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Agricultural Finance Markets in Transition
Proceedings of The Annual Meeting of NCT-194 Hosted by the Center for the Study of Rural America,
Federal Reserve Bank of Kansas City
October 6 - 7, 2003

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The Conservation Reserve Program (CRP) was established by the Food Security Act of 1985 and began enrolling farmland in 1986. Under this voluntary program, the U.S. Department of Agriculture contracts with agricultural producers and landowners to retire roughly 34 million acres of highly erodible and environmentally sensitive cropland from production for a period of 10-15 years. Enrolled land is planted to grasses, trees, and other cover, thereby reducing erosion and water pollution, providing other environmental benefits, and reducing the supply of agricultural commodities. CRP rental payments give participants a stable source of revenue and CRP's impact on production increases the market price of commodities for all crop farmers. The program's benefits to the environment, CRP participants, and other crop farmers have made it a recurring focus of subsequent farm program legislation; but the program's potential impact on hired farm labor and off-farm jobs in nearby communities has been a concern.

As with other farmland retirement programs, enrollment in CRP could reduce demand for farm inputs and agricultural marketing services unless cultivation is expanded by an equivalent amount elsewhere. While CRP rental payments compensate participants for the losses they incur from idling their land, CRP does not reimburse others for associated reductions in demand. As a result, if cultivation on nonenrolled land does not increase as CRP land is taken out of production, demand for local labor could decline as participation in CRP increases. For this reason, enrollment in CRP is capped at 25 percent of each county's total cropland unless permission to waive the cap is requested by county officials and granted by USDA. On the other hand, CRP provides environmental benefits which can enhance natural resource based tourism and recreational spending. Our aim in this paper is to determine if high levels of CRP enrollment had a measurable impact on job growth in affected counties during the program's first 15 years of operation.

Analytical Approach

Most research on CRP's economic impacts has relied on input/output models, such as IMPLAN, to estimate what is likely to happen as farmland is taken out of production. Studies by Martin, et al. (1988), Standaert and Smith (1989), Mortensen, et al. (1990), Hines et al. (1991), Hyberg, et al. (1991), Siegel and Johnson (1991), Dodson, et al. (1994), and Otto and Smith (1996) generally find that CRP could have a small negative impact on areas with high CRP participation. While providing a rough estimate of the potential adjustments local communities might face as farmland is retired, such simulations do not necessarily reflect how local economies actually adjust.[2] Our approach examines job growth trends before and after CRP was

[2] Input/output models capture economywide linkages at one point in time, but they hold these relationships constant when estimating the effects of subsequent policy changes. As the size of the CRP changes, industrial sectors, workers, and factor owners are expected to change in predictable ways. But as farm commodity prices change, previously uncultivated land may be planted, reducing CRP's impact on demand for farm-related goods and services. And as the program's environmental benefits begin to accumulate, other business opportunities not anticipated by existing input/output relationships, such as recreation, can emerge, altering the impact of a policy shock on job growth.

enacted and compares trends in counties with high levels of CRP enrollment with similar counties having little or no CRP enrollment. To our knowledge, this is the first nationwide econometric analysis of how job growth in rural counties reacted as land was enrolled in the CRP during the late 1980s and early 1990s.

In measuring the local importance of CRP, the enabling legislation implicitly adopted the proportion of each county's total cropland enrolled in CRP, capping it at 25 percent. After 1990, the mean proportion of cropland enrolled in CRP among counties with acreage in the program was roughly 6.6 percent. This is a reasonable metric when the primary concern is CRP's effect on farms and farm-related industries. But if the primary concern is with broader measures of community well-being, such as the change in total employment, high CRP enrollment relative to cropland may have little effect on the local economy if farming is a minor source of economic activity. A more direct measure of the local economic importance of resources retired by the CRP is the proportion of total household income received by county residents from CRP rental payments.[3] The mean rental-payment-to-income ratio among participating counties was remarkably stable during the early 1990s at about 0.75 percent. The two measures of CRP's local importance are positively correlated, but they measure different aspects of the program's importance.

To focus on locales most likely to be affected by cropland retirement, only counties in which farm employment comprised more than 5 percent of jobs in 1980 are considered. Furthermore, only counties in the contiguous 48 States that had an urban population of less than 20,000 in 1980 are analyzed. The resulting universe is composed of 1,481 counties located throughout the country, but concentrated in the Plains. These counties accounted for 79 percent of land enrolled in the CRP in both 1990 and 2002.

We further identify counties in which CRP is relatively important, based on the ratio of average CRP rental payments during 1991-1993 to total household income in 1985 (adjusted for inflation).[4] Focusing on counties with a payments-to-income ratio exceeding 2.75 percent and having more than 5,000 acres enrolled in the program yields 195 high-CRP counties, most of which were in the Plains. These high-CRP counties were matched with similar counties having little or no CRP enrollment to highlight CRP's impact on job growth trends. Figure 1 shows the location of the 195 high-CRP counties and their low-CRP matches.

To assess CRP's impact on the job growth process, we develop a single-equation, reduced-form rural job growth model based on previous literature. Four groups of explanatory variables are used in the analysis in addition to measures of CRP's local importance: (1) pre-CRP measures of employment and population change, (2) pre-CRP industrial and farm structure

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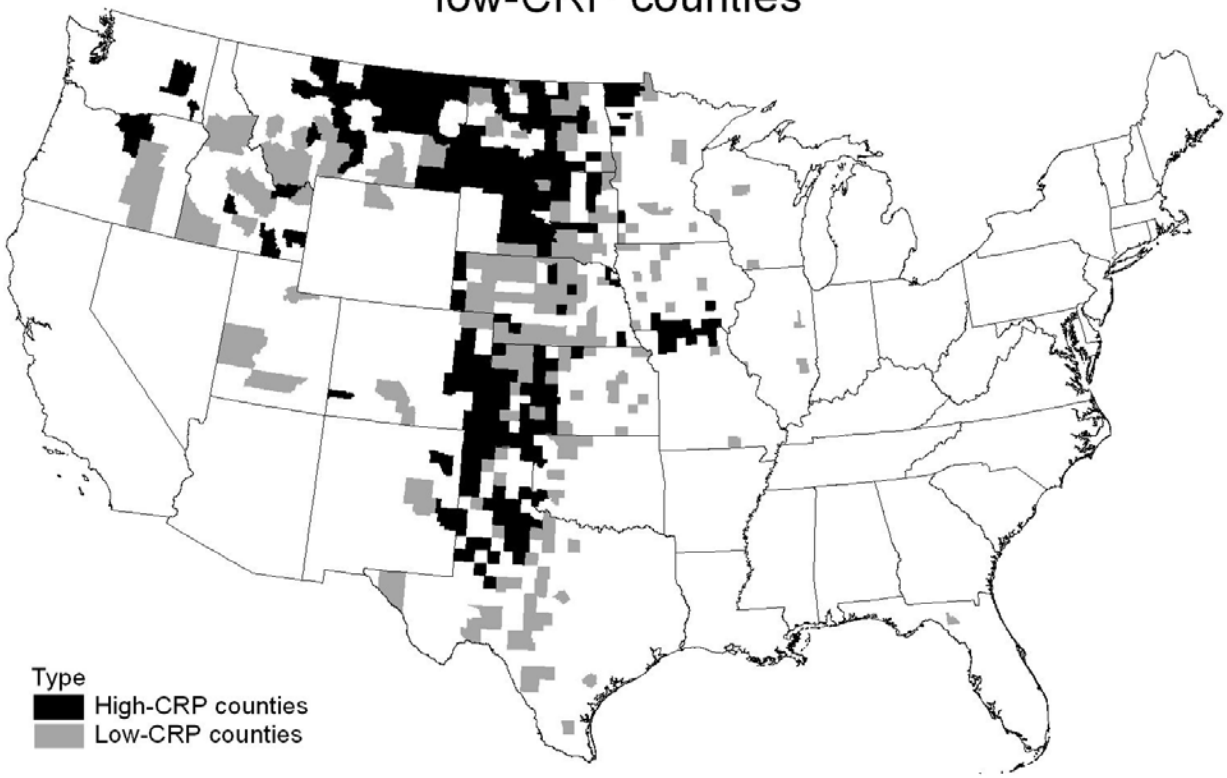
[3] Because we do not want the denominator of our measure to be influenced by CRP, we use pre-CRP estimates of county cropland and total household income to standardize CRP enrollment and rental payments, respectively.

[4] The program was nearly fully implemented by 1993. Using a 1991-93 average allows us to assess both the short-term impacts of CRP enrollment as well as impacts over a longer period, after local economies had time to adjust to the retirement of county farmland.

measures, (3) quality of life/amenity measures, and (4) pre-CRP demographic measures. To avoid biasing the estimated parameters, our non-CRP explanatory variables are from before CRP was enacted whenever possible. The dependent variable measures county employment change after 1985, as land began enrolling in the CRP. To capture both the short- and long-term response to CRP enrollment, employment change is measured over two periods—1985-1992 and 1985-2000. The specific measures included in our analysis are discussed in the appendix.

Figure 1: Matched pairs of high- and low-CRP counties



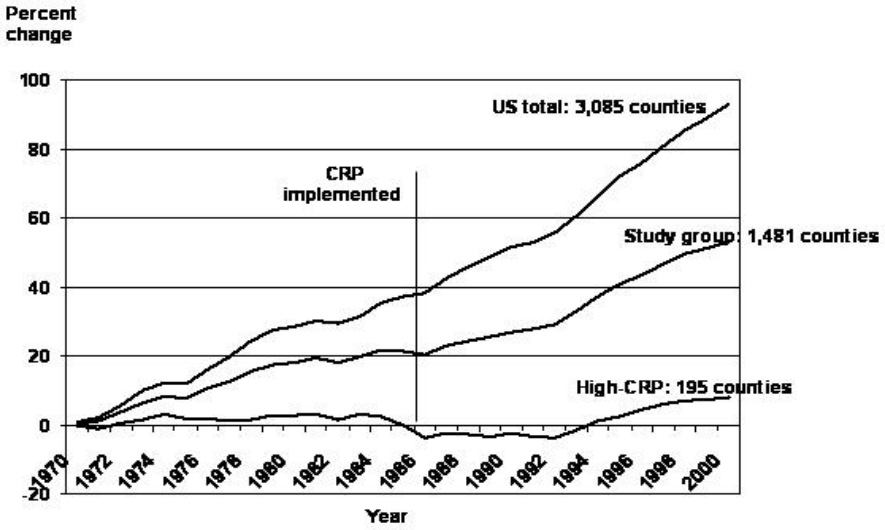
Source: CRP contracts file

Our database includes over 45 measures that previous studies have associated with job change or that reflect local agricultural conditions. While these explanatory variables should capture the independent effects of many county characteristics potentially related to employment change, several socioeconomic measures are highly correlated, with no *a priori* reason for selecting one over the other. To avoid statistical problems from estimating relationships with an over-identified model, in addition to a standard analysis including all explanatory variables, a backward stepwise regression procedure narrows the set of variables.

Although the selection criteria provide a reasonably homogeneous group of observations, the resulting counties still exhibit enormous variation in socioeconomic factors. This variability, coupled with the complexity of the economic growth process, invites erroneous estimates due to misspecified models. One approach to testing for program impacts where the underlying process is complex is the use of quasi-experimental, or matched-pair, control group analysis (Bohm and Lind, 1993; Reed and Rogers, 2003). Intuitively, if high-CRP (treatment) counties were compared to otherwise identical low-CRP (control) counties, differences in economic performance between the two groups would demonstrate the effects of high CRP enrollment. In reality, the matches are imperfect so econometric analysis is still required, but the use of matched-pairs should help clarify relationships.[5]

In theory, the standard econometric approach should provide efficient, unbiased estimates of CRP's influence on job growth trends. However, in practice there are several reasons for preferring a more controlled analytical design. First, enrollment in the CRP likely depends on the economic health of the community. While all environmentally sensitive land is eligible for enrollment, the program initially appealed most to owners of farmland with below-average productivity that didn't have particularly high value for nonfarm uses. That is, CRP use was most heavily concentrated in isolated areas with relatively poorly performing economies—not in fast growing areas. This can be seen in figure 2.

Figure 2: Average job growth, 1969-2000



Source: ERS analysis of BEA Employment Files.

[5] Ideally, counties should be similar in every respect except for the amount of CRP-eligible land, with low-CRP counties classified as such because their land was ineligible based on environmental sensitivity criteria. Unfortunately, it seems likely that some low-CRP counties are such because their eligible lands were too productive or too valuable for nonfarm uses to make enrollment in the CRP attractive. To the extent that considerations other than program eligibility led low-CRP counties to enroll fewer acres, our matched-pair comparisons will overstate the impact that CRP enrollment has on socioeconomic trends.

Counties with a high ratio of CRP rental-payments-to-income (greater than 2.75 percent) tended to have anemic local economies both before and after CRP was enacted in 1986. So the appropriate question is not whether high-CRP counties have performed worse than other counties, but whether CRP has affected their relative economic performance. This is much easier to evaluate within a quasi-experimental control group (QECG) analysis where high-CRP counties can be compared with counties having similar pre-CRP job growth trends, economic structures, etc.

Another reason why the traditional econometric approach might not be very fruitful is that CRP is not a sizeable program in the aggregate and for most counties with CRP enrollment. After an initial ramp-up period in the late 1980s, CRP rental payments have held steady at $1.4 to $1.7 billion per year. This isn't much when compared to other Federal farm program payments, let alone to all the other government programs and market fluctuations that influence job growth trends. By isolating counties with sizeable CRP enrollments, QECG analysis focuses on those counties most likely to be measurably affected by the program. Furthermore, the stability of CRP payment streams (guaranteed for the life of the 10-15 year contract) reinforces the analysis of high-CRP counties as "treatment" subjects from a program analysis perspective. Local CRP enrollment and rental receipts were fairly stable once the program was up and running.

Finally, QECG analysis makes it easier to assess program impacts when the precise functional form of the relationship between CRP enrollment and job growth is uncertain. It seems likely that the relationship between CRP and job growth is nonlinear, changes over time, and varies with economic conditions. By comparing "treatment" counties with "control" counties, QECG analysis can standardize many of the incidental characteristics which might influence the CRP-job growth relationship while putting variations in CRP's local importance in stark relief.

Therefore, in addition to estimating a traditional job growth model based on 1,481 study counties, we also estimate a series of models based on matched pairs of high- and low-CRP counties. Potential matches were restricted to study group counties which were not themselves high-CRP (based on either enrollment or rental payments) at any time during the program's history and which had CRP use measures that were less than 50 percent of the high-CRP county being matched.[6] Unique matches were selected which minimized the "Mahalanobis distances" between the high-CRP counties and all possible combinations of eligible low-CRP counties.[7] The Mahalanobis distance measures the similarity between observations based on a set of key characteristics—the smaller the distance, the more similar the matching is, based on the

[6] Paired t-tests indicate that the mean values of CRP's local importance (based on enrollments and rental payments) in high-CRP counties and their matches differ by more than two standard deviations, with a 99 percent level of confidence.

[7] The Mahalanobis distance metric takes the form $d^2(\mathbf{X}_T,\mathbf{X}_C)=(\mathbf{X}_T-\mathbf{X}_C)' \sum^{-1}(\mathbf{X}_T-\mathbf{X}_C)$, where $\mathbf{X}$ is the vector of selection variables, T is the treatment (i.e. high-CRP) county, C is a possible control county, d is the distance between the two vectors, and $\sum$ is the variance-covariance matrix of possible control counties (Isserman and Rephann, 1995).

characteristics being examined. Matches were based on pre-1984 measures of population growth, population density, commuting patterns, racial mix, mining employment, and the importance of Federal farm commodity program payments. In addition, contemporaneous measures of land in forest and the presence of natural amenities were included because historical data were not available. The aim is to find matched pairs of counties which were very similar before CRP enrollment began, and to then compare their development as land is enrolled.

The traditional growth model takes the form:

$$\log (J_{i,t} / J_{i,1985}) = f(CRP_i, \mathbf{X}_i)$$

where $J_{i,t}$ is the number of jobs in county i at time t greater than 1985, CRP_i is the local importance of CRP (i.e., the proportion of county cropland enrolled or the ratio of CRP rental-payments-to-income) in county i during 1991-1993, and $\mathbf{X}_i$ is a vector of county i's pre-1985 socioeconomic and amenity characteristics hypothesized to influence local job growth.

For the matched-pair analysis, the difference in job growth trends between high-CRP counties and their matches were estimated as a function of differences in explanatory variables between matched pairs of counties. That is:

$$(\log (J_{Tt}) - \log (J_{Ct}))_i = f((CRP_T - CRP_C)_i, (\mathbf{X}_T - \mathbf{X}_C)_i)$$

where J_{Tt} is the ratio of jobs in high-CRP county i at time t relative to jobs in 1985, J_{Ct} is the identical ratio for jobs in the low-CRP county uniquely matched with i, $(CRP_T - CRP_C)_i$ is the difference between CRP's local importance in high-CRP county i (the treatment county) and its matching low-CRP county (the control county), and $(\mathbf{X}_T - \mathbf{X}_C)_i$ is a vector of the differences between each explanatory variable in high-CRP county i and its match. This approach examined whether differences in development trends between high-CRP counties and their matches could be accounted for by differences in pre-CRP socioeconomic factors and CRP's local importance (Blundell and Dias).[8]

Finally, shifts in mining activity had a pronounced impact on several high-CRP counties and their matches. In addition to including mining employment in 1980 as an explanatory variable, we also created a separate set of matched pairs that excluded counties where mining comprised over 5 percent of 1980 employment. Doing so clarified the relationship between community development and CRP, since variations in mining added substantial statistical "noise" to the data.

Empirical Results

Between the matched-pair and study data sets, the two measures of CRP's local importance, whether mining counties are excluded or included, and whether all variables are

[8] When parameters are estimated without a measure of CRP's local importance, the constant term measures the marginal effect on job growth trends of being classified as a high-CRP county. When CRP's local importance is included as an explanatory variable, the constant term is constrained to equal zero.

included in the model or a backward stepwise procedure is used, we have 20 different estimates of the relationship between CRP use and employment trends for each time period examined. By first looking at all of these estimated relationships, we can better assess the consistency of the matched-pair estimations

The results, reported in Table 1, are fairly consistent. CRP was associated with slower job growth in the short run. All coefficients were negative, and in 7 cases the coefficient was statistically significant at the .10 level or better. However, this negative relationship did not persist over the longer period. Apparently, if negative effects existed, they were short-lived. Over the long run, the sign on the estimated CRP coefficient shifted from negative to positive in all but one equation; in three equations this estimate was statistically different from zero at the 0.10 level. This suggests that local economies were generally able to adapt to any loss in jobs associated with the CRP.

Table 1: Summary of initial analyses of CRP's relationship with employment trends

	Sign of CRP coefficients:			
	Positive		Negative	
	All	Significant	All	Significant
Change in the number of jobs:				
1985-1992 (short-term)	0	0	**20**	**7**
1985-2000 (long-term)	**19**	**3**	1	0

Note: The data refer to the sign and statistical significance of the CRP regression coefficient in 20 different versions of the growth model, allowing the functional form and the list of independent variables to vary. In each case, the dependent variable is the log of the ratio of jobs at the end of the period relative to 1985 (when matched pairs are analyzed, the dependent variable is the difference in the log of the jobs ratio in high- and low-CRP counties). Statistical significance is based on a 2-tailed t-test at the .10 level.

We have argued that CRP's effect on job growth trends should be easier to detect using the QECG approach, and among the 7 analyses that report a significant negative relationship between CRP's local importance and job trends, 5 rely on the matched pairs of counties. Focusing on the results of the backward stepwise regression analysis of the matched pairs, we find that job growth trends are particularly sensitive to CRP enrollment relative to county cropland.[9] Table 2 presents the key results of a series of regressions on differences between high-CRP counties and their matched pairs. The first group of results shows whether differences in the size of the CRP payments-to-income ratio had a significant impact on county trends. Here

[9] This result is not unique to the backward stepwise regression analysis. The ratio of CRP payments-to-income was significantly related to job trends over 1985-1992 in only 1 of the 8 regressions it appeared in (these include standard and backward stepwise regressions of all study counties and study counties other than those with more than 5 percent employed in mining as well as similar analyses of matched-pairs of high- and low-CRP counties). On the other hand, the ratio of CRP enrollment-to-cropland was significant in 6 of the 8 regressions it appeared in. The remaining 4 regression analyses summarized in table 1 were for matched-pairs where neither measure of CRP's local importance was present (allowing the constant term to capture the marginal impact of being classified as a hgh-CRP county).

the results differ depending upon whether mining counties are included in the analysis or not. With mining counties excluded, job growth between 1985 and 2000 was positively related to CRP use.[10] The second group of results shows whether differences in the proportion of cropland enrolled in the CRP are related to differences in county trends. It appears that the relative size of CRP enrollment has a consistent, statistically significant, negative effect on job growth between 1985 and 1992, but little effect over the longer period.

One explanation for the discrepancy between the statistical significance of the coefficients for our two measures of CRP's local importance is that CRP-related job losses are most likely to occur in agricultural service centers. Counties with the highest CRP payments-to-income ratios have very low populations, are heavily dependent on farming, and lack significant numbers of nonfarm businesses. However, counties with the highest proportions of *land* in CRP may still have small towns with nonfarm businesses that could be adversely affected by declining sales of farm inputs and services.

Table 2: CRP's association with employment trends, 1985-2000

	Matched pairs[1]		Matched pairs/no mining[1]	
	Beta	Adj. R^2	Beta	Adj. R^2
CRP payments/income ratio[2]				
1985-1992 employment change	-0.0020	0.33	-0.0007	0.43
1985-2000 employment change	0.0014	0.38	**0.0045***	0.37
CRP enrollment/county acreage ratio[2]				
1985-1992 employment change	**-0.0027***	0.34	**-0.0028****	0.45
1985-2000 employment change	0.0009	0.38	0.0001	0.36

Source: Economic Research Service calculations using data from the 1980 Census of Population, the 1982 Census of Agriculture, the Bureau of Economic Analysis, and the CRP Contracts file.

* and ** indicate the regression coefficient is statistically different from 0 at the .05 and .01 level of significance, respectively. Beta represents the standardized regression coefficient for the CRP variable. Adjusted R^2 indicates the portion of variation explained by the regression.

[1] There are a total of 195 high-CRP-low-CRP matched pairs; when counties with more than 5 percent employed in mining in 1980 are excluded, this number drops to 190.

[2] When the difference-in-difference equations include a continuous variable measuring CRP's local importance, the constant is constrained to equal 0.

To investigate this issue further, we focus on the matched pair data set as these counties all have relatively low population densities.[11] By including a population density-CRP interaction term in the regression, we can measure CRP's differential impact on local communities as

[10] Mining employment was very volatile during the study period with employment increasing rapidly in some areas and decreasing rapidly in others. As a result, neither a continuous variable measuring the proportion of local jobs in mining nor a dummy variable for mining counties was effective at capturing mining's impact.

[11] This analysis was replicated for all counties remote from major cities and lacking towns of 2,500 or more. Results were generally consistent with those reported in table 3.

county population density varies. Because agricultural service centers may have been losing out to larger centers during this period, we also include an interaction term (percentage employed in agriculture multiplied by population density) to reflect any tendency for employment loss to be greater in more densely settled agricultural areas over the study period. The results of these analyses indicate that the negative effects of CRP on the number of jobs in the county were stronger in more densely settled rural counties than in thinly settled counties (Table 3). This was true over both the short and the long run, but the CRP coefficient was slightly higher in the long run equation while the absolute size of the CRP-density interaction term was noticeably smaller. The net result was that the association between CRP and depressed job growth in more densely populated rural counties was not nearly as strong in the long run.

Table 3: Interaction between population density and CRP's impact on nonfarm job growth

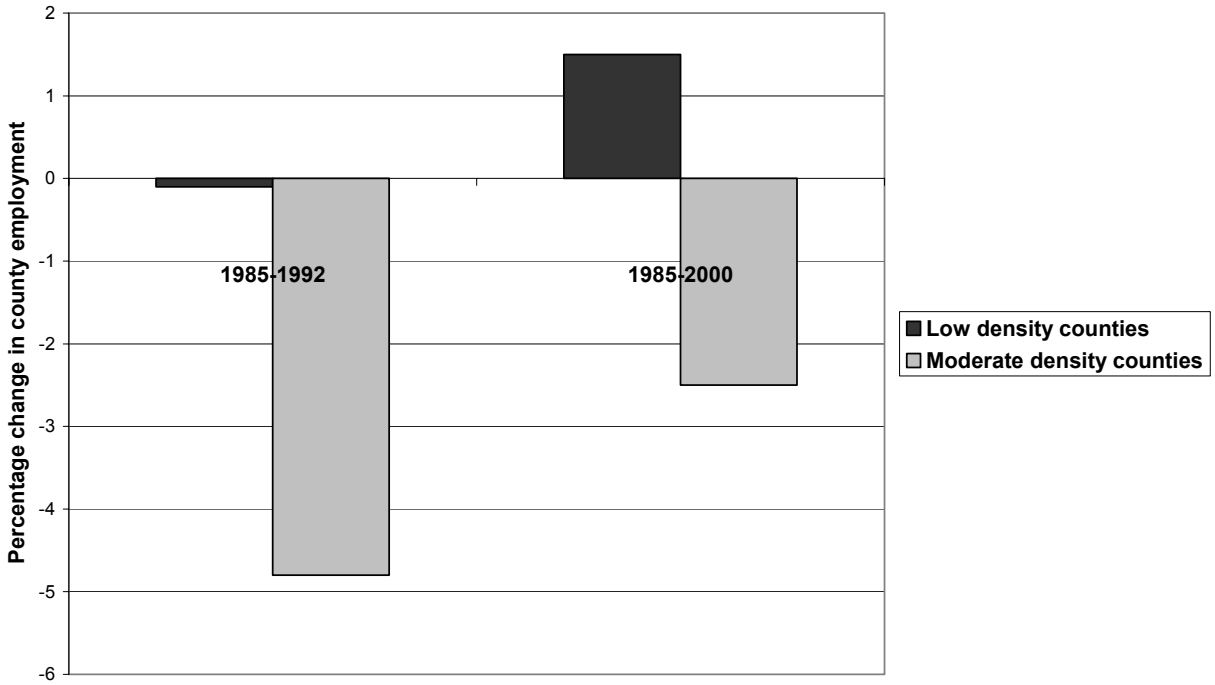
	Short term job growth (1985-1992)		Long term job growth (1985-2000)	
	Beta	t-statistic	Beta	t-statistic
CRP payments/income ratio	**0.232**	**2.26***	**0.247**	**2.28***
Population density, 1980 (log)	-0.286	2.05*	-0.012	0.08
Population density x CRP ratio	**-0.354**	**3.90****	**-0.201**	**2.20***
Agricultural jobs, 1980 (%)	-0.507	4.69**	-0.027	0.23
Population density x agricultural jobs	0.141	1.41	0.009	0.92
Population under 18, 1980 (%)	0.226	3.66**	0.243	3.70**
Black population, 1980 (%)	-1.142	2.25*	-0.238	3.68**
Mining jobs (%)	-0.302	4.71**	-0.133	2.02*
Working outside the county, 1980 (%)	--	--	0.122	1.66
Median household income, 1979 (log)	-0.177	2.79**	--	--
Great Plains dummy	-0.209	2.90**	-0.158	1.92
Land in forest (%)	--	--	0.256	3.38**
Govt. payments/total income, 1981-83	--	--	-0.268	2.40*
Wheat/total farm sales, 1982 (%)	-0.126	1.74	--	--
Adj. R^2	0.341		0.321	

Source: Economic Research Service calculations using data from the 1980 Census of Population, the 1982 Census of Agriculture, the Bureau of Economic Analysis, and the CRP Contracts file. All variables represent the difference between the level in each high-CRP and its matching low-CRP county, excluding pairs that include a county with more than 5 percent employed in mining. The first 5 variables are included by default while the remaining variables were selected by the backward stepwise procedure from among all explanatory variables based on the statistical significance of their contribution. The constant term was constrained to equal 0.

* and ** indicate the regression coefficient is statistically different from 0 at the .05 and .01 level of significance, respectively. Beta represents the standardized regression coefficient for the CRP variable. Adjusted R^2 indicates the portion of variation explained by the regression.

The marginal effect of CRP in thinly and more densely populated rural counties is easier to see in Figure 3. This figure shows the estimated impact of CRP on employment change as the difference in the ratio of CRP payments-to-income between low- and high-CRP counties increases from 0 to 4 percent. For low-density counties (those with fewer than 2 persons per square mile), CRP appears to have made little difference for employment change in either the short- or long-term. For higher density rural counties (those with more than 9 persons per square mile), the effect of a 4 percentage point increase in the ratio of CRP payments-to-income on county employment growth was substantial in the short-run, but effects dissipated over time as local economies adjusted. We interpret these results to mean that CRP had its most negative effects on jobs in counties with agricultural service centers, but that these effects were largely confined to the short term.

Figure 3: Nonfarm job growth in counties with low and moderate population density



Note: The bars indicate the estimated change in job growth if a county's ratio of CRP rental payments-to-household-income increased from 0 to 4 percent, holding other county characteristics constant. Low density counties have fewer than 2 persons per square mile. Moderate density counties have more than 9 persons per square mile. (The average for all 1,481 counties in the broader study group is 24 persons per square mile.)

These results are consistent with earlier estimates of CRP's likely effect on local economies in Oregon. In their forecasts, Martin, et al. (1988) projected that CRP would negatively affect farm dependent communities with small subregional agricultural supply centers. They expected farm dependent communities that were too small to support such centers (low density in our terminology) to be either unaffected or positively affected by CRP

enrollments. Our results and the earlier forecasts by Martin, et al., focus on small isolated farming economies. Larger, more diversified economies are less likely to be significantly affected by CRP's impact on demand for farm-related goods and services.

Summary, Limitations, and Future Work

Previous attempts to estimate CRP's socioeconomic impacts have relied on: (1) deterministic models of the local economy, most often based on IMPLAN; (2) surveys of program participants and local government officials; and (3) econometric analyses of similar types of programs. While each of these approaches is useful and adds valuable insight into the adjustment process farming communities go through as they accommodate policy shocks, none can accurately evaluate what happens in response to changes in CRP enrollment. To our knowledge, this is the first systematic attempt to econometrically model the impact that CRP has had on farming communities nationwide based on observed data. These results suggest that local job growth may be sensitive to CRP enrollment, particularly in areas with small agricultural service centers. However, detrimental effects tend to be modest and fairly short lived. Rural economies, even those in undiversified farm-dependent areas, appear resilient enough to adapt to shifting demands and opportunities.

We designed our analysis to err on the side of finding a relationship between CRP and job growth. Nonetheless, limitations of the model and available data need to be acknowledged. Our analysis was conducted at the county level, so is not sensitive to changes in the distribution of jobs within counties. CRP could have much larger impacts on small geographic areas, such as individual towns, that are obscured by job growth elsewhere within the county.[12] Furthermore, while we have found evidence of a short-term relationship between CRP enrollment and job growth trends in some counties, we haven't demonstrated causality. CRP enrollment may be a more attractive option in areas experiencing economic problems whether or not that enrollment contributes to the area's problems. Finally, our matched pairs of high- and low-CRP counties were drawn from the same geographic area since high-CRP counties have unique characteristics that make them hard to match. To the extent that CRP's impacts are areawide, rather than confined to the county where CRP land is located, our analysis of differences between high- and low-CRP counties may be biased. The likely direction of the bias, if it exists, is unclear since CRP could have both positive and negative areawide impacts.

Our results hint at the complex economic changes that may have accompanied land retirement in counties with high levels of CRP participation. But to better understand how the adjustment process unfolded, we plan to perform cross-section time series analysis of changes in aggregate employment to see what the time lags were and what happened when CRP contracts began to expire after 1996. As time permits, we also plan to disaggregate the analysis to look at job growth in farm inputs and services industries as well as recreation and tourism industries to see how responsive they were to land retirement. Was the growth in recreation industries responsible for the longer term job growth patterns experienced by high-CRP counties or was the trend more widespread?

[12] Research has shown that the relative size of program impacts is greatest within small geographic units (Hamilton and Levens, 1998) and that program impacts vary from community to community within a local area (Henderson, et al., 1992).

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Appendix: Modeling Rural Job Growth

We measure job growth as the natural log of the ratio of the number of jobs in each county in 1992 or 2000 relative to its 1985 job count. In modeling rural job growth, a county's historic pattern of population and employment change are often key predictors. County changes in population and employment are included for both the 1970s and the years immediately preceding the introduction of the CRP (1982-85). In the 1970s, agriculture, mining, and manufacturing were all relatively prosperous and contributed to the rural rebound of the period. In contrast, these industries suffered in the 1980s. The inclusion of 1982-85 changes captures some of this decline. As with the dependent variable, these explanatory variables take the log form. Table A-1 provides the mean values of the population and employment change variables, expressed as simple percentage changes, for the study group, high-CRP counties, and their matched pairs.

Table A-1: Mean values of population and employment trend variables

Variable description	Units	Study counties	High-CRP[1]	Matched counties
Dependent variables--				
Post-CRP employment change:				
1985-1992 (short run)	Pct.	5.6	-3.7	1.4**
1985-2000 (long run)	Pct.	23.9	7.6	13.4**
Explanatory variables--				
Pre-CRP population change:				
1970-1982	Pct.	11.3	-3.2	3.3**
1982-1985[2]	Pct	-0.3	-2.3	-1.3**
Pre-CRP employment change:				
1970-1982	Pct.	17.6	1.6	13.5**
1982-1985[2]	Pct.	2.6	-1.7	0.3**

Source: BEA Income files.
** indicates that the difference between high-CRP counties and their matched pairs is significantly greater than 0 at the 0.01 level.
[1] High-CRP counties have an average CRP rental-payment-to-income ratio for 1991-93 exceeding 2.75 percent. Of the 1,481 study counties, 195 were high-CRP by this definition.
[2] We include 1982-85 trends separately because rural county growth was slower in this period than during the preceding 12 years.

Measures of initial industry structure are ubiquitous in studies of job growth. The basic assumption is that local trends reflect national trends. Industry structure is measured by the proportion of employed residents working in agriculture, manufacturing, mining, business services (finance, insurance, real estate, and other professional services), and recreation (eating places, amusement, and recreation, other than hotels) in 1980, based on Census of Population data. Three types of somewhat unique rural industrial expansion that began in the late 1980s are

casino resorts, prisons, and large meatpacking plants. These expansions were not affected by CRP, yet could have major impacts in counties where they are located. To take account of the sometimes dramatic changes accompanying these types of development, dummy variables were included to reflect whether a county had any of these industries in 2000.

Because CRP primarily affects farming-dependent areas, several agricultural variables in addition to employment were included in the analysis. Farm sales in 1982 relative to 1980 household income and farm income from government payments in 1981-83 relative to total personal income over this 3-year period were included to better measure the farm sector's importance to the local economy.[13] Also included were the percentage of county land in crops, the percentage of county farmland that was irrigated, the percentage of farm sales by type (livestock, all grains, and wheat), and to reflect farm size, the proportion of sales going to very small farms (under $20,000 sales) and large farms (over $250,000 sales). The proportion of farm operators working off-farm over 200 days a year was included, since the availability of off-farm work might enhance CRP participation. Finally, the ratio of CRP enrollment-to-total-cropland or the ratio of CRP rental payments to county household income is included to measure CRP's local importance. All of these data, with the exception of CRP and commodity program payments and county income were from the 1982 Census of Agriculture. Government payments and income for 1981-83 were from the BEA, and household income was from the 1980 Census of Population. CRP enrollment and rental payments were calculated from data reported in the CRP contracts file. Mean values of the industry and farm structure variables are presented in Table A-2.

The final set of economic measures reflects local labor market conditions. Higher employment rates and higher incomes might encourage local job growth through migration, but might discourage new employers. These are measured by the proportion of the population employed in 1980 and the log of median household income in 1979. The percentages of young adults (ages 25-44) who completed less than 12 or at least 16 years of school are also included. In general, both earnings and the likelihood of employment rise with education.

The attractiveness of an area is a function of its access to services and other amenities. Access to services is measured by whether the county was adjacency to a metropolitan area in 1983 (represented as a 0/1 dummy variable) and the log of its population density in 1980. The growth potential of a county may also depend on the percentage of its residents commuting outside the county to work. Finally, because the Great Plains has its own unique characteristics, a dummy variable indicates whether or not the county was in the Plains.

A series of demographic variables captures the effects of race, ethnicity, and age on the community growth process. The percentages of the population classified as Black, Hispanic, or American Indian were included in the equation, as was the percentage of the population under 18 years of age and over 62 years of age. All of the labor market and demographic variables were from the 1980 Census of Population.

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[13] Goetz and Debertin (1996) found that farm program payments were negatively associated with population change, controlling for a number of farm and industry measures. Van der Sluis and Peterson found a similar relationship, although they attributed it to cropland diversion requirements (1998).

Table A-2: Mean values of industrial and farm structure variables

Variable description	Units	Study counties	High-CRP[1]	Matched counties
Local economic characteristics:				
Agricultural employment, 1980	Pct.	16.7	31.7	24.7**
Manufacturing employment, 1980	Pct.	17.6	5.7	8.4**
Mining employment, 1980	Pct.	2.5	2.2	2.3
Business services employment, 1980	Pct.	4.2	3.9	4.2*
Recreation employment, 1980	Pct.	4.1	4.1	4.5*
Special development dummy variables[2]:				
Prison county dummy	0/1	2.6	1.0	0.0
Casino county dummy[3]	0/1	0.9	0.0	1.5
Meatpacking plant county dummy	0/1	1.4	0.5	1.0
Agricultural characteristics:				
Cropland/all land, 1982	Pct.	40.5	46.7	45.1
Irrigated farmland, 1982	Pct.	4.5	4.3	8.5**
Grain/total sales value, 1982	Pct.	29.5	38.4	31.5**
Wheat/total sales, 1982	Pct.	8.8	25.2	12.2**
Livestock/total sales, 1982	Pct.	56.2	51.5	61.6**
Govt. payments/total income, 1981-83	Pct.	1.6	6.0	2.6**
CRP enrollment-to-cropland, 1991-93	Pct.	8.0	21.3	5.1**
CRP payments-to-income ratio, 1991-93	Pct.	1.3	6.7	0.8**
Farm sales/household income, 1980	Pct.	0.8	1.9	1.4**
Farms w/ sales over $250,000 in 1982	Pct.	4.7	5.3	5.8
Farms w/ sales under $20,000 in 1982	Pct.	51.5	35.7	38.9*
Farmers working off-farm 200+ days	Pct.	28.0	17.9	21.0**

Source: 1980 Census of Population, 1982 Census of Agriculture, BEA Income file, and CRP Contracts file.
* and ** indicate that the difference between high-CRP counties and their matched pairs is significantly greater than 0 at the 0.05 and 0.01 level, respectively.

[1] High-CRP counties have an average CRP rental-payment-to-income ratio for 1991-93 exceeding 2.75 percent. Of the 1,481 study counties, 195 were high-CRP by this definition.

[2] The data reported for all 0/1 dummy variables represent the percentage of observations coded "1" rather than the mean for expositional ease.

[3] In Tunica, MS, a hitherto declining agricultural county, the development of a casino-hotel complex led to a sixfold increase in the number of jobs between 1990 and 2000. Because Tunica County was an extreme outlier, a dummy variable was included for that county in the study group equations. In addition, a dummy variable reflecting Somervel, TX, enters the equation for the entire sample to adjust for its inordinate growth due to the construction of a nuclear power plant in an adjacent county.

To measure scenic attractiveness, the presence of high mountains (0/1 dummy variable), the prominence of surface water (in logarithmic form) and forests (percentage of land area) are included in analyses of the entire study group. Also included are z-scores of several climate measures, including average January and July temperature, relative humidity in July, and sunny days in January, all of which were found to be associated with an area's attractiveness (McGranahan, 1999). For the matched-pair analysis, these amenity measures were replaced by the "natural amenity scale" developed by McGranahan (1999) to combine all of these factors into one measure. Table A-3 presents descriptive statistics for these variables.

Table A-3: Mean values of labor market, demographic, and amenity variables

Variable description	Units	Study counties	High-CRP[1]	Matched counties
Labor market and location characteristics:				
Civilian employment, aged 15-64, 1980	Pct.	62.7	64.9	65.6
Working outside the county, 1980	Pct.	19.0	10.9	12.9*
Under 12 years of school, aged 25-44	Pct.	23.4	17.2	16.5
College grads, aged 25-44, 1980	Pct.	14.1	16.9	17.4
Median household income, 1979	$	12,840	12,620	12,936
Population density, 1980	P/sq mi	24	5	10**
Adjacent to a metropolitan area, 1983	0/1[2]	41.3	15.9	22.6
Great Plains dummy variable	0/1[2]	27.1	80.0	59.5**
Demographic characteristics:				
Black population, 1980	Pct.	7.1	0.6	0.4
Hispanic population, 1980	Pct.	4.2	4.4	6.9
Native American population, 1980	Pct.	1.5	3.3	1.9
Population under 18, 1980	Pct.	29.7	29.8	29.3
Population over 62, 1980	Pct.	18.2	19.3	19.7
Natural amenity characteristics:				
High mountains dummy variable	0/1[2]	7.4	5.6	10.8
Water/total area (x 10)	Log	-2.1.	-6.5	-6.2
Land in forest	Pct.	26.7	3.7	8.5**
January days with sun (x 10)	Z-score	1.8	5.2	5.4
January temperature (x 10)	Z-score	-1.9	-8.3	-6.1*
July humidity (x 10)	Z-score	2.3	9.7	7.1**
July temperature (x 10)	Z-score	-2.6	-4.8	-5.0
Natural amenities scale (x 10)	Z-score	-3.6	-7.2	-6.6

Source: 1980 Census of Population and McGranahan (1999).

* and ** indicate that the difference between high-CRP counties and their matched pairs is significantly greater than 0 at the 0.05 and 0.01 level, respectively.

[1] High-CRP counties have an average CRP rental-payment-to-income ratio for 1991-93 exceeding 2.75 percent. Of the 1,481 study counties, 195 were high-CRP by this definition.

[2] The data reported for all 0/1 dummy variables represent the percentage of observations coded "1" rather than the mean for expositional ease.