Goeth and Debertin, for example, have found that larger farm program payments as a share of total cash marketing receipts were associated with greater population losses from rural counties. The results of our analysis can be used in conjunction with other such studies to provided location−specific information on potential changes in cropland values. These estimates provide a useful measure of the economic impact of changes in commodity policy on the agricultural sector.

Footnotes

[1] This section draws heavily on Young and Westcott. Back.
[2] More recent legislation has included environmental quality and export enhancement goals. Back.
[3] There are limitations on production of fruits and vegetables. Back.
[4] Use of dummy variables and interaction terms could permit limited subregional estimation, but, in implementation, the data would not support subregions smaller than States. Back.
[5] Population density was used instead of the "gravity" measures used in the OLS model. In some sense the bandwidth and other aspects of the nonparametric approach already incorporate the effects of distance from population centers. Back.
[6] At higher dimensions, the data becomes sparse,the so−called "curse of dimensionality." In order to get meaningful results, we had to use large bin sizes and employ a large bandwidth. This account for the relatively low resolution of Figure 7. Back.

FIGURES

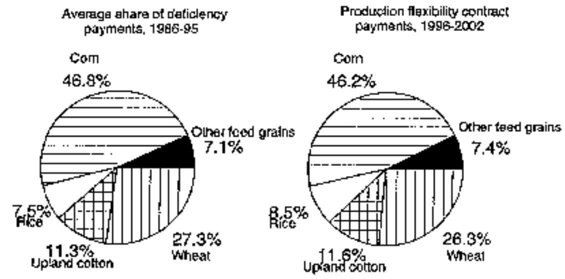
Figure 1: Production flexibility contract payments fixed over 7−year Farm Act.



*Production flexibility contract payments have been adjust for deficiency payments owed to farmers and repayments owed by farmers to the Government under the previous farm program. Payment limitations may result in slightly reduced contract payments.

Compiled by Economic Research Service, USDA.

Figure 2: Distribution of production flexibility contract payments similar to historical shares of deficiency payments.



Compiled by Economic Research Service

Figure 3: A.S.H. estimate of land values.

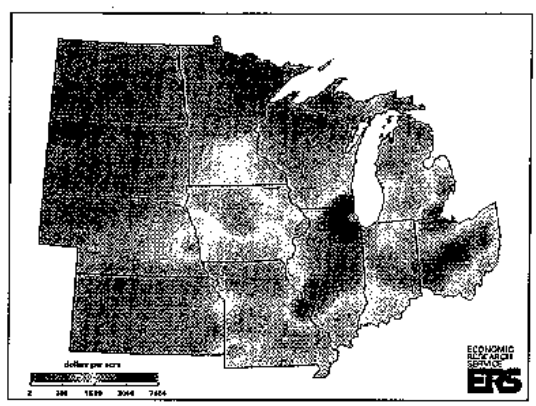


Figure 4: Population density at same resolution as other figures.

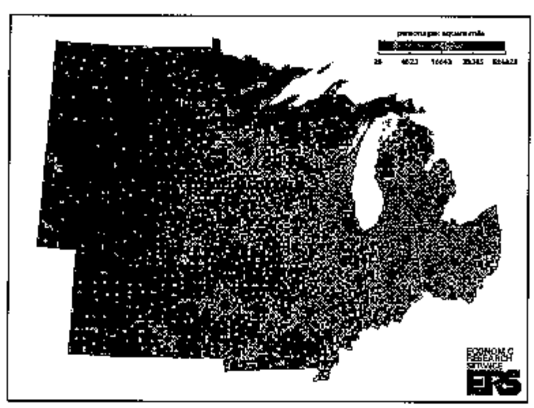


Figure 5: Land values with the influence of population removed.

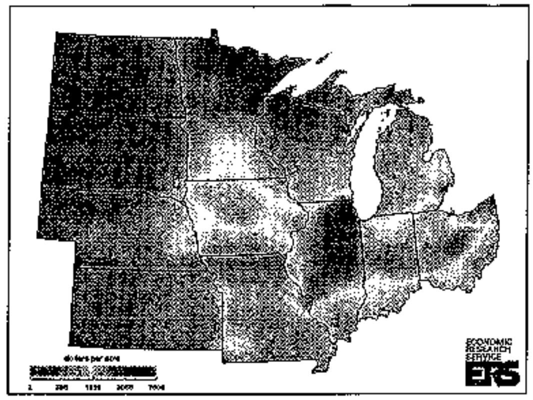


Figure 6: Direct government payments per acre.

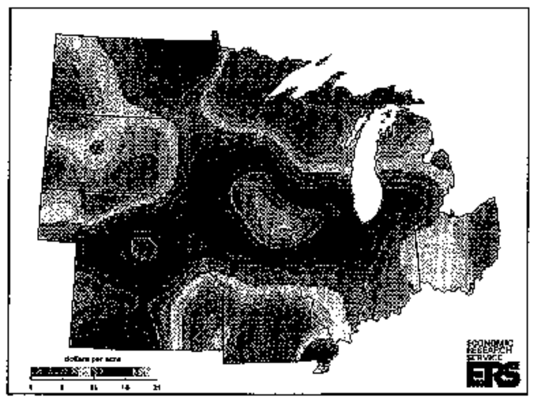


Figure 7: Proportion of land value due to direct government payments.

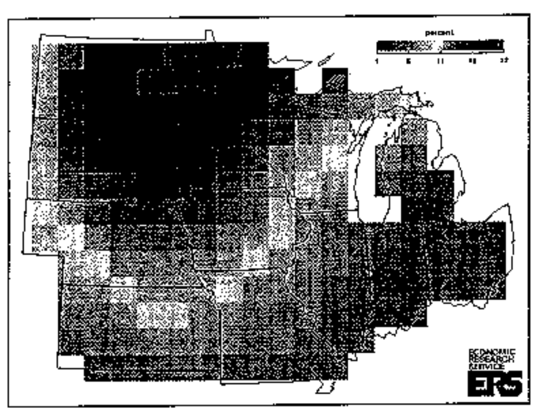
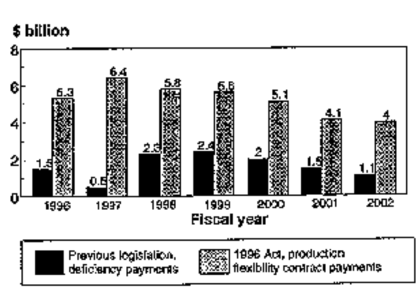


Figure 8: Production flexibility contract payments exceed projected deficiency payments.



TABLES

Table 1. Variable Definitions, Sources, and Statistics

Variable	Mean Value	Standard Deviation	Definition	Source
VALUE	1287.37	1513.07	Per−acre value of individual tracts of nonirrigated cropland, 1996	June Agric. Survey
RAIN	30.75	7.12	30−year avr. annual precipitation, county level	Nat'l. Center Res. Innov.
RAINSQ	995.97	415.23	*RAIN* squared	Nat'l. Center Res. Innov.
SRPG	66.25	11.24	Avr. soil relative productivity rating, county level	NRCS
POPACCESS	98.42	143.19	Population accessibility index, for sample segment	1990 Census of Population
GOVPMTS	12.39	4.27	Government payments per acre, county level	1992 Census of Agriculture
LATITUDE	41.88	2.79	Latitude of the centroid for the sample segment	June Agric. Survey
LONGITUDE	−92.28	5.42	Longitude of the centroid for the sample segment	June Agric. Survey
MICHIGAN	0.06	0.25	Dummy variable=1 if State is Michigan	June Agric. Survey
WISCONSIN	0.07	0.26	Dummy variable=1 if State is Wisconsin	June Agric. Survey
MINNESOTA	0.08	0.27	Dummy variable=1 if State is Minnesota	June Agric. Survey
INDIANA	0.09	0.29	Dummy variable=1 if State is Indiana	June Agric. Survey
ILLINOIS	0.12	0.33	Dummy variable=1 if State is Illinois	June Agric. Survey
IOWA	0.14	0.34	Dummy variable=1 if State is Iowa	June Agric. Survey
MISSOURI	0.09	0.28	Dummy variable=1 if State is Missouri	June Agric. Survey
NDAKOTA	0.07	0.26	Dummy variable=1 if State is North Dakota	June Agric. Survey
SDAKOTA	0.06	0.23	Dummy variable=1 if State is South Dakota	June Agric. Survey
NEBRASKA	0.06	0.24	Dummy variable=1 if State is Nebraska	

				June Agric. Survey
KANSAS	0.09	0.29	Dummy variable=1 if State is Kansas	June Agric. Survey

Table 2. Regression Results

Variable	Parameter Estimates	t−values
log of RAIN	4.44	9.00
log of RAINSQ	−0.74	−9.74
log of SRPG	0.67	21.45
log of POPACCESS	0.29	52.71
log of GOVPMTS	0.19	15.99
log of LATITUDE	0.60	3.24
log of LONGITUDE	−3.67	−11.99
MICHIGAN	−0.44	−19.53
WISCONSIN	−0.35	−11.15
MINNESOTA	0.03	0.63
INDIANA	0.17	7.47
ILLINOIS	0.48	17.29
IOWA	0.33	8.62
MISSOURI	0.12	3.06
NDAKOTA	−0.04	−0.85
SDAKOTA	−0.08	−1.68
NEBRASKA	0.07	1.58
KANSAS	−0.03	−0.59
Intercept	10.21	5.73
Adjusted R−Square	0.66	

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