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Abstract

This report estimates the impact that high levels of enrollment in the Conservation Reserve Program (CRP) have had on economic trends in rural counties since the program's inception in 1985 until today. The results of a growth model and quasi-experimental control group analysis indicate no discernible impact by the CRP on aggregate county population trends. Aggregate employment growth may have slowed in some high-CRP counties, but only temporarily. High levels of CRP enrollment appear to have affected farm-related businesses over the long run, but growth in the number of other nonfarm businesses moderated CRP's impact on total employment. If CRP contracts had ended in 2001, simulation models suggest that roughly 51 percent of CRP land would have returned to crop production, and that spending on outdoor recreation would decrease by as much as $300 million per year in rural areas. The resulting impacts on employment and income vary widely among regions having similar CRP enrollments, depending upon local economic conditions.

Keywords: Conservation Reserve Program, CRP, rural development, rural employment, land retirement impacts, land-use changes, recreation spending

Acknowledgments

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Summary

By retiring over 34 million acres of cropland since 1986, the Conservation Reserve Program (CRP) has substantially reduced soil erosion, enhanced wildlife populations, and protected soil quality. But, despite its considerable environmental and farm sector benefits, concerns continue that the program may adversely affect nearby communities as farmland is retired and demand for farm inputs and agricultural marketing services declines. This report examines the economic trends accompanying changes in CRP enrollment and finds that, in aggregate, the adverse economic impacts of the CRP are generally small and fade over time.

High CRP enrollment was associated with a net loss of jobs in some rural counties between 1986 and 1992, but this relationship did not persist throughout the 1990s. Farm-related businesses, such as input suppliers and grain elevators, continued contracting throughout the 1990s, but other business expansions moderated the CRP's impact on total employment. In particular, the CRP may be responsible for as much as $300 million dollars per year in increased outdoor recreational expenditures in rural areas.

We found no statistically significant evidence to support the commonly held belief that CRP encourages rural outmigration. Once county characteristics, such as population density, economic base, and distance to urban centers, are taken into account, post-1985 population trends in rural counties are largely unaffected by CRP enrollment. In addition, high levels of CRP enrollment appear not to have affected beginning farm trends (although whole-farm enrollment was negatively related with beginning farmer trends and partial-farm enrollment was positively related). Nor does CRP participation seem to encourage absentee ownership.

In aggregate, the economies of rural counties, even those experiencing long-term population and employment declines, were able to adjust to CRP-induced shifts in demand. But what would happen if CRP enrollments were reduced or eliminated now that the program has been in operation for nearly two decades? Supplementing this retrospective analysis, economywide impacts of allowing CRP contracts to expire were also estimated. Based on market conditions prevalent in 2000, we estimate that only about half of the land enrolled in CRP would have immediately returned to crop production if CRP contracts had expired in 2001. The remainder would have gone into pasture or stayed in conservation uses. Land brought back into production would increase demand for farm-related goods and services (farm inputs, labor, marketing and transportation services, etc.), leading to job growth in these industries. But reduced outdoor recreational spending would lead to job losses in other industries. And, as income is redistributed away from farm households to other sectors of the economy, shifting demand for consumer goods and services could lead to other job changes as well.

Nationally, the economic effects of allowing CRP land to return to production would be very small, with positive and negative effects within particular industries and regions largely canceling each other out. But, the potential effects could be noticeable in areas of the country where CRP enrollment is relatively high. CRP's impact on local economies is sensitive to local conditions. The value of alternative uses of CRP land, the value of the environmental benefits attributable to land retirement, and the extent to which goods and services are produced and provided locally all affect the CRP's local economic impacts. While regional output and jobs are estimated to increase at least slightly, this is largely due to changes in the farm sector. Nonfarm output and employment would decline in some regions if CRP contracts expired, as would aggregate household income.

Introduction

The Conservation Reserve Program (CRP) was established by the Food Security Act of 1985 (the 1985 Act) and began enrolling farmland in 1986. Under this voluntary program, the U.S. Department of Agriculture (USDA) establishes contracts with agricultural producers and landowners to retire highly erodible and environmentally sensitive cropland and pasture from production for a period of 10-15 years.[1] 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 other 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. From its beginning, however, the program's potential effect on farm communities has been a concern.

As with other farmland retirement programs, enrollment in CRP can reduce demand for farm inputs and agricultural marketing services. As land is taken out of production, purchases of farm inputs such as seed, fertilizer, pesticides, herbicides, farm machinery, and labor decline unless cultivation is expanded by an equivalent amount elsewhere (either on new land or through more intensive use of existing cropland). Furthermore, if local agricultural production declines, there is less need for grain elevators, packing and processing facilities, and related transportation and marketing services. While CRP rental payments compensate participants for the losses they incur from idling their land, CRP does not reimburse businesses for associated reductions in demand for farm inputs and services. As a result, if cultivation on nonenrolled land does not increase as CRP land is taken out of production, parts of the local economies of rural counties can be adversely affected. If alternative economic activities (such as hunting, fishing, and outdoor recreation) do not develop as farmland is taken out of production, farm-dependent communities with high CRP enrollment can experience economywide slowdowns. For this reason, enrollment in CRP is normally capped at 25 percent of each county's cropland acreage. Whether the 25-percent cap has been effective at limiting adverse community impacts remains an open question.

The CRP may have other unintended consequences as well. As CRP participants enroll more of their land, their financial dependence on farming declines, allowing them to more easily retire from farming completely. Not only do these "whole-farm" enrollments reduce demand for farm inputs and services, but if the participant chooses to move elsewhere, the local economy is also deprived of the CRP rental payments. There are concerns that the CRP may have spurred a cycle of population decline in some communities, with a drop in the farm population leading to a decline in retail and government services, which encourages still others to leave the community. As population declines, it becomes harder for local retailers to survive and it becomes more expensive (per capita) for local governments to maintain public services such as education, police protection, and infrastructure. While casual observation supports the notion that many of the communities most dependent on CRP rental payments as a source of income are

[1] The primary focus of the CRP is to retire cropland from production. A limited amount of pasture has been enrolled in the program as riparian buffers for water-quality enhancement. Currently, around 250,000 acres of marginal pasture is enrolled in CRP, amounting to less than 1 percent of total enrollment.

losing population, it is not clear whether CRP enrollment is a cause of their decline or merely a symptom.

By providing additional competition for agricultural land, the CRP may also affect the ability of established farmers to expand their operations and of beginning farmers to lease or purchase farmland. Since the program is voluntary, CRP rental rates need to be sufficient to reimburse participants for the losses they would otherwise incur from taking land out of production. And, since environmentally sensitive land targeted by CRP is not necessarily of marginal productivity, CRP can sometimes retire highly productive land, leaving expanding operations and beginning farmers competing for less productive land at rental rates that are higher than would be the case in the program's absence. In areas where CRP participation is high, it has been hypothesized that beginning farmers may have a difficult time becoming established and farm operations that depend heavily on rented land may be disadvantaged.

Implicit in all of these concerns is the notion that CRP enrollment influences individual and market behavior. That is, CRP could depress local economies *if*, in the absence of CRP, more local land would have been farmed. CRP could affect local populations *if*, in the absence of CRP, more farmers and local business owners would have retained residence. But, at least in some cases, it is likely that a farmer's behavioral choices were largely unaffected by the decision to enroll in CRP. Then too, the range of possible choices open to program participants changes with economic circumstances, so the impacts of the CRP when the farm sector and the rural economy are in recession are likely to be different from the program's impacts during an economic expansion. Blanket statements about CRP's impacts may not apply equally well to all communities or time periods, so any analysis of CRP's impacts is necessarily sensitive to prevailing market conditions and a host of other factors.

This report examines concerns about CRP's unintended consequences by evaluating the program's effects over the first 10-15 years of its life on counties where CRP rental payments made up a relatively large share of total household income, or where CRP enrollment comprised a relatively high proportion of cropland. Since administration of the CRP has changed over time, along with the economic choices facing potential enrollees and their communities, this report also estimates the potential economic and land-use effects that discontinuing the program would have in regions of the country that were heavy participants as of 2000.

An Overview of the Conservation Reserve Program

The CRP was not the first farmland retirement program operated by the Federal Government, nor was it the only land-diversion program operating at the time of its enactment. In 1956, a Soil Bank Program was instituted to retire farmland from production for 3-10 years, with conservation cover maintained on the idled land. Primarily a supply control program (erodible land was not targeted), the Soil Bank Program was phased out in favor of idling a portion of a producer's cropland base to establish commodity support program eligibility. The last Soil Bank Program contracts expired in the early 1970s, but annual paid land-diversion and Acreage Reduction Program (ARP) requirements continued through 1995. As can be seen in figure 2.1, diverted acres outnumbered CRP enrollment until 1990. While land-diversion requirements varied from year to year, they affected the supply of cropland available for production and may have had some of the same effects as CRP enrollment.[2]

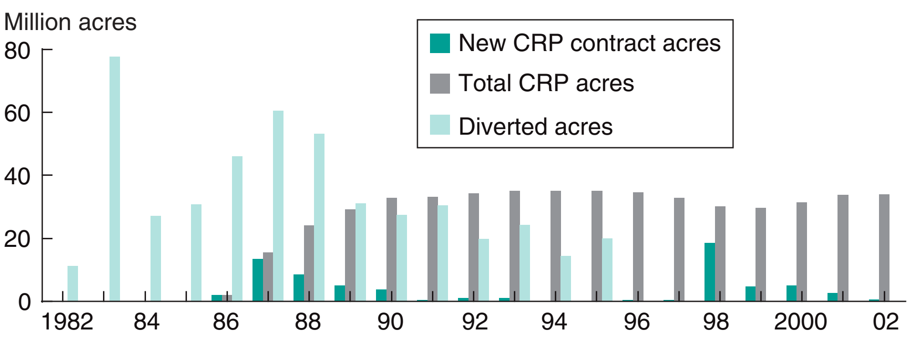
Unlike other land-diversion programs, which focused on supply control, the primary goal of the CRP in the years immediately following its creation in 1985 was to reduce soil erosion on highly erodible cropland (Osborn et al., 1995). But, given the financial crisis facing the farm sector at the time, curbing production of farm commodities and providing income support for CRP participants were also important program goals (Dicks, 1987; Martin et al., 1988). Other objectives included protecting the Nation's long-term ability to produce food and fiber, reducing sedimentation, improving water quality, and fostering wildlife habitat. Subsequent legislative and regulatory actions altered the weight given these various objectives and spurred other important changes in the way CRP contracts are awarded.

Enrollment in CRP increased rapidly once the program got underway (fig. 2.1). Nearly 34 million acres were enrolled between 1986 and 1989. In exchange for retiring eligible land for 10-15 years, participants received an

[2] Since CRP enrollments influenced land-diversion requirements through their impact on production decisions and commodity prices, analyses of CRP's impacts over 1986-1995 should ideally reflect the impact that these requirements had as well. Between 1982 and 1985, paid land diversion and ARP averaged 37 million acres annually—slightly more than the level retired by CRP at its height.

Figure 2.1

CRP enrollment and other diverted acreage, 1982-2002



Source: Farm Service Agency, CRP Summary Statistics and U.S. Land-Use Summary annual rental payment that averaged roughly $50/acre, and were reimbursed for half of the cost of establishing permanent cover (usually grasses or trees).

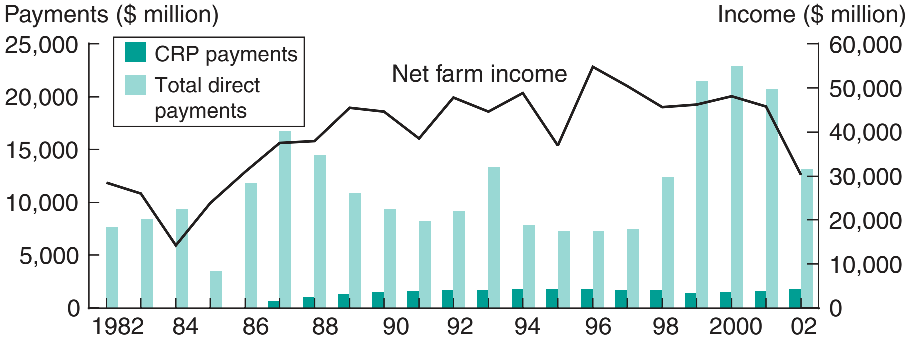
Farm operators and nonoperator landowners with highly erodible land could apply during any signup period, indicating the field(s) or portions of fields they wished to enroll and the annual rental payment they required. USDA determined the maximum acceptable rental rate for each bid pool (comprised of all the bids from multicounty areas with similar farm production and land characteristics). Bids at or below this rate were accepted (subject to a 25-percent county acreage cap) and those above the maximum rental rate were rejected. While the maximum rental rate was not preannounced, bidders quickly estimated what it was likely to be for their area and began offering rental rates close to the maximum (Shoemaker, 1989).[3]

The program's early focus on erodible land, its award structure, and the frequency of signup announcements made it reasonably easy for potential bidders to determine their eligibility for, and their costs and benefits of participating in, CRP. In essence, USDA was willing to enroll all eligible land that farm operators and nonoperator landowners were willing to offer at or below the area's maximum rental rate (Plantinga et al., 2001; Smith, 1995). As a result, program participation grew rapidly and the farm sector benefited from a stable source of Federal financial support, as can be seen in figure 2.2. One of the major drawbacks to this approach was the program's inability to target all environmentally sensitive lands for retirement. The use of an areawide maximum rental rate meant environmentally sensitive but highly productive land was unlikely to be retired, and the government overpaid for the least productive land being enrolled (Cooper and Osborn, 1998; Daniels, 1988; GAO, 1989). As the program grew and pressure to quickly enroll more acreage eased, program eligibility and bid acceptance rules began to change.

With enactment of the Food, Agriculture, Conservation, and Trade Act of 1990 (the 1990 Act), eligibility for CRP was broadened to include more environmentally sensitive land, but not necessarily highly erodible land. The 1990 Act extended eligibility to land in conservation priority areas (the Chesapeake Bay, Long Island Sound, and Great Lakes watersheds) and State water quality priority areas as well as generally smaller plots of land

Figure 2.2

CRP payments, total direct farm payments, and net farm income, 1982-2002



Source: Farm Service Agency, CRP Summary Statistics; Economic Research Service, Farm Income and Costs Briefing Room.

[3] Nonetheless, among eligible farmers who chose not to participate in the CRP, survey results indicate that nonbidders tended to underestimate the maximum rental rate applicable in their area (Esseks and Kraft, 1988).

adopting high-priority conservation practices (Barbarika, 2001). USDA also began ranking bids based on the environmental benefits they offered (using an environmental benefits index, or EBI), and set maximum allowable rental rates based on a soil-specific estimate of the rent earned on comparable local cropland. The EBI gave weight to water quality and other environmental benefits in addition to soil erosion. When coupled with soil-specific maximum rental rate, these changes enabled USDA to enroll environmentally sensitive—but highly productive—land into the program. When combined with limits on the number of acres that could be enrolled, the result was a much more competitive but complex bidding process.[4]

During 1991-94, an additional 2.5 million acres were added to the CRP. While this had little impact on the program as a whole, the revised eligibility and bidding rules did have an influence on the type of land that was added over this period. Relatively fewer accepted bids came from the Great Plains as enrollment shifted eastward (Osborn and Heimlich, 1994).

Starting with signup 13 in 1995, the EBI score and soil-adjusted maximum rental rates were announced to potential bidders ahead of time, making the bidding process much more transparent. In addition, after passage of the Federal Agriculture Improvement and Reform Act of 1996 (the 1996 Act), USDA added wildlife habitat to the EBI and provided other options for farmers to participate in CRP. A continuous signup was initiated for acreage devoted to specific conservation practices, such as filter strips, riparian buffers, grassed waterways, field windbreaks, shelterbelts, living snow fences, salt-tolerant vegetation, shallow-water areas for wildlife, and wellhead protection (Osborn, 1997). These practices involve relatively small parcels of land but provide large environmental benefits (Smith, 1999). Farm operators and nonoperator landowners adopting these practices can enroll in the CRP at any time without competing in the EBI ranking process. In return, they receive up to the maximum soil-adjusted rental rate and may be eligible for special signup and other maintenance and practice incentive payments.

In 1997, USDA also established the Conservation Reserve Enhancement Program (CREP), a Federal-State partnership designed to encourage farm conservation practices that meet specific State and National conservation and environmental objectives (Smith, 2000). CREP participants receive payments similar to those available to CRP continuous signup participants as well as additional incentives. As of 2002, slightly over 2.1 million acres had been enrolled under the continuous signup and CREP provisions, receiving an average per-acre payment rate well over twice that for acres enrolled through the general signup process (USDA, 2002).

Following the 1996 Act, contracts on acreage enrolled during the early years of the program began expiring. Most contracts were for 10 years, but while new regulations were being implemented and new signups established, contract holders were allowed to extend their contracts for 1 year. In addition, to provide USDA with flexibility, selected CRP participants were offered the choice of terminating their contracts early. As a result, signup 15, conducted in 1997, was the largest ever, with over 16 million acres accepted into the program. The size of subsequent signups conducted in 1997-1999 was also reminiscent of the early years of the program, together

[4] While the original legislation envisioned the program retiring 40-45 million acres, enrollment authority was capped at 38 million acres in 1992 and reduced to 36.4 million acres in 1996. In 2002, CRP's enrollment authority was increased to 39.2 million acres.

accepting nearly 13 million acres. Unlike the early signups, competition was keen and all bids were ranked on the basis of the environmental benefits they offered and their cost. As a result, there was no guarantee that expiring contract holders would be allowed to re-enroll their CRP acreage.[5]

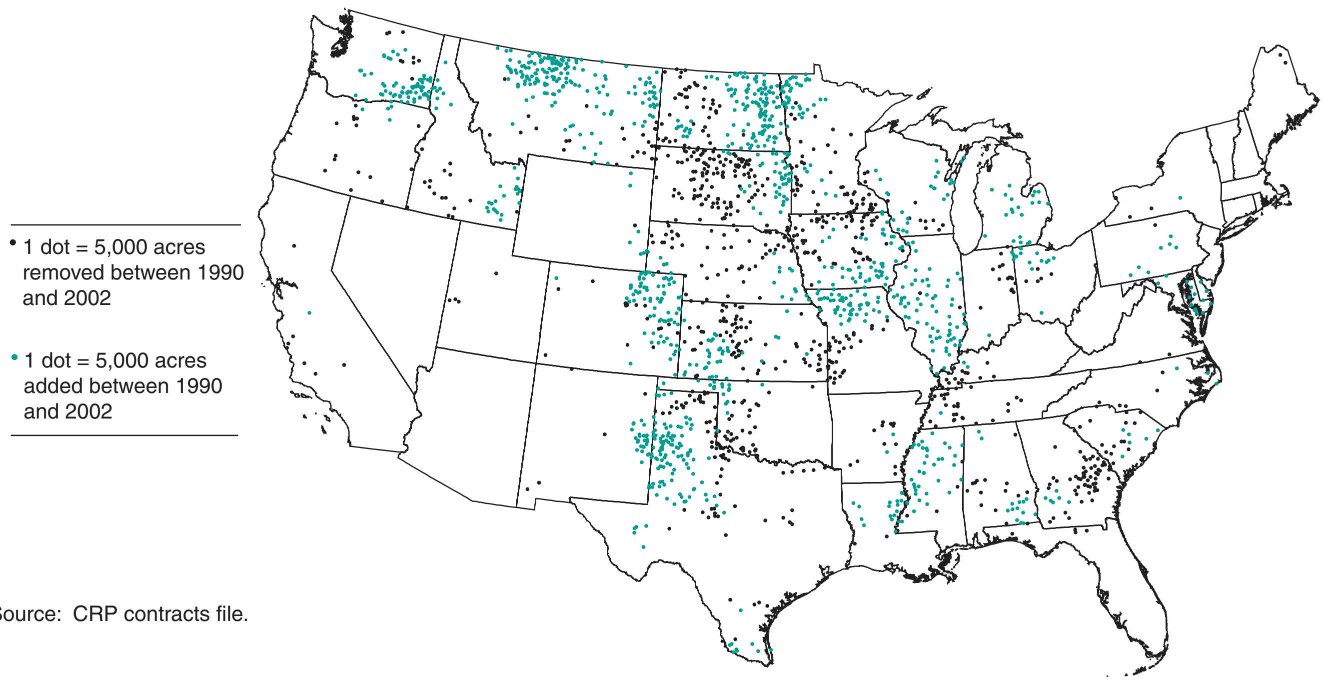
While most expiring CRP contract holders who wished to remain in the program were successful in doing so, some were not.[6] Previous CRP contract holders were facing the EBI ranking process for the first time, which now placed equal weight on erosion control, water quality, and wildlife habitat. Furthermore, because of expansion in program eligibility over the years, an estimated 240 million acres of farmland had the environmental attributes needed to qualify for post-1996 CRP signups, compared with roughly 100 million acres eligible for the program when it was implemented in 1986 (Osborn, 1997). While nearly all eligible bids requesting rental payments below the maximum were accepted into the program in the 1980s, the relative cost of each bid was now a factor in the selection process. As a result, the distribution of CRP enrollment shifted somewhat during the 1990s, environmental benefits (as measured by the EBI and subsequent analyses) increased, and the per-acre cost of the program declined. This shift means that, to some extent, the characteristics of enrolled acres and their impact on surrounding communities may have changed over time. As a result of program shifts and changing agricultural commodity market conditions, CRP's community impacts are likely to be time sensitive.

Figure 2.3 shows the change in the geographic distribution CRP enrollment at the end of 2002 compared with enrollment at the end of 1990, prior to adoption of the EBI and soil-specific rental rates. Of the nearly 34 million acres enrolled in the program in 2002, 17 percent represented net additions to county CRP acreage (shown as blue dots on the map). And of the nearly 33 million acres enrolled in 1990, a net 14 percent was dropped from the

[5] The Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act of 1997 precluded the automatic extension of expiring CRP contracts beyond 1 year.

[6] For example, during 1997, contracts were due to expire on roughly 21 million acres of CRP land. For signup 15, conducted in March, a total of 23.3 million acres was bid, of which 16.1 million acres was accepted, including nearly 12 million re-enrolled acres and a little over 4 million new acres (Osborn, 1997). Roughly 55 percent of all acres enrolled in CRP at the end of 2001 was re-enrolled acreage (Barbarika, 2001).

Figure 2.3
Change in the geographic distribution of CRP acres between 1990 and 2002



Source: CRP contracts file.

program by 2002, based on county aggregate enrollments (shown as black dots).[7] While there were roughly equal numbers of counties that gained and lost CRP acreage due to such factors as program changes and shifting market conditions, there was very little redistribution of acreage at the regional level. Table 2.1 shows the number of counties gaining and losing more than 5,000 enrolled acres during the 1990s among the ERS farm resource regions (fig. 2.4). While the number of counties involved in shifts of this size was considerable, the regional distribution of enrolled acres was remarkably stable. Enrollment rose slightly in the Northern Great Plains and declined in the Heartland (probably due to the lower rental rates requested

[7]There was a much higher percentage of turnover on specific parcels of land, but from a community development perspective it is the net change in local enrollment that is likely to be important, not whether parcel A or parcel B is enrolled.

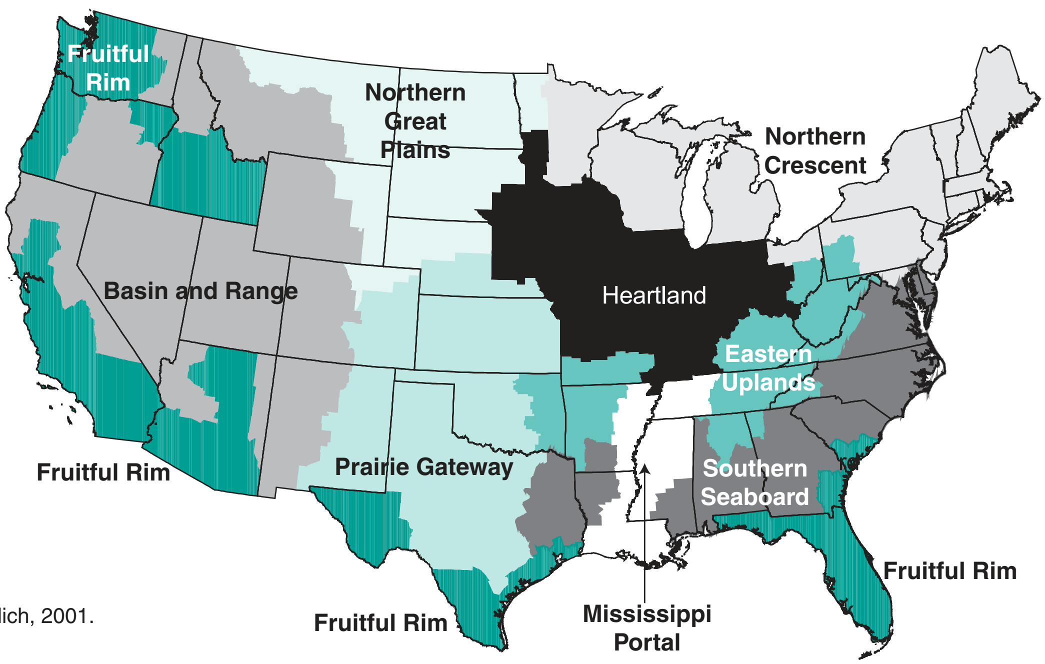
Table 2.1—Regional shifts in CRP enrollment and payments, 1990-2002

	Counties with more than 5,000 acres enrolled in CRP			Distribution of total CRP			
	Total*	Losing*	Gaining*	Acres		Payments	
Farm resource region	1990-2002	1990-2002	1990-2002	1990	2002	1990	2002
	Number	*Percent*		*Percent*			
Heartland	364	20	21	19	18	28	32
Northern Crescent	91	9	26	4	4	4	5
Northern Great Plains	158	30	41	26	28	19	21
Prairie Gateway	256	31	23	30	30	28	23
Eastern Uplands	23	22	4	1	1	1	1
Southern Seaboard	113	25	13	5	4	4	3
Fruitful Rim	69	26	23	6	6	7	6
Basin and Range	56	23	20	5	5	5	5
Mississippi Portal	96	10	18	4	4	4	4
U.S.	1,226	23	23				

*The first set of columns focus on counties that had more than 5,000 acres enrolled in the program at some point during 1990-2002 and the percentage that either lost or gained more than 5,000 program acres during 1990-2002. The final set of columns focus on the regional distribution of total CRP acres and payments, including those in counties with 5,000 acres or less in CRP.

Source: ERS analysis of FSA CRP Contracts file. Regions are delineated in figure 2.4.

Figure 2.4
Farm Resource Regions



Source: Heimlich, 2001.

by Plains bidders) and the Southern Seaboard (where many CRP acres planted in trees were not offered for re-enrollment). However, the payment distribution was more volatile due to changes in the way maximum rental payments were determined and the way bids were evaluated. The Heartland registered the largest increase in regional share of program receipts while the Prairie Gateway registered the largest decline.

The Farm Security and Rural Investment Act of 2002 (the 2002 Act) increased the CRP's enrollment authority to 39.2 million acres, while USDA continued its policy of reserving roughly 4 million acres for continuous signups. Eligibility requirements on cropland were tightened, but managed haying and grazing restrictions and cover requirements on marginal pasture were eased.

The 2002 Act also expanded CRP's Farmable Wetland Pilot Program, established by the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2001. Enrollment of wetland and associated buffers is now authorized in all States through the continuous signup process, subject to a 100,000-acre limit for each State and an overall limit of 1 million acres. As of August 2003, 86,000 acres of farmable wetland had been enrolled in the program, out of a total of 34 million CRP acres (USDA, 2003).

Characteristics of Farm Operators Participating in the CRP

Based on USDA's Agricultural Resource Management Survey (ARMS), roughly 279,000 (or 13 percent) of all farm operators had acres enrolled in CRP during 2001, the most recent year for which data is available (see box, "Farm Operators and CRP Participants" for a comparison of ARMS with other sources of data used in this report). Since enrollment of eligible land in the CRP is voluntary, participation is a function of the bid selection process and the potential net benefits from enrolling eligible land. The principal benefit from the participant's perspective is a guaranteed annual rental payment for 10-15 years that can initially equal or exceed the land's cash rental value at the time of enrollment. Participants often cite other advantages, including reduction in soil erosion, increased wildlife hunting and viewing opportunities, improved air and water quality, more scenic landscapes, and increased future income potential (Allen and Vandever, 2003).

The principal disadvantage is the extended length of time land use and rents are "locked in" without inflation adjustments. Additional drawbacks include the possible proliferation of weeds and pests, the potential fire hazard and unkempt appearance of CRP cover, and conservation cover maintenance requirements (Hodur et al., 2002). How these advantages and disadvantages are weighed depends on the participant's circumstances, expectations, and goals. For example, farm operators wishing to transition out of farming, either into retirement or to pursue off-farm opportunities, may find the CRP appealing because it provides a steady source of income and requires relatively little operator involvement, but allows the operator to retain ownership of enrolled property. Such participants often want to enroll as much land as they can to speed up the transition while maintaining ties to the farm, perhaps as a homestead or an investment.

Farm Operators and CRP Participants

Eligible land can be enrolled in the CRP by the landowner or by a producer who has control of the land, but the vast majority of CRP participants own their enrolled land since few tenants have control of the land they rent for the entire 10-year CRP contract period. In assessing the characteristics of CRP participants, we rely on two sources of information: the 2001 ARMS survey and the Census of Agriculture (used in the next section where county-level information is needed). Both ARMS and the Census of Agriculture collect information from and about the principal operator of any farm from which $1,000 or more of agricultural products (crops and livestock) were sold or normally would have been sold during the year under consideration. Data are not collected from nonoperator owners of farmland, so information from either ARMS or the Census of Agriculture fails to cover all CRP participants. The differing definitions of a farm and a CRP participant among the various databases make precise calculations impossible, but a comparison of FSA's CRP contracts file (covering all participants) and CRP data reported in ARMS and the 1997 Census of Agriculture suggests that most CRP participants are considered farm operators while nonoperator landowners are less frequent. Farm operators can be landowners, tenants, or both.

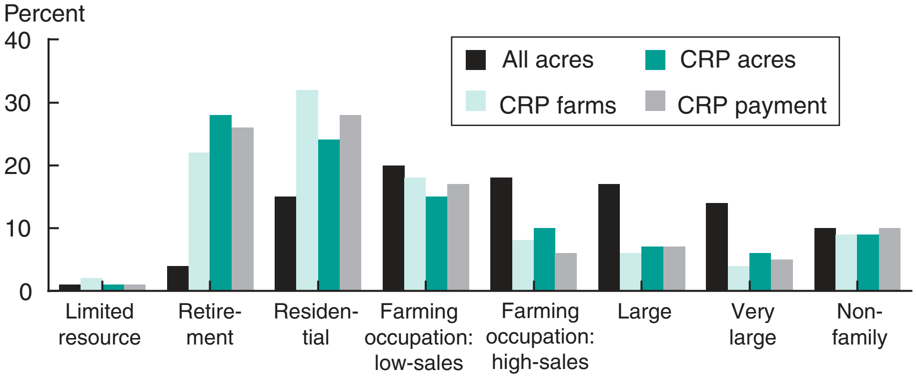
For this report, information on the characteristics of CRP participants or farms in general (e.g., young and short-tenure farmers) excludes nonoperator landlords. However, when the CRP contract file is analyzed to evaluate the size and distribution of program acres, all enrollees, including nonoperator landowners, are included. While the CRP contracts file does not include the rich detail on farm finances and operator characteristics found in the ARMS data, it does include all enrollees and provides the county-level data needed to assess CRP's local socioeconomic impacts. Nonetheless, since ARMS and the CRP contracts file use very different concepts of "farm" and "CRP enrollee," care needs to be taken when moving from one data source to the other. For ARMS, a farm generally encompasses all of the land controlled by a farm operator. For the CRP contracts file, a farm is a tract of land used to determine eligibility for farm programs. One farm operator can easily control more than one "CRP farm." One result is that FSA reports nearly 100,000 additional "farms" participating in CRP when compared with ARMS farm operator data, only a small portion of which can be attributed to nonoperator landowners.

Farm operators who have no interest in transitioning out of farming may find enrollment in the CRP appealing as a way of diversifying risk, improving the productivity of adjacent fields (by reducing wind erosion, for example), and satisfying conservation compliance requirements. Such participants are likely to be much more selective about the amount and type of land enrolled in the CRP. Figure 2.5 shows the distribution of farm operators participating in the CRP by ERS farm typology.[8] The majority of farm operator participants can be characterized as either retirement or residential farm operators. Retirement farms are operated by those who identify themselves as "retired." Residential farms are operated by those who identify something other than farming as their principal occupation. These two farm categories also included a majority of CRP acres and received a majority of the payments. Earlier research found that older, part-time farmers also made up a sizeable percentage of initial CRP enrollees (Hatley et al., 1989).

While retired farm operators are disproportionately represented among CRP enrollees, residential farm operators participate less than would be expected

[8] The ERS farm typology combines farm characteristics, including operator occupation and size of farm, to develop homogeneous groups of farmers (Hoppe et al., 1999). The different categories reflect an operator's expectations and goals from farming, stage of life, dependence on agriculture, and size of operation. In addition to retirement and residential farms mentioned above, the typology categorizes small farms (those with under $250,000 in sales) as either limited-resource, farming occupation/low sales, or farming occupation/high sales, depending on level of sales and the primary occupation of the operator. Large ($250,000-$499,999 in sales), very large (over $500,000 in sales), and nonfamily (corporate or cooperative) farms round out the typology.

Figure 2.5
Farm operator participation in CRP, by farm type, 2001



Source: Agricultural Resource Management Survey, 2001. All acres refers to the percentage of total farmland controlled by each farm category. The remaining bars refer to the percentage of all participating farm operators, enrolled acreage, and CRP payments accounted for by each farm category.

given the distribution of all farms among the typology groups (not shown in fig. 2.5). Nonetheless, it appears that both residential and retired farm operators have more *acres* enrolled than would be expected as these two groups, on average, enroll a higher percentage of their eligible land in CRP than do other types of farms. The desire to limit the number of hours spent working on the farm may help explain why retired and residential farm operators comprise most of CRP's whole-farm enrollees. But figure 2.5 also shows that CRP is used by a wide range of farm operators.[9] Larger farms participate in the CRP at higher rates (not shown in fig. 2.5), but they enroll a smaller proportion of their land. By definition, they are partial-farm enrollees, often using CRP to maximize returns on farm assets.

From a community development perspective, it is useful to synthesize the diversity of program participants into two groups—"whole-farm" enrollees and "partial-farm" enrollees—even though these two groups each encompass a wide range of farms. We use two definitions for "whole-farm enrollee" in this report, but the one that comes closest to reflecting the farm operator's involvement in the agricultural sector includes farm operators who had acres enrolled in the CRP and did not produce farm commodities in 2001.[10] Whole-farm enrollees may have received other government program payments or had sales of agricultural commodities in 2001 by selling inventories remaining from the previous year, but produced no farm commodities in 2001. According to the ARMS data, about 7 percent of U.S. farm operators (and over half of farm operators participating in the CRP) are whole-farm enrollees using this definition (table 2.2). Other farm operators use the CRP as part of an ongoing farm business. These "partial-farm" enrollees are those with acres enrolled in the CRP and farm commodity production in 2001; they account for another 6 percent of U.S. farms.

Enrolled acres are split roughly evenly between whole- and partial-farm enrollees, but more than 60 percent of the acres operated by whole-farm enrollees (and over 95 percent of their cropland) is in the CRP, compared with only 12 percent of the acres operated by partial-farm enrollees (and 20

[9] Konyar and Osborn (1990) found that young farmers were more likely to participate in CRP, even though their small number makes them less prevalent among participants.

[10] The second definition of "whole-farm enrollees" is based solely on the percentage of cropland enrolled in CRP. At best, it is a proxy for whether the enrollee continues his or her involvement in farming after enrolling in the CRP. Using the FSA definition of a farm, it is entirely possible that a whole-farm enrollee could be an active farmer on other tracts he owns or rents, and so should be considered a partial-farm enrollee. Likewise, a partial-farm enrollee may not actively farm the nonenrolled portion of his or her farm, and so should be considered a whole-farm enrollee.

Table 2.2—Characteristics of farm operators, by CRP participation, 2001

Item	CRP enrollees		Non-	All
	Whole-farm	Partial-farm	enrollees	farms
Percent of farms	7	6	87	100
Acreage (per farm):				
Operated	257	1,129	419	454
Owned	305	640	235	266
Rented in	14*	526	197	207
Rented out	62*	37	14	18
CRP acreage:				
Per farm	159	138	0	19
Percent of total CRP acres	54	46	0	100
Percent of acres operated	62	12	0	4
Percent of cropland acres operated	96	20	0	10
Production specialty (percent of farms):				
Cash grains	4**	46	15	17
Other crops (including CRP)	94	21	22	26
Livestock	2**	33	63	57
Beef cattle	—	26	42	38
Farm operator:				
Age (years)	61	56	54	55
Primary occupation (percent of farms):				
Farming	4**	69	41	40
Retirement	38	9*	11	12
Nonfarm job	58	23	48	47

Single (*) and double asterisks (**) indicate a coefficient of variation between 25 and 50, and greater than 50, respectively.

Source: ERS analysis of the 2001 Agricultural Resource Management Survey. Whole-farm enrollees were defined as farm operators who had acres enrolled in the CRP program and did not produce farm commodities in 2001. Partial-farm enrollees were defined as farm operators with acres enrolled in the CRP and farm commodity production in 2001.

percent of their cropland).[11] On average, whole-farm enrollees operate smaller operations than nonenrollees (farms not enrolled in the CRP), while partial-farm enrollees have substantially larger operations. Should their CRP contracts end, most partial-farm enrollees appear positioned to convert their CRP land to grain production or cattle grazing fairly easily should it make economic sense to do so. In contrast, whole-farm enrollees are not engaged in crop or livestock production, and thus are likely to be less equipped or able to bring CRP acreage back into production themselves. Although whole-farm acreage which is not planted to trees could be brought back into production relatively quickly if it were rented or sold to other farm operators, given the number of residential farm operators within the whole-farm group, it seems likely that some CRP enrollees would choose not to have their land farmed intensively even in the absence of CRP.

Whole-farm enrollees are, on average, older than partial-farm and nonenrollees and are far less likely to report farming as their primary occupation. The majority of whole-farm enrollees report off-farm work as their primary occupation, and nearly 40 percent are retired. This is consistent with patterns reported in figure 2.5. The average age of whole-farm enrollees masks a pronounced difference between retired farm operators, averaging 70 years, and residential farm operators, averaging 49 years. The majority of gross cash farm income generated by whole-farm enrollees is from government payments, with CRP payments representing most of this (table 2.3).

[11] The non-CRP land left idle by whole-farm enrollees includes pasture and range land, cropland left fallow, and parcels too small to be farmed efficiently.

Partial farm enrollees rely on government payments less than whole-farm enrollees, but still more than the national average.

Despite the difference in farm income among whole-farm, partial-farm, and nonparticipating farm operators (net farm income of partial-farm enrollees in 2001 was more than double that of nonenrollees and nearly five times larger than that of whole-farm enrollees) total household income is much the same. The average household income of the three groups ranged from $64,000 to about $68,000 in 2001. The difference in farm income is offset by a much higher level of off-farm income earned by the households of whole-farm enrollees and non-enrollees.

While farm sector coverage and the definition of whole-farm enrollees differ, an earlier study found similar patterns in the characteristics of CRP participants. Relying on the USDA's 1991 Farm Costs and Returns Survey (FCRS), the forerunner to the ARMS survey used above, whole-farm enrollees were found to be older than average, supplied little operator labor, did not consider farming as their primary occupation, and received most of their household income from off-farm sources. In contrast, partial-farm enrollees were more likely to consider farming their primary occupation, and received most of their household income from farming (Dodson and McElroy, 1995). Thus, while the program has changed over the years, the

Table 2.3—Financial characteristics of CRP farm operations, 2001

Item	CRP enrollees: Whole-farm	CRP enrollees: Partial-farm	Non-enrollees	All farms
Farm income statement ($ per farm):				
Gross cash income	9,636	169,341	86,041	86,395
Livestock sales	0	55,099	32,454	31,785
Crop sales	—	66,324	37,706	37,078
Government payments	7,215	28,533	5,655	7,229
CRP payments	6,535	5,126	0	758
Other farm-related income	2,400*	19,384	10,227	10,303
Cash expenses	4,653	124,377	70,446	69,605
Net cash farm income	4,982	44,964	15,596	16,790
Net farm income[1]	7,418	35,977	14,689	15,582
Farm balance sheet ($ per farm):				
Assets	261,984	907,734	565,223	567,391
Liabilities	10,871*	127,435	59,645	60,811
Equity	251,114	780,299	505,578	506,580
Debt/asset ratio (percent)	4*	14	11	11
Return on equity (percent)	3.0	4.6	2.9	3.1
Farm household income ($ per hh):				
Total household income	66,104	67,539	64,132	64,465
Farm business income[2]	3,307*	21,215	3,010*	4,205
Off-farm income	62,795	44,132	59,729	58,894
Earned sources	42,798*	25,846	44,603	43,286
Unearned sources	19,997	18,286	15,127	15,608

Notes: Whole-farm enrollees were defined as farm operators who had acres enrolled in the CRP program and did not produce farm commodities in 2001. Partial-farm enrollees were defined as farm operators with acres enrolled in the CRP and farm commodity production in 2001.
— indicates insufficient data for legal disclosure; single asterisks (*) indicates a coefficient of variation between 25 and 50.

[1]Net farm income is net cash farm income less costs for depreciation and non-cash benefits for hired workers, plus the value of the inventory change in 2001 and any non-money income. Non-money income includes the value of farm products consumed on the farm and an imputed rental value for the farm operator dwelling.

[2]Farm business income is that portion of farm income that is accrued by the farm household. Farm business income is net cash farm income less costs for depreciation, wages paid to the farm operator, and farmland rental income. The total is then adjusted to reflect any other households that share in the farm business income.

Source: ERS analysis of the 2001 Agricultural Resource Management Survey.

marked differences between whole- and partial-farm enrollees seem to have remained fairly constant. These two types of participants are likely to react very differently to major changes in the CRP, and may affect their surrounding communities differently.

Geographic Dispersion of Whole-Farm Enrollees

What is not clear from the ARMS/FCRS data is the extent to which the mix of whole- and partial-farm enrollees varies from one county to another. Based on the CRP contracts file, it is possible to determine the proportion of each participating farm's cropland that is enrolled in the CRP. Unfortunately, these data do not include information on farm finances, so an acreage-based definition of whole-farm enrollees had to be developed. In order to exclude as many partial-farm enrollees as possible from the acreage-based definition of whole farms, we apply a cutoff of 95 percent or more of cropland enrolled in CRP to designate whole-farm enrollees.[12] Using this fairly strict definition of whole-farms, their prevalence in participating counties ranged from 0 to 100 percent of enrolled acres in both 1994 and 2002.[13] In both years, whole-farm enrollments comprised more than half of the CRP acres in 1 out of 5 counties that had more than 5,000 acres enrolled in the program.

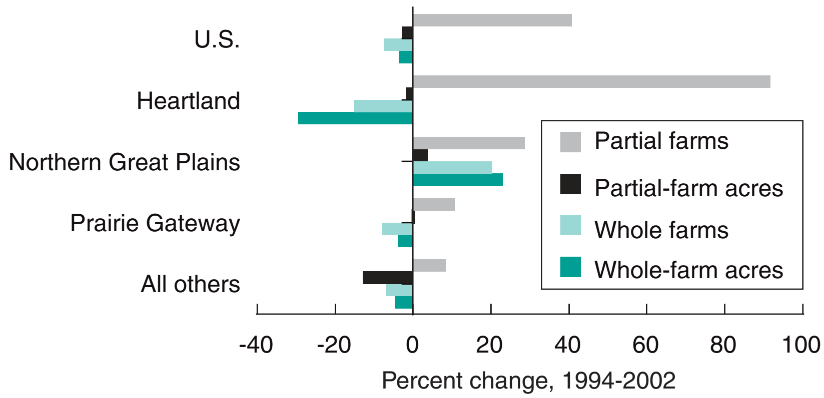
The advent of continuous signups and the other program changes that took full effect in 1997 appear to have reduced the prevalence of whole-farm enrollees somewhat. In 1994, 37 percent of enrollees had at least 95 percent of their cropland in the program. By 2002, whole-farm enrollees accounted for 28 percent of participants, but this smaller group still accounted for 40 percent of enrolled acres—essentially unchanged from its 1994 level. This is because far more farms are participating in the program now, but at lower levels. The number of participants (i.e., FSA farms with CRP enrollment) increased by 23 percent from 1994 to 2002, while the average enrollment by the typical participant fell from 44 to 31 percent of the farm's cropland over this period. By enrolling smaller plots of environmentally sensitive land, the continuous signups and more competitive general signups characteristic of the post-1997 era have broadened participation. But the generally lower bids possible by re-enrolling large tracts of less productive land (and perhaps the willingness of retired operators and absentee landowners to accept low rental rates to stay in the program) have resulted in a fairly constant proportion of whole-farm acres over the years.

Figure 2.6 shows the change in whole- and partial-farm participation in the CRP program between 1994 and 2002, while figure 2.7 shows the mix of program participants among farm resource regions that had high CRP enrollment in both years. The Prairie Gateway currently has the largest share of its CRP acreage coming from whole-farm enrollments. Between 1994 and 2002, the number of whole farms and whole-farm acres in the Heartland dropped significantly (continuous signups have been heavily used in this region). The only Midwestern region to experience a significant increase in the number of whole-farm enrollees and whole-farm enrolled acres between 1994 and 2002 was the Northern Great Plains, where both increased by over 20 percent. The combination of low wheat prices, the lack of alternative land uses, relatively low farm rental rates, and an aging farm

[12] The CRP contracts data on farms refer to the land unit the Farm Service Agency (FSA) uses to track commodity program use and eligibility. They do not correspond to the land controlled by a farm operator (one farm operator often controls several FSA "farms"), and so are not strictly comparable with the ARMS data discussed earlier. None-theless, of the ARMS farm operators participating in the CRP, roughly 72 percent of the "whole-farm" participants had at least 95 percent of their cropland enrolled in the program while only 9 percent of the partial-farm enrollees met this cutoff.

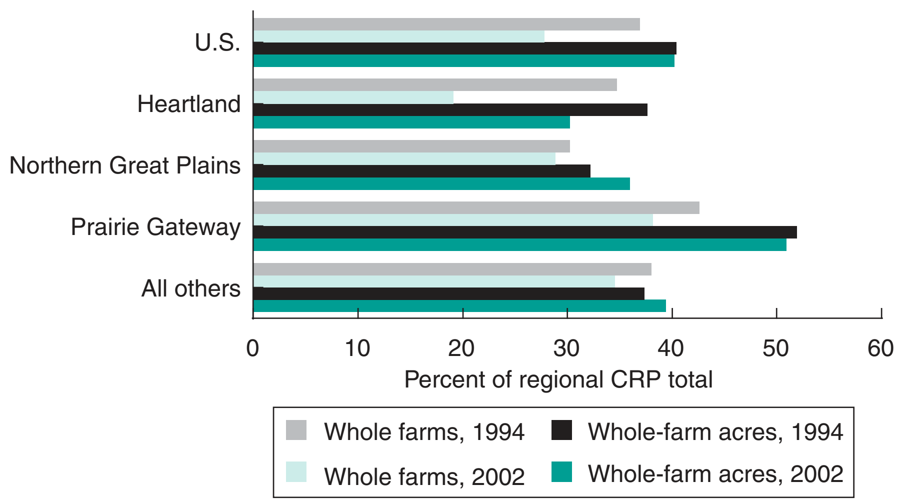
[13] Acreage enrolled in the CRP during the first phase of the program (1986-1995) reached its zenith in 1994, while 2002 represents the high-water mark for the second phase of the program, at the time of this study.

Figure 2.6
Growth in CRP farms, by type and region, 1994-2002



Whole farms are those with 95 percent or more of cropland enrolled in the CRP.
Source: ERS analysis of the CRP Contracts file. Regions are delineated in figure 2-4.

Figure 2.7
Whole-farm participation in CRP, 1994 and 2002



Whole farms are those with 95 percent or more of cropland enrolled in the CRP.
Source: ERS analysis of the CRP Contracts file. Regions are delineated in figure 2-4.

population may explain the popularity of whole-farm enrollments in the Northern Great Plains.

The relationship between whole-farm enrollment in CRP and local economic development is not necessarily straightforward. In parts of the Northern Great Plains, the lack of alternative sources of income might encourage whole-farm enrollments if farming becomes too risky or unprofitable. On the other hand, whole-farm enrollees tend to rely much more heavily on off-farm sources of income than other farmers. Thus, in some communities, such as those close to urban centers, whole-farm enrollment may reflect a vibrant local job market. In stagnant economies, whole-farm enrollments might further dampen economic prospects as land that might otherwise be farmed is left idle. In communities with tight labor markets, whole-farm enrollments might boost the local economy as CRP payments supplement participants' disposable incomes, as long as CRP payment recipients retain residence and continue working in the area. Of concern, however, is the possibility that whole-farm enrollees may choose to relocate in search of better employment opportunities or living conditions.

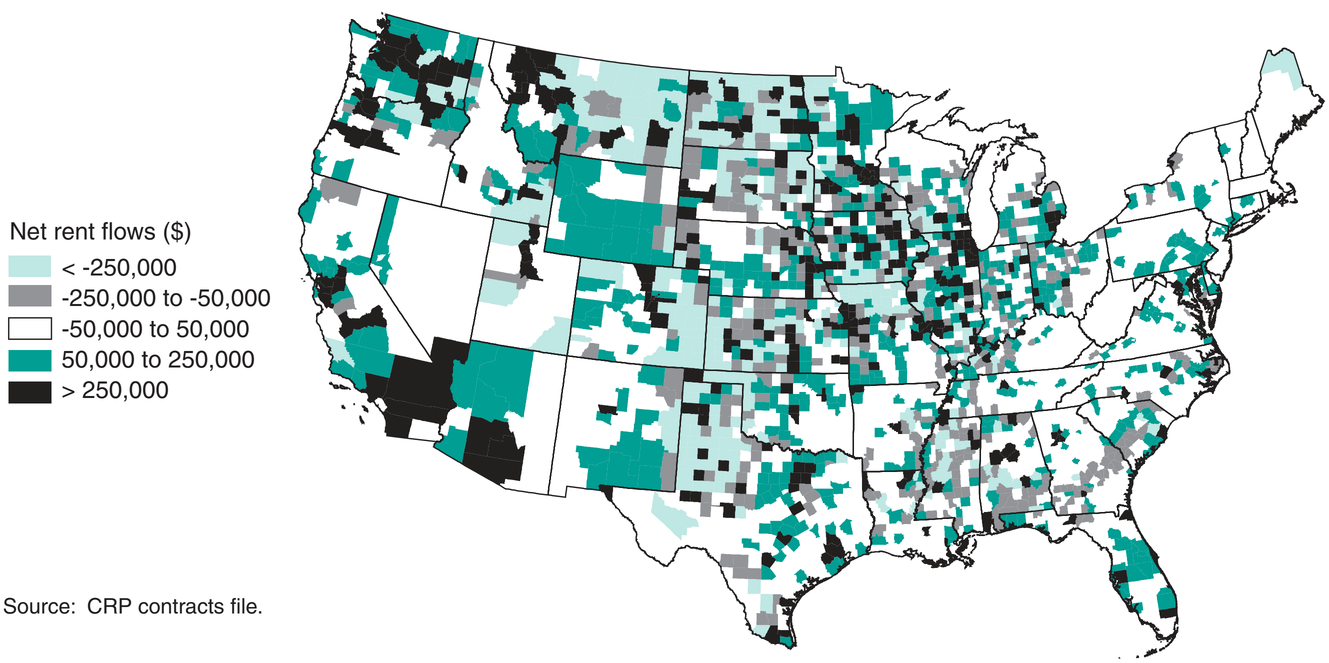
CRP Rental Payments and Absentee Landowners

Using CRP contracts data on the location of CRP acres and where CRP payments are delivered, we can roughly gauge the degree to which CRP payments go to absentee landowners. Because of difficulties accounting for all the adjustments made to CRP payments for such things as establishing and maintaining ground cover, adopting favored conservation practices, and emergency haying and grazing, this report does not attempt to follow payment flows on specific CRP enrollments. Figure 2.8 presents information from 2001 on the *net* flow of CRP payments into and out of each county.[14] Net payments equal the CRP rental payments mailed to a county's CRP enrollees minus the rental payments received on a county's CRP land. A positive figure indicates the county receives CRP payments (inflows) on land enrolled elsewhere, while a negative figure indicates that CRP payments are flowing out of the county (presumably to absentee landowners). Of counties with at least 5,000 acres enrolled in CRP, 30 percent experienced net outflows of CRP payments exceeding $250,000 (averaging 37 percent of the funds earned on their CRP acreage). As would be expected, most of these counties were located in the central United States, where CRP enrollment is highest.

Table 2.4 details the interregional flow of CRP payments. While counties in all regions experienced net inflows and outflows of CRP funds, three regions experienced aggregate net outflows of CRP payments: the Northern

[14] Since it is far easier to ascertain where CRP payments were delivered than it is to estimate each acre's contribution to this payment stream, the total amount of payments is roughly 5 percent higher than the payment estimates based on the location of CRP acres. To get a clearer picture of which areas gain (or lose) more than they "contribute" to the program, figure 2.8 and table 2.4 use adjusted payment streams which equalize net payment inflows and outflows for the Nation as a whole.

Figure 2.8
Geographic distribution of net CRP payments, 2001



Source: CRP contracts file.

Table 2.4—Interregional flow of CRP payments, 2001

Farm resource region	Net flow of payments: $ millions	Net flow of payments: Percent of base CRP	Counties with net flows over $250,000: Number	Percent of all counties*: Outflow	Percent of all counties*: Inflow
Heartland	26.9	5	173	14	18
Northern Crescent	17.2	19	32	2	6
Northern Great Plains	-46.7	-15	96	38	16
Prairie Gateway	-34.3	-10	140	24	12
Eastern Uplands	8.2	40	10	0	3
Southern Seaboard	1.7	3	29	3	4
Fruitful Rim	30.1	36	60	6	16
Basin and Range	2.5	45	36	11	10
Mississippi Portal	-6.4	-10	28	12	6
U.S.	0	0	604	11	10

*Net flow of payments is the amount of CRP rental payments delivered to each region (or county) minus the estimated payments earned on that region's (or county's) CRP enrollment. Base CRP refers to the estimated CRP payment generated by the region's enrolled acres. The final two columns report the percentage of all counties in the region that generate or receive CRP payments that have net outflows or net inflows exceeding $250,000.

Source: ERS analysis of CRP Contracts file. Regions are delineated in figure 2.4.

Great Plains, the Prairie Gateway, and the Mississippi Portal. Net outflows there amounted to 10 percent or more of the CRP payments attributable to enrolled acres within their territory. But, even in the Northern Great Plains where outflows were highest, 85 percent of CRP rental payments stayed within the region.

Most counties that benefited from net inflows of CRP payments were located close to areas with CRP enrollment, and often contained CRP enrolled acreage. There were also a number of metropolitan centers which had no CRP enrollment in 2001, but which received a significant share of CRP payments that year. While these included some popular retirement locations and major cities, such as Chicago, San Francisco, and New York, they also included regional trade centers throughout the country. What is not clear is whether this pattern of payment flows is the result of CRP making residential relocation easier, or whether it merely reflects the reality of modern agriculture. That is, are net outflows of CRP payments, as measured here, different from what would happen if the CRP land was being farmed? Between 40 and 50 percent of the land being farmed in the United States is farmed by someone other than the owner (table 2.2). While many nonoperator landowners live fairly close to their farmland, others live hundreds of miles away. Since the vast majority of CRP recipients identified themselves as landowners in a recent nationwide survey (Allen and Vandever, 2003), the geographic distribution of CRP payments may simply mirror the pre-existing distribution of farmland ownership. One way to assess whether the geographic distribution of CRP payments is unique is to compare it to the distribution of farm commodity program payments.

Table 2.5 presents information on the distribution of cropland and CRP payments by the degree of urbanization of the recipient's payment location, together with similar information for Federal commodity payments based on

Table 2.5—Distribution of cropland, CRP, and select commodity program payments, 2001

Urban influence at destination*	Cropland	CRP	Corn	Cotton	Wheat
	Percent	*Percent of total payments*			
None	74	63	57	66	65
Low urban influence	7	9	11	9	9
Medium urban influence	8	9	11	8	9
Strong urban influence	11	19	21	18	17

* Urban influence at destination refers to the degree of urbanization in the location where the program payment was delivered. Counties are classified into four categories based on urban influence as measured by a gravity model that simultaneously accounts for population size and proximity. Urban influence increases as population size and proximity increase (or distance decreases).

Source: FSA Producer Payments Reporting System data.

historic corn, cotton, and wheat production.[15] While there are differences in the geographic dispersion of payments for the various commodity programs, the overall patterns are strikingly similar. Thus, the proportion of CRP payments going to "absentee" participants appears to be no different than that of other farm programs. Payment flows most probably reflect pre-existing land ownership patterns and do not reflect much residential relocation by CRP participants.

Surveys of program participants and local officials suggest that the incidence of absentee participation is far lower than the prevalence of whole-farm enrollees, but may be roughly comparable to the proportion of net payment flows. In a 1998 survey of North Dakota CRP enrollees, roughly 10 percent of the respondents were out-of-state landowners (Mortensen et al., 1989). In a more recent survey, 13 percent of North Dakota respondents lived outside the State (Hodur et al., 2002). These results are roughly comparable to the estimated percentage of CRP fund outflows in 2001 (10.4 percent for the State as a whole), but are far lower than the 24 percent of North Dakota farms and 31 percent of North Dakota CRP acres attributable to whole-farm participants.[16] Unfortunately, the limited geographic coverage of such surveys makes any generalizations about the relationships between absentee landlords and measures of whole-farm participants and net flows of CRP payments questionable for other regions or different levels of geography. Furthermore, based on simple regression models, no statistically significant relationship was found between the proportion of whole-farm enrollments and the relative size of CRP payment flows. While the lack of a formal model explaining outflows and inflows of CRP rental payments makes this finding tenuous at best, at a minimum it suggests that any relationship that exists between whole-farm enrollment and absentee owners is likely to be complex.

In summary, the characteristics of CRP participants vary widely, as do the reasons for their participation. Program participants can be divided into at least two broad groups based on the extent to which CRP enrollment displaces farming activity. Whole-farm enrollees are those who rely on CRP payments to transition out of (or in rarer cases, into) farming. They are generally older retired operators or younger "lifestyle" operators who consider their primary occupation to be something other than farming.

[15] Roughly 40 percent of the land enrolled in CRP was previously planted in wheat, corn, or cotton. To the extent that CRP payments go to landowners while commodity program payments go to farm operators, one would expect a comparison of the geographic distribution of payments to show more CRP payments than commodity payments going to urban locales. This is not evident in table 2.5.

[16] Of course, whole-farm participants could reside outside of the county but within the State, so this observation does not imply that local jurisdictions aren't affected simply because absenteeism based on State residence is low.

Partial-farm enrollees are those who use CRP payments to supplement their farm income and get the best overall return on their farm assets while improving the environmental performance of their operations. They are far more likely to consider farming their principal occupation and typically derive more of their household income from farming than do other farm operators. While both forms of participation can reduce demand for farm inputs and services, the differing motivations for participating in the CRP may yield different community effects depending on the mix of whole- and partial-farm enrollment. One of the questions we will address in the next section is whether the community effects of CRP enrollment vary depending on the dominant type of program participant.

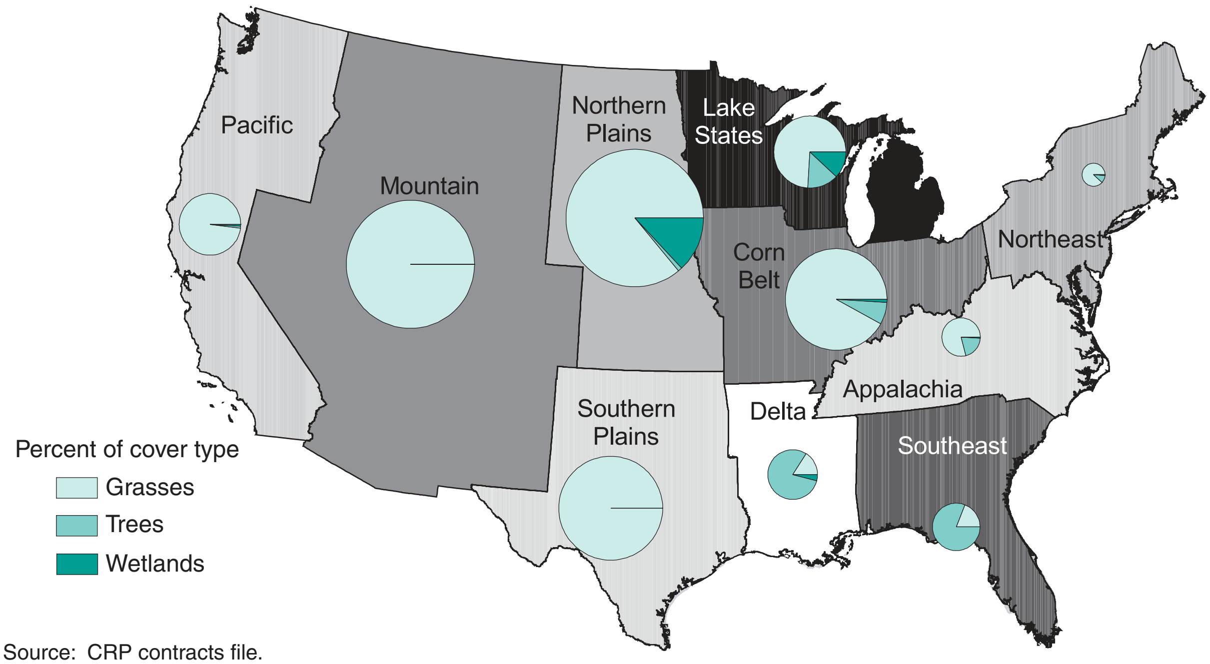
Part of the concern over whole-farm enrollees is their ability to relocate. Absentee CRP participants not only take land out of production, thereby reducing demand for local inputs and services, but they also take their CRP payments with them, potentially dampening demand for local consumer goods and services. Since many of the communities with net outflows of CRP payments are also losing population, it may be tempting to attribute both of these trends to whole-farm enrollment. Nonetheless, there does not appear to be a simple relationship between the prevalence of whole-farm CRP enrollment and loss of CRP payments. And, it seems likely that the geographic distribution of CRP payments, in large part, merely reflects the preexisting distribution of landowners and operators. Therefore, it is clearly unjustified to attribute decisions on residential location to participation in the CRP. Nonetheless, the prevalence of absentee landowners influences the local effect of *all* farm payment programs, so payment flows are included in our analyses (although caution should be used when interpreting the results).

Environmental and Scenic Impacts of the CRP

When land is enrolled in the CRP, it is retired from agricultural production, planted with approved ground cover, and managed with approved conservation practices. The current mechanism for selecting land offered for enrollment evaluates the environmental benefits, thus ensuring that program objectives are addressed and environmental benefits from taking land out of production accrue to society. But, in addition to environmental impacts, the land-use choices embedded in CRP offers may also affect local economies by making the rural landscape more or less attractive to residents and tourists. The relationship between natural amenities and rural development is well established. Wirtz (2002) found that improved quality of life can translate into population and economic growth. McGranahan (1999) and Deller et al. (2001) found that population and employment growth in rural areas are sensitive to the level of a community's natural amenities, as are business location decisions (Goe, 2002; Goetz and Rupasingha, 2002). While natural amenities include many characteristics which are hard to influence, such as mountains and climate, ground cover is one attribute of natural amenities that CRP can affect.

Figure 2.9 provides information on ground cover choices on CRP land in 2001 by farm production region. (Note that farm production regions are based on State boundaries and are different from the farm resource regions discussed previously.) By far the most common ground cover adopted by CRP

Figure 2.9
CRP conservation cover in 2001, by farm production region



Source: CRP contracts file.

participants is grasses and legumes, planted on 87 percent of CRP acres nationwide. Since the bulk of CRP acres is in the Plains and Mountain regions, where tree cover is seldom an economically viable option, the popularity of more easily planted and managed forbs and grasses is not surprising. Taking land out of production and establishing permanent ground cover largely eliminates erosion originating from acres enrolled in the CRP.

Cleaner air and streams, together with the varied vistas that CRP cover can offer, can improve the appeal of nearby communities. But one consequence of relying so heavily on grasses is that most CRP acres can readily (if not always cheaply) be converted back to crop production or grazing at the end of the CRP contract. Whether they are or not depends upon development options, the outlook for profitably farming the land, business transition plans, and the landowner's lifestyle preferences.

Trees account for only 8 percent of CRP ground cover nationwide, but are the overwhelming choice for CRP enrollments in the Delta and Southeast. The timber industry in these regions makes trees a potentially valuable cash crop, albeit one with a very long rotation period.[17] Land planted in trees is far less likely to be converted back to farmland simply because the CRP contract ends. And, research has shown that people generally find forested landscapes more appealing than open spaces, at least up to a point. A recent study found that rural communities in the Upper Great Plains were far more likely to have experienced population growth in the 1990s if they had even a modest amount of forested land (Wirtz, 2002). However, additional tree cover in heavily forested areas may actually detract from the landscape's scenic beauty and discourage wildlife diversity.[18]

While most of the conservation practices encouraged by CRP involve planting or maintaining grasses or trees, restoring wetlands and creating

[17] In their evaluation of the community impact of planting CRP acres to trees, Broomhall and Johnson (1991) assume that trees would be harvested 20-25 years after they were planted.

[18] Research has found that most people find park-like settings, with clumps of trees, open traversable fields, and water most appealing (Ulrich, 1986). With the exception of farmers, most people rank cropland fairly low in terms of its landscape appeal (Kaplan et al., 1989).

shallow-water areas for wildlife is a third option. Wetland restoration and related activities account for only 5 percent of CRP enrolled acres nationwide, but are somewhat more prevalent in the Lake States and the Northern Plains. Wetlands in and of themselves are not generally considered desirable scenery (Gourlay and Slee, 1998), but they can enhance the appeal of nearby communities through improved (and potentially lucrative) hunting, fishing, and wildlife viewing opportunities for residents and visitors.

Table 2.6 provides information on the distribution of wildlife-related CRP conservation practices together with estimates of the economic value of some wildlife-related activities. Virtually all CRP-approved ground cover is likely to support a wider array of wildlife than actively farmed land. Permanent cover greatly improves the health of wildlife ecosystems by providing nesting cover, wintering habitat, and plant and insect feeds for most indigenous wildlife species. For example, the added CRP acres in the Northern Plains have significantly increased duck populations, which require dense vegetative cover within 3 miles of wetland for successful nesting (Reynolds et al., 1994). But, it seems likely that land enrolled in the CRP specifically to enhance wildlife habitat may have wildlife-related benefits that exceed typical practices. In 2001, a total of 4.7 million acres was enrolled to provide permanent wildlife habitat, shallow water area for wildlife, wildlife food plots, riparian buffers, wetlands restoration, and rare and declining habitats (Barbarika, 2001). While this may have had a measurable affect on wildlife populations, data limitations make it difficult to reliably model the benefits of specific wildlife-related practices. As a result, the value of unique program features providing wildlife can seldom be estimated with accuracy.

Table 2.6—Selected wildlife-related practices and estimated annual CRP benefits

Farm production region[1]	Distribution of CRP enrollment		Estimated annual nonmarket benefits from:			
			Wildlife	Pheasant	Total wildlife benefits	
	Total	Wildlife	viewing	hunting	Overall	Per acre
	Percent of total		*$ Million*			*Dollars*
Northeast	0.6	0.5	8	—	8	45
Lake States	7.8	16.3	113	19	132	52
Corn Belt	14.7	15.6	213	35	249	52
Northern Plains	26.2	44.5	33	30	63	7
Appalachia	2.8	1.0	36	—	36	41
Southeast	4.6	1.5	60	—	60	40
Delta	3.6	2.5	47	—	47	40
Southern Plains	15.4	1.2	135	—	135	27
Mountain	19.3	12.0	3	2	6	1
Pacific	5.1	4.9	1	—	1	1
U.S.			650	87	737	22

— indicates that the impact was not estimated.
[1]Regions are delineated in figure 2.9. The Pacific farm production region excludes Alaska and Hawaii.

Source: Each region's percentage of national acreage using conservation practices related to wildlife habitat (establishing permanent wildlife habitat, shallow water area for wildlife, wildlife food plots, riparian buffers, wetland restoration, and rare and declining habitats) is based on 2001 enrollment (Barbarika, 2001). Benefit estimates are derived from Feather et al. (1999), adjusted for inflation to represent 2000 dollars and rounded to the nearest million dollars.

Based on available measures, selected wildlife-related benefits attributable to CRP enrollments are estimated to be approximately $737 million per year (table 2.6).[19] This represents a lower-bound estimate of wildlife benefits because it does not include improved hunting for many species and the increased protection CRP land affords to threatened and endangered species, for which good nationwide data do not exist.

Wildlife viewing represents roughly 88 percent of estimated wildlife benefits presented here. Wildlife-viewing benefits are a function of the range of activities that are affected by CRP conservation practices and the number of people that potentially benefit from improved viewing opportunities. Increases in wildlife populations have improved the quality of activities focused on wildlife viewing (e.g., bird watching and wildlife photography) as well as many outdoor activities where wildlife viewing is not the central focus (e.g., picnicking, hiking, walks in the park, and relaxing in the backyard).

Estimated wildlife-viewing benefits, which accrue to society as a whole and not just to landowners, are most significant in the Corn Belt and Southern Plains. Each of these regions has a high proportion of total CRP enrollment and is relatively populous. The importance of population in the benefits calculations is made even clearer by examining estimated wildlife-viewing benefits in the Lake States. This region has far fewer acres enrolled in the CRP than the Northern Plains and Mountain regions, but has estimated benefits exceeding $100 million each year from CRP-induced wildlife viewing.

The estimated value of CRP-related changes in the quality of pheasant hunting is reported for 13 States—Montana and the States in the Corn Belt, Lake States, and Northern Plains regions (Hansen et al., 1999).[20] These benefits are relatively small since, unlike wildlife viewing, pheasant hunting is a single activity associated with a single species. Nonetheless, for the area studied, the value of CRP's impact on pheasant hunting totals over $87 million annually.

As important as wildlife-related benefits are from a community development perspective, the primary focus of the CRP has historically been on reducing soil erosion. Permanent cover has prevented nearly all wind, sheet, and rill erosion on enrolled lands. Erosion of topsoil typically reduces productive characteristics of the remaining soil—water-holding capacity, nutrient concentration, etc.—so yields tend to fall. Increased input use can offset some of the yield loss, but at additional cost to farm operators. Increases in agricultural productivity attributable to CRP enrollments are referred to as on-site benefits. They represent the discounted present value of the net yield gains and the cost saving from decreased input use (alternatively, they represent the added costs farm operators would face in the absence of the CRP program). Soil erosion directly affects the quantity of sediment in neighboring lakes and streams and the concentration of air particulates. Increases in sediment and dust increase economic burdens (the "off-site costs") on consumers, businesses, and government. Consumers must deal with additional costs and adverse health effects. Operating costs increase as businesses are forced to deal with the effects of water and air pollution (e.g., reduced lifespan of pumping equipment and increased water treatment costs). Governments are faced with larger outlays to mitigate the impacts of

[19] Measures of all the benefits attributable to CRP's impact on wildlife populations are not available. The economic values for the environmental benefits presented in this section have been adjusted for inflation to represent 2000 dollars. Dollar-per-acre wildlife benefits, by region, are from Feather, et al. (1999). Total wildlife benefits within each region are the product of the per-acre benefit estimate and the number of CRP acres enrolled.

[20] While we don't have good estimates of the benefits attributable to CRP's impact on duck, quail, deer, and other game species, older estimates suggest that pheasant hunting accounts for about one-fourth of the small game hunting benefits attributable to the CRP (Ribaudo et al., 1990). However, this ratio should be viewed with caution since it is based on a generalized wildlife response function that was estimated before CRP was fully implemented.

sediment and dust. By reducing these off-site costs, CRP provides off-site benefits.

Soil erosion on all agricultural lands decreased nearly 40 percent between 1982 and 1997 (Claassen et al., 2001). While improved conservation measures adopted by the farm sector following the 1985 Act are responsible for much of this decline, CRP had a significant impact as well. CRP reduced wind erosion on cropland by over 13 percent and water erosion by nearly 7 percent from what it otherwise would have been in 1997 (table 2.7). The program's greater effect on wind erosion is due to the large portion of CRP acres in drier areas of the country.

Nationwide, CRP is credited with reducing soil erosion by nearly 224 million tons a year, based on 1997 enrollments, with the largest reductions occurring in the Southern Plains, Mountain States, and Corn Belt, where CRP enrollments were highest.[21] The Southern Plains and Mountain regions benefit most from CRP's impact on wind erosion—together accounting for 70 percent of CRP's wind erosion impact. CRP acreage in both of these regions is high and both areas have dry and windy growing conditions. On the other hand, significant rainfall and a high concentration of row crops have made agricultural lands in the Corn Belt especially sensitive to sheet and rill erosion. As a result, the Corn Belt accounts for over 40 percent of CRP's impact on water erosion.

Reductions in lake and stream sediment have increased the quality of fishing, boating, and other water-based recreation. While the benefits accrue outside the normal market mechanism, they are nonetheless real. Improvements in the quality of outdoor amenities can also have market impacts. For example, improved fishing might increase sales of fishing equipment, cabin rentals, boat purchases, and similar items. These market impacts are not included in the measures of on- or off-site benefits presented here, but, as discussed later, they can have a positive affect on local economies.

Table 2.7—CRP's impact on cropland soil erosion

	Wind erosion		Water erosion		Total cropland erosion	
Farm production region[1]	1997	CRP impact[2]	1997	CRP impact	1997	CRP impact
	Million tons per year					
Northeast	0.2	—	48.9	-0.6	49.1	-0.6
Lake States	134.3	-10.4	97.9	-5.7	232.2	-16.1
Corn Belt	24.2	-0.6	452.3	-37.9	476.5	-38.6
Northern Plains	191.5	-23.2	104.4	-7.2	256.2	-30.4
Appalachia	0.4	—	137.5	-6.9	137.9	-6.9
Southeast	—	—	66.9	-6.1	66.9	-6.1
Delta	—	—	90.5	-9.2	90.5	-9.2
Southern Plains	267.8	-58.3	155.3	-9.4	462.7	-67.7
Mountain	196.3	-36.7	42.8	-3.9	239.1	-40.6
Pacific	41.5	-5.3	28.5	-2.0	70.0	-7.3
U.S. Total	856.3	-134.6	1,224.9	-89.0	2,081.1	-223.5

— indicates that the impact was less than 0.05.
[1]The farm production regions are delineated in figure 2.9. Note that the Pacific farm production region excludes Alaska and Hawaii.
[2]The reduction in erosion attributable to CRP enrollment. These impacts have already been netted out of the 1997 totals.

Source: Economic Research Service, USDA.

[21] CRP erosion reduction estimates assume that conservation practices on land enrolled in the CRP would be similar to 1997 cropland practices in the program's absence and are considerably smaller than erosion reduction estimates based on comparisons of erosion rates on CRP land before and after CRP enrollment.

Table 2.8 summarizes the estimated economic value of CRP's impact on soil erosion. The on-site economic benefit of reduced soil erosion (increased soil productivity) due to the CRP is approximately $122 million per year based on the 1997 Natural Resources Inventory (NRI). The on-site economic impacts of reduced soil erosion cover the combined effects of wind, sheet, and rill erosion. Approximately 60 percent of the productivity benefits are due to CRP's impact on future yields; the remaining 40 percent results from decreased input use when CRP acres are returned to production (Ribaudo et al., 1990). Regional measures of productivity benefits reflect both the quantity and quality of soil enrolled in the CRP.

Off-site benefits from reduced wind erosion stem from particulate-related cost savings enjoyed by those living or working in areas downwind from CRP land, particularly in the more arid regions of the country (Huszar and Piper, 1986). Measures of all off-site benefits of reduced soil erosion are not available. However, based on available measures, CRP reduces off-site costs of soil erosion by approximately $378 million per year, and decreases annual off-site damages from dust by approximately $61 million. These benefits occur in the four western regions where measures of the costs of particulate pollution have been developed. Impacts of wind erosion in other regions are not expected to be as significant (Ribaudo et al., 1990).

Sheet and rill erosion increases sediment in surface waters throughout the United States, imposing economic costs on many sectors of the economy (Hansen and Claassen, 2001). By reducing water erosion, CRP reduces these sediment-related costs by an estimated $317 million per year. This estimate includes economic measures of sediment's impact on municipal water treatment facilities, marine and freshwater fisheries, navigation,

Table 2.8—Annual economic benefits of CRP's impact on soil erosion

Farm production region[1]	On-site benefits[2]	Off-site benefits[3]			Total benefits	
		Dust	Sediment	Total	Overall	Per acre
	$ Million per year					*Dollars*
Northeast	1	—	8	8	8	44
Lake States	19	—	32	32	51	20
Corn Belt	39	—	136	136	175	37
Northern Plains	13	15	13	28	41	5
Appalachia	4	—	29	29	33	36
Southeast	3	—	23	23	26	17
Delta	4	—	40	40	44	37
Southern Plains	25	22	24	46	71	14
Mountain	11	18	6	25	36	6
Pacific	3	6	6	12	15	9
U.S.	122	61	317	378	500	15

— indicates that the impact was not estimated.

[1]Regions are delineated in figure 2.9. The Pacific farm production region excludes Alaska and Hawaii.

[2]On-site benefits accrue to the owners and operators of CRP acreage (such as increased soil productivity).

[3]Off-site benefits accrue in areas that are indirectly affected by CRP acreage (such as cleaner water in a lake downstream of CRP acreage).

Note: All benefits estimates are adjusted for inflation to represent 2000 dollars and are rounded to the nearest million dollars. Components may not sum to total due to rounding.

Source: Economic Research Service, USDA.

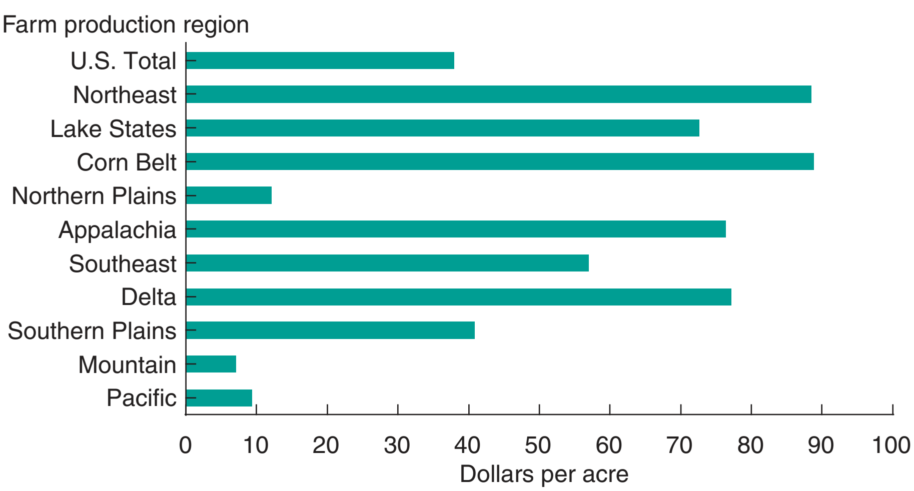
flooding, industrial production, reservoirs, and water-based recreation. Because measures of the other economic impacts of sediment have not been developed, the results presented here can be viewed as lower-bound estimates. These cost savings are most significant in the Corn Belt, which accounts for over 40 percent of all sediment-related off-site benefits.

The annual benefits of the CRP's impact on wildlife and soil erosion amount to roughly $38 per acre for the categories we have examined (fig. 2.10). But only about 10 percent of these benefits accrue to the enrollee as on-site benefits. The remaining 90 percent accrues over a broader region. As a result, communities near affected lakes and streams benefit from CRP's impact on sediment even though they may not be near the fields enrolled in the program. For example, as CRP reduces soil erosion, downstream communities can see catch rates and fishing incomes increase, water filtration costs decline, and sediment-related damage to cooling systems fall. This potential "disconnect" between those who make land-use decisions and those who reap the resulting environmental benefits (or incur the resulting costs) is one of the primary justifications for operating a Federally financed environmental program.[22] But, in terms of measuring CRP's economic impacts, environmental benefits complicate our analyses in three ways.

First, environmental benefits are often realized as cost savings or quality-of-life improvements rather than as more jobs or increased market activity—the usual measures of economic progress.[23] While CRP may succeed in reducing erosion, sedimentation, and windblown particulates, the resulting cost savings could reduce employment and income while increasing societal well-being. In such a case, change in the number of jobs is a misleading indicator of community well-being.

Second, as we have seen, the dollar value of the environmental benefits generated by enrolling land in the CRP varies considerably from place to place. To the extent that these benefits lead to market impacts, an acre of

Figure 2.10
Selected annual nonmarket environmental benefits from CRP



Regions are delineated in figure 2.9. The Pacific farm production region excludes Alaska and Hawaii. Benefits are adjusted for inflation to represent 2000 dollars.

Source: Economic Research Service, USDA.

[22] Beck et al. (1999) point out that the "disconnect" between the distribution of land conservation program benefits and costs makes it difficult to finance such programs at the local level.

[23] Of course, environmental benefits can improve job prospects even as they improve the quality of life. See, for example, Carlino and Mills (1987) and Lewis, Hunt, and Plantinga (2002, 2003). However, job creation is not the focus of environmental programs nor is program success a function of job generation.

CRP land in one region could have very different employment impacts than an acre of CRP land enrolled elsewhere.

Finally, the considerable environmental benefits enjoyed by a community may be due to the CRP enrollment in neighboring places, making comparisons of local development trends among high- and low-CRP counties misleading.

As a result, while CRP's environmental benefits affect the quality of life in rural counties, which in turn can lead to demographic and economic change, our analyses only capture these effects indirectly and imperfectly. We may underestimate the size of the positive economic impacts and overestimate the relative size of the negative economic impacts of CRP enrollment.

Rural Economic Trends Following CRP's Implementation

While the CRP is *not* a community development program, its effort to reduce soil erosion and protect environmentally sensitive resources can affect local economies and populations. By providing a stable source of income to participants, it has been credited with allowing financially vulnerable farm operators to remain on the farm when they might otherwise have been forced to leave in search of other employment (Hodur et al., 2002; Mortensen et al., 1990; Nowak et al., 1990). And, by improving wildlife populations and helping to provide a cleaner and more scenically appealing environment, CRP may have contributed to the quality of life in many rural communities and helped support a growing tourist and recreation industry. On the other hand, by retiring productive farmland, CRP may have reduced demand for certain farm services, undermining the strength of local economies in farm-dependent areas. And, by making it easier for farm operators to retire from farming, CRP may have facilitated population outmigration from farming communities. These same effects can be viewed positively or negatively. For example, CRP may have allowed some isolated rural communities to protect open spaces by slowing sprawl (Johnson and Maxwell, 2001), while other communities might view this as an impediment to much needed growth.[24]

Local adjustments to economic and social shocks are complex and difficult to model. A community's reaction to CRP-induced changes in land use, purchasing patterns, and environmental quality will depend on the size and nature of the local economy and its relationship to regional and national markets, the quality of public and private community leadership, the adaptability of the workforce, and the size of the changes, among other things. Based on analyses of CRP's impact on rural communities over the years, it is clear that the size of the program relative to the local economy is critically important.[25] During its 17 years of existence, CRP has retired land in nearly 2,700 counties and has disbursed over $1.5 billion per year, on average, in direct payments. In the majority of cases, CRP enrollment is too small relative to the local resource base to have much of an effect on local communities. Program impacts should be easiest to detect among communities that were most dependent on the land enrolled in the CRP.

Two measures of CRP's local importance are used in this section (see box, "Measuring the Local Importance of CRP"). The first is the proportion of the area's total cropland enrolled in the CRP. This acreage-based measure is used to evaluate CRP's effect on beginning farmers—a group that is likely to be sensitive to CRP-induced changes in land-use patterns. The second is the size of an area's CRP rental payments relative to local income. This payments-based measure is used to evaluate CRP's effect on population and employment trends. The rental-payments-to-income ratio combines information on the value of the land being retired and the importance of the associated farming activity to the local economy. The higher the ratio, the larger the potential effect of CRP on surrounding communities.

[24] But, as Parks and Schorr (1997) make clear, CRP is of limited value in slowing urban sprawl in fast-growing metropolitan areas where the value of land for development dwarfs its value for agricultural production.

[25] Nearly every published analysis of CRP's community impacts focuses on areas of the country with high CRP enrollment. Analyses which report results for more than one area generally find that CRP's impacts varied with agriculture's importance to the local economy as well as the level of CRP enrollment (Hines et al., 1991; Hyberg et al., 1991; Martin et al., 1988; Otto and Smith, 1996; and Standaert and Smith, 1989).

Measuring the Local Importance of CRP

The measure of CRP's local importance adopted by the 1985 Act is the proportion of each county's total cropland enrolled in CRP. This is a reasonable metric when the primary concern is CRP's effect on farms and farm-related industries. Because we don't want our measure of cropland to be influenced by CRP, we use county cropland from the 1982 Census of Agriculture (4 years before CRP was implemented) as the denominator. The numerator is the average CRP enrollment within each county from 1991 to 1993. After 1990, the annual mean proportion of cropland enrolled in CRP among counties with acreage in the program varied little around the 1991-1993 average of 6.6 percent.

If the primary concern is with broader measures of community well-being, such as the change in county population, then CRP acreage relative to cropland may not be totally relevant. If farming is a minor source of economic activity, high CRP enrollment relative to cropland may have little effect on the local economy. A more direct measure is the local economic importance of resources retired by the CRP. The denominator is total household income received by county residents in 1985, adjusted for inflation. The numerator is the average annual CRP rental payment earned on the county's enrolled acres from 1991 to 1993. The annual mean 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.

Since the focus of this section is on areas 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.[1] Alaska and Hawaii are unique enough to warrant exclusion, and more populated and economically diverse areas are unlikely to be measurably affected by CRP enrollment. The resulting universe is comprised of 1,481 counties located throughout the country, but concentrated most heavily in the Plains. These counties accounted for 79 percent of land enrolled in the CRP in both 1990 and 2002.

While the selection criteria provide a reasonably homogeneous group of observations for econometric analysis, 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 involves 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 with 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.[2] However, the strong association between matched treatment and control counties simplifies statistical modeling by comparing growth processes in similar environments. By minimizing the effects of other growth factors, the effects of high-CRP enrollment should be easier to identify.

To apply this approach, the measures of CRP's local importance were used to identify high-CRP counties which had more than 5,000 acres enrolled in the CRP at some point between 1986 and 1995. Using the acreage-based metric, high-CRP counties had a ratio of CRP enrollment to cropland that exceeded 20 percent. There were 194 high-CRP counties based on 1991-93 enrollments. Using the payments-based metric, high-CRP counties had a ratio of CRP rental payments to total household income that exceeded 2.75 percent. There were 195 high-CRP counties based on 1991-93 rental payments. Fifty-six percent of high-CRP counties were classified as such by both measures.

Each high-CRP county was matched as closely as possible to a similar county which had a low CRP enrollment and payment ratio. 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.[3] Unique matches were selected which minimized the "Mahalanobis distances" between the high-CRP counties and all possible combinations of eligible low-CRP counties. The Mahalanobis distance measures the similarity between observations based on a set of key characteristics-the smaller the distance, the more similar the matching, based on the characteristics being examined.[4] Matches were based on county characteristics associated with population, employment, and beginning farmer trends. The aim is to find matched pairs of counties which were very similar before CRP enrollment began, and then compare their development as land is enrolled in the CRP.

For counties with high enrollment to cropland ratios, suitable matches were based on pre-1984 measures of the structure and type of farming in each county; the age, ownership, and off-farm work characteristics of farm operators in each county; and nonfarm characteristics that are related to farm structure, such as the county's population growth, racial mix, employment rate, and manufacturing base. For counties with high rental payments to income ratios, 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.

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[1]Farm employment includes members of the farm operator's family employed on the farm as well as hired farm workers, and is from the 1980 Census of Population. An urban population cutoff of 20,000 (to focus on less-diversified economies) was chosen to coincide with the urban adjacency (or Beale) codes created by ERS.

[2]Ideally, counties should be similar in every respect except for the amount of CRP-eligible land, with low-CRP counties classified as such because land was ineligible based on environmental sensitivity criteria. Unfortunately, it seems likely that at least some low-CRP counties are such because eligible lands were too productive or too valuable for non-farm 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.

[3]Paired t-tests indicate that the mean values of CRP enrollment/cropland and CRP rental payment/income in high-CRP counties and their matches differ by more than two standard deviations, with a 99-percent level of confidence.

[4]The Mahalanobis distance metric takes the form $d^2(X_T,X_C) = (X_T-X_C)' \Sigma^{-1}(X_T-X_C)$, where 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 Mahalanobis distance between the two vectors, and Σ is the variance-covariance matrix of possible control counties (Isserman and Rephann, 1995).

In an effort to focus on areas that might be measurably affected by the CRP, we analyze two groups of counties: (1) nonmetropolitan counties with at least 5 percent of their workforce employed on the farm, and (2) counties considered "high-CRP" based on one of the ratios discussed earlier together with matching "control" counties having relatively low CRP ratios.[26] Figure 3.1 maps the 1,481 counties examined in this section as well as the high-CRP counties, as defined using 1991-1993 average enrolled acreage and rental payments.[27] While some of the effects of retiring agricultural land may be evident quickly, other effects may not be apparent for some time. To capture both short and longrun effects, a series of econometric models is estimated for different time periods to determine if and when local socio-economic trends were influenced by CRP enrollment. The detailed regression results presented in this section are from the matched sample, which highlights differences between high- and low-CRP counties.

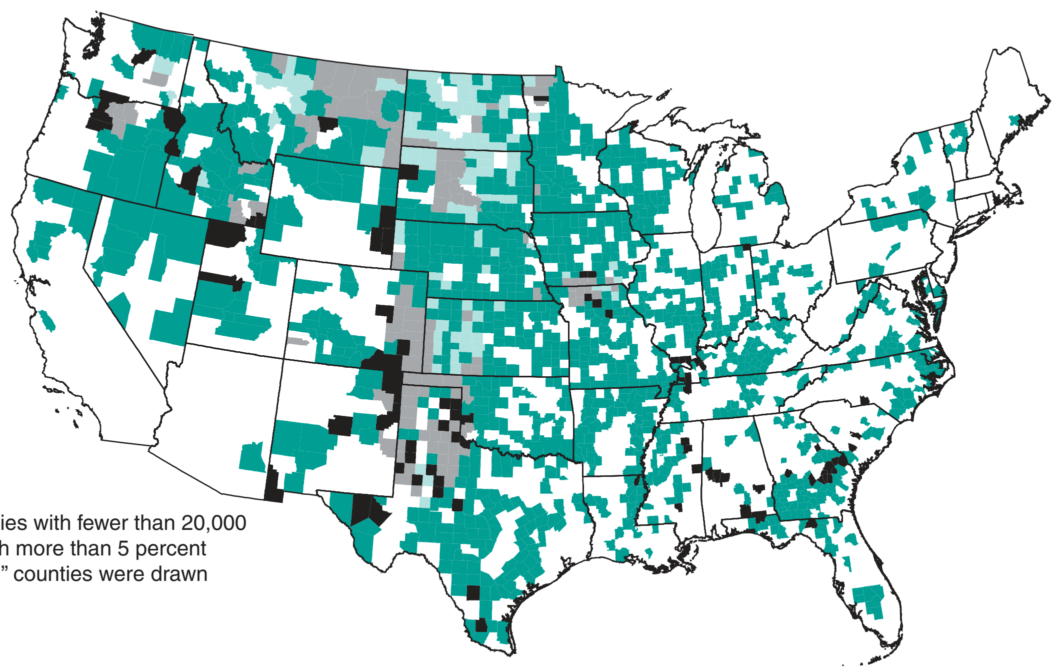
The CRP was initiated during a difficult period for farmers and farming communities. The farm sector was suffering its worst financial crisis since the 1930s when the 1985 Act became law. While agricultural exports, incomes, capital investments, and land values all surged in the 1970s, all of these indicators of financial well-being plummeted during the 1980s. As farmers went out of business, so did many community banks and local merchants. By 1986, when the CRP first began enrolling land, the farm financial crisis was still in full swing, with land values continuing their decline for another year or two (Collender, 1999). As a result, care must be taken to avoid blaming the CRP for the sectorwide problems of the 1980s or crediting the program for the subsequent sectorwide recovery.

To the extent that whole- and partial-farm enrollees use the program in different ways, the program's impact on the broader community may differ.

[26] Research has shown (and economic logic suggests) that the relative size of program impacts is likely to be greatest within small geographic units (Hamilton and Levins, 1998) and that program impacts vary from community to community within a local area (Henderson et al., 1992). Nonetheless, data limitations preclude examining impacts within subcounty units, such as towns and cities.

[27] The program was nearly fully implemented by 1993 and much of the available data ends in 1997. Changes in socioeconomic trends resulting from CRP enrollment in 1993 should be observed by 1997. Had a later period been used to measure CRP's importance, resulting socioeconomic changes in counties with recent enrollments might not be readily apparent in the 1997 data.

Figure 3.1
Counties studied to determine CRP's community impacts



Other study counties*
High - CRP enrollment
High - CRP payments
High - CRP enrollment and payments

*Includes nonmetropolitan counties with fewer than 20,000 urban residents in 1980, and with more than 5 percent employed in agriculture. "Control" counties were drawn from this group.

Source: CRP contracts file.

To allow for varying impacts, the regression analysis estimates whole- and partial-farm enrollment effects separately.[28] We also include the percentage of CRP payment outflows as a proxy for absentee ownership of CRP land. While we don't consider this a characteristic of the program as much as an indication of landownership patterns, these patterns can influence the impact that CRP has on local communities (see the previous section). When either the type of CRP enrollment or the flow of CRP funds is important to understanding CRP's community impacts, these relationships are fully explored.

[28] While whole- and partial-farm enrollments are highly correlated, the simple correlation coefficient is 0.61 for our acreage-based measure and 0.75 for our payments-based measure. Both of these coefficients are below the level commonly assumed to cause serious multicollinearity problems with estimated regression coefficients (Studenmund, 1997).

Population and Employment

To the extent that CRP enrollment represents a net reduction in the amount of land being cultivated within a local market, demand for agricultural inputs and marketing services would likely fall.[29] At a minimum, this would imply adjustments in the local labor market as resources shift from farm-related activities to other pursuits. Assuming that resources were previously being put to their most profitable use, land-retirement-induced adjustments could dampen the local economy unless new, more profitable opportunities arise. Furthermore, if institutional rigidities slow such adjustments, employment levels could decline even more than shifting demands would suggest. And, since migration patterns are sensitive to employment opportunities, pronounced shifts in a community's economy could also affect its desirability as a place to live and work, and ultimately its population level.

[29] Enrolling land in the CRP does not prevent other land from coming into production. Indeed, if commodity prices rise or agricultural input prices fall due to CRP land retirement, economic theory suggests that agricultural markets should adjust by increasing production, either by bringing additional land into production or by cultivating existing land more intensively. This phenomenon is referred to as "slippage" and would be expected to weaken CRP's economic impacts.

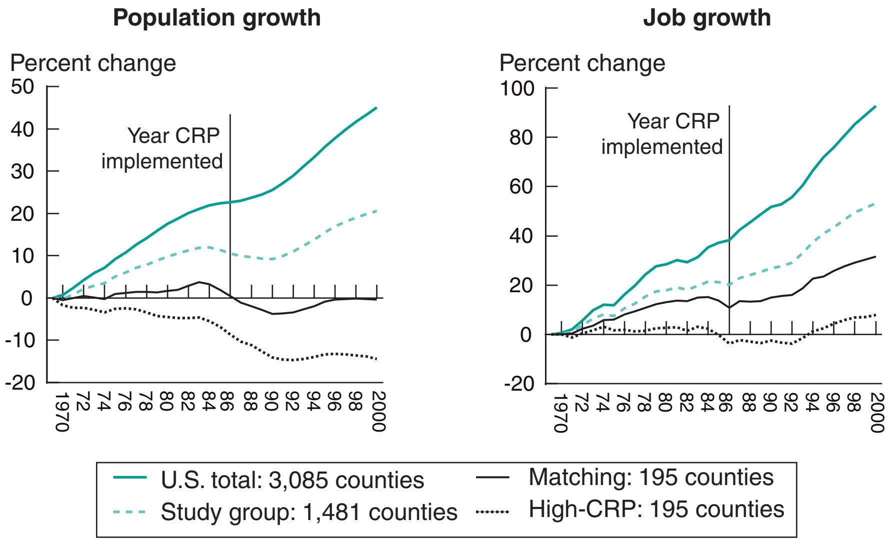
On the other hand, particularly during the early years of the program's operation, CRP rental payments may have helped many financially stressed farm operators stay on the farm. Whether as farmers, retirees, or nonfarm employees, CRP payment recipients may have helped stabilize the economies and populations of some farming communities simply by remaining in the area. By helping stabilize local land markets at a time when farmland values were falling, CRP enrollments may have helped nonparticipating farmers retain their operations. Over time, as CRP fostered increased populations and varieties of wildlife, a more diverse landscape, and a cleaner environment, increased recreational activities may have provided new job opportunities and increased the appeal of some farming communities as places to live.

Do high levels of CRP enrollment *systematically* affect rural employment and population trends in the short or the long run?[30] One consideration with any attempt to analyze the relationship between CRP participation and population and employment trends is that CRP enrollment tends to be heaviest in the Plains States, where many counties have a long history of population decline. Changes in technology and sectorwide consolidation have reduced the farm population in these counties, and their remoteness and low population density have discouraged other employers from moving in. Of the 195 high-CRP payment counties analyzed in this section, nearly 3 out of every 4 lost population between 1970 and 1985 (before CRP was implemented).

[30] When analyzing employment trends, we examine changes in the number of jobs rather than changes in the number of employed persons. Throughout this section, we use employment and jobs interchangeably.

Thus, CRP participation is not randomly distributed with respect to economic and demographic trends. Figure 3.2 presents average long-term trends in population and employment for high-CRP counties, their matched pairs, all 1,481 study counties, and all counties in the 48 contiguous States.

Figure 3.2
Average population and employment growth trends, 1969-2000



Note: The CRP program started enrolling land in 1986, with enrollment reaching a stable level of 33 million acres by 1990.
Source: ERS analysis of BEA income and employment files.

It is clear that, as a group, high-CRP counties have long been prone to population loss and anemic employment trends. Their problems accelerated in the early 1980s, but farming communities nationwide were also experiencing population and employment problems. The policy issue is whether high enrollment in the CRP has made local economic conditions worse or better than they otherwise would have been. That is, counties with unusually high levels of CRP enrollment do worse, on average, than other rural counties, but it is unclear whether CRP enrollment contributed to this situation or merely reflects the greater appeal CRP has to eligible landowners in poorly performing economies.

County population and employment change are closely, but not directly, linked, since commuting patterns change, people enter and exit the labor force depending on the availability of jobs, and retirees migrate without corresponding effects on employment. Nonetheless, employment and population tend to rise and fall together and we use the same model to explain variation in both population and employment trends. Four basic groups of explanatory variables are used in the analysis: (1) prior-change measures of both employment and population; (2) economic measures, which generally relate more to employment change than population change; (3) quality of life/amenity measures, which primarily affect population change; and (4) demographic measures, which may affect both population and employment change. These measures and the modeling techniques are discussed more fully in Appendix A.

Figure 3.2 not only shows that high-CRP counties have been weak economic performers for the past 30 years, but they have done worse, on average, than the matching (low-CRP) counties. This reflects the limitations of the matched-pairs approach when the counties of interest are unique. In an effort to highlight counties that are most likely to be affected by the CRP, we have isolated a disproportionate number of counties having few residents and small, relatively undiversified economies. Few counties with low CRP-payment-to-income ratios exhibited such extreme characteristics. As a result, the matching procedure reduces differences between high-CRP counties and the other counties studied, but it does not eliminate them. Regression analysis that analyzes patterns among all the study counties and between high-CRP counties and their matched pairs is used to correct for the differences in initial socioeconomic conditions.

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.[31] The rationale for adopting this econometric approach is discussed in Appendix A.

Between the matched-pair and study data sets, the different measures of CRP usage, and other variations as discussed in Appendix A, we have 20 different estimates of the relationship between CRP use and population and employment trends. This approach allows us to assess the consistency of the matched-pair estimations. Given that estimated coefficients can change from one model to the next, consistent estimates provide some confidence that the absence of statistical significance can be interpreted as "CRP has no effect," even though we do not know the probability of a Type II or false negative error. Since the absence of evidence is not evidence of absence, this approach helps to corroborate the findings from the matched-pair analysis.

The results, reported in table 3.1, report the sign of the CRP coefficient with respect to changes in population and employment over the short and long run. To determine whether there is any evidence that a meaningful relationship might exist, we report the number of times the coefficient is significant at the 80-percent level of confidence—far lower than is typically used to reject the null hypothesis. For those who want stronger proof that identified

[31] 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.

Table 3.1—Summary of CRP's estimated population and employment impacts

	Sign of CRP coefficients:			
	Positive		Negative	
	All	Significant	All	Significant
Population change				
1985-1992 (short term)	13	0	7	1 (0)
1985-2000 (long term)	17	4 (0)	3	0
Change in the number of jobs				
1985-1992 (short term)	0	0	20	11 (7)
1985-2000 (long term)	19	5 (3)	1	0

Note: The data refer to the sign and statistical significance on the CRP regression coefficient in 20 different versions of the growth model. A series of traditional growth models, using all 1,481 study counties and a series of difference-in-difference models, using the 195 matched pairs, allow the functional form and independent variables to vary. In each case, the dependent variable is the log of the ratio of population or jobs at the end of the period relative to 1985 (when matched pairs are analyzed, the dependent variable is the difference in the population or jobs log-ratio in high- and low-CRP counties). Statistical significance is based on a 2-tailed t-test at the .20 level with the number in parentheses significant at the .10 level.

Source: Economic Research Service, USDA.

relationships are less likely due to pure chance, the number of significant coefficients at the 90 percent level is reported in parentheses.

The results of the 20 regressions are broadly consistent. They provide no convincing evidence that CRP had a statistically significant negative effect on county population changes in either the short or long run. In fact, the results suggest that CRP may actually have been weakly associated with gains (or reduced losses) in population between 1985 and 2000, since most estimates suggest a positive relationship between CRP and population change. However, the coefficients representing the effects of CRP on population change were small and statistically insignificant at the 90-percent level of confidence. Thus, our conclusion is that the CRP did not tend to systematically reduce county population. This, of course, does not imply that no county lost (or gained) population because of its enrollment in the CRP. But high levels of enrollment in the CRP did not have a discernible *systematic* effect on population trends in rural communities once other factors were taken into account.

There is evidence that CRP was associated with job loss in the short run. All coefficients were negative, and in 7 of 20 cases the coefficient was statistically significant at the 90-percent level of confidence. However, this negative relationship did not persist over the longer period. Apparently, if negative effects existed, they were short-lived. Most models reported a positive relationship between CRP and employment growth over the long run. Since there was little evidence of a shortrun loss in population associated with CRP participation, it suggests that local economies were generally able to adapt to any loss in jobs associated with the CRP.

Table 3.2 presents the key results of a series of regressions on differences between high-CRP counties and their matched pairs. The first group of results (i.e., the "constant term") indicates that high-CRP counties had a significantly lower rate of job growth between 1985 and 1992. The second group of results shows whether differences in the size of the CRP payments-

Table 3.2—CRP's association with population and employment trends, 1985-2000

	Matched pairs[1]		Matched pairs/no mining[1]	
	Beta	Adj. R^2	Beta	Adj. R^2
Constant term[2]				
1985-1992 population change	-0.0099	0.32	-0.0032	0.40
1985-2000 population change	-0.0106	0.45	0.0198	0.48
1985-1992 employment change	-0.0293**	0.27	-0.0309**	0.32
1985-2000 employment change	0.0037	0.35	-0.0184	0.29
CRP payments/income ratio[3]				
1985-1992 population change	0.0011	0.39	0.0006	0.48
1985-2000 population change	-0.0011	0.50	0.0017	0.53
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[3]				
1985-1992 population change	0.0000	0.39	-0.0001	0.48
1985-2000 population change	0.0023	0.49	0.0006	0.55
1985-1992 employment change	-0.0027*	0.34	-0.0028**	0.45
1985-2000 employment change	0.0009	0.38	0.0001	0.36

* 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]See "Measuring the Local Importance of CRP" for a discussion of the matching process. 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]The model explains the difference in population and employment trends in high- and low-CRP counties as a function of the difference in socioeconomic variables between matched pairs of counties. The constant term is the equivalent of a dummy variable indicating membership in the high-CRP group.

[3]When the difference-in-difference equations include a continuous variable measuring CRP usage, the constant is constrained to equal 0.

Source: ERS calculations using data from the 1980 Census of Population, the 1982 Census of Agriculture, the Bureau of Economic Analysis, and FSA's CRP Contracts file.

to-income ratio had a significant impact on county trends. Here 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.[32] The third 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 had a consistent, statistically significant, negative effect on job growth between 1985 and 1992, but little effect over the longer period. In general, excluding mining counties produced stronger and more consistent results. Therefore, the remainder of our analysis of changes in population and employment trends excludes counties with over 5 percent employed in mining in 1980.

The results of the analyses of changes in the number of jobs over 1985-1992 were somewhat puzzling. The consistent significant relationships involved the CRP acreage/total cropland acreage measure and the simple difference in employment change between the high CRP counties and their matches. There was little evidence that a very high ratio of CRP *payments to income* was associated with job loss in the short run, and the regression coefficient was positive in the long run. One possible explanation is that CRP-related job losses occurred in small agricultural services centers. Counties with the highest CRP-payment-to-income ratios have very low populations, and are almost exclusively involved in farming and lacking in nonfarm businesses. However, counties with the highest proportions of *land* in CRP may still include small towns that could be adversely affected by declining sales of farm inputs and services.

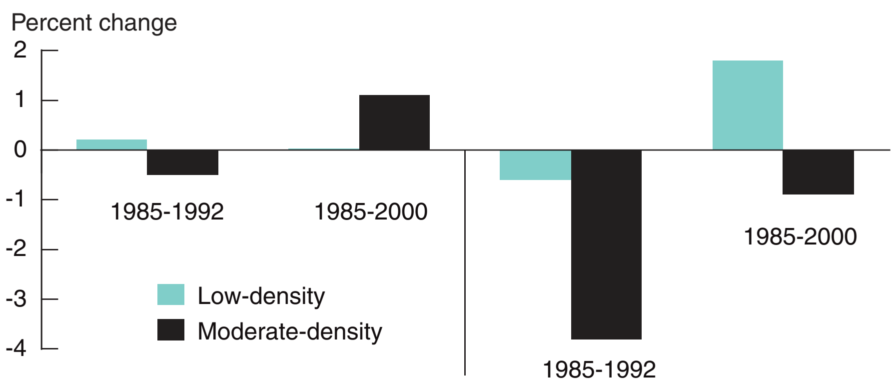
[32] Mining employment was very volatile during the study period with employment increasing rapidly in some areas and decreasing rapidly in others. As a result, neither a continuous variable measuring the proportion of local jobs in mining nor a dummy variable for mining counties was effective at capturing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

To investigate this issue further, we focus on the matched-pair data set as these counties all have relatively low population densities.[33] We have no direct measure of the presence of small agricultural centers in these counties, but more densely settled rural counties are likely to have one or more small towns. By including a population density-CRP interaction term in the regression, we can measure CRP's differential impact on local communities as county population density varies.

Statistically, we want to determine whether the relationship between the CRP payment-to-income ratio and population or job trends changes as population density varies. Because agricultural service centers may have been losing out to larger centers during this period, we also include an interaction term (percent employed in agriculture multiplied by population density) to reflect any tendency for population or employment loss to be greater in more densely settled agricultural areas over the study period. The results of these analyses (see appendix table A.4) indicate that CRP did not systematically affect population trends in either low or moderate population density counties, but the negative effect of CRP on the number of jobs in the county was larger in more densely settled rural counties than in thinly settled counties.

Figure 3.3 shows the estimated impact that CRP had on population and employment change in our selection of moderate- and low-density rural counties 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 two persons per square mile), CRP appears to have made little difference for population change in either the short or long term. For higher density rural counties (those with more than nine 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 significant 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

Figure 3.3
CRP's effect on population and job trends, by population density



Note: Bars represent predicted changes in population and employment due to an increase in the ratio of CRP payments to income. Predictions are determined by computing estimates with the CRP-payments-to-income ratio set to zero in both low- and high-CRP counties, recomputing estimates with the ratio set to 4 percent, and comparing the two estimates. Low- and moderate-density counties have fewer than 2 and more than 9 persons per square mile, respectively. The impact on population change is not statistically different from 0 at the .10 level.

Source: Economic Research Service, USDA.

[33] This analysis was also replicated for all counties remote from major cities and lacking towns of 2,500 or more. Analysis of these totally rural counties provided generally consistent results and for expositional ease will not be presented.

effects on jobs in counties with agricultural service centers, but that these net effects were largely confined to the short term.

These results are consistent with Martin et al.'s (1988) projections that CRP would negatively affect farm dependent communities in Oregon 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.

Thus far, we have tested for population and employment impacts as total CRP payments vary. However, whole-farm enrollments may have a different impact on population and employment than partial-farm enrollments. There is also a concern that any positive impacts CRP might have on the local economy would be weakened if CRP participants live elsewhere. To investigate these issues, we divide CRP enrollment into its various components and examine the relationship between these components and local population and employment trends.

It is often suggested that whole-farm CRP participation might be associated with lower county population growth. However, we found little evidence of this when we repeated the general analyses of population change using measures of both partial- and whole-farm participation. Coefficients for whole-farm participation were more likely to be negative than coefficients for partial-farm participation (particularly for population change between 1985 and 2000), but none of the whole-farm coefficients were statistically significant. For both partial- and whole-farm participation, CRP tended to have a negative association with employment change in the short term, but a positive association in the longer term. Our conclusion is that whether participation involved whole or partial farms has not made an important difference in population and employment trends.

Using a similar approach to distinguish CRP payments going to local residents from CRP payments going to absentee landowners, we examine whether CRP was more negatively related to population and employment growth when payments went outside the county. In this case, there were consistent if usually small differences (table 3.3). Where payments stayed within the county, CRP participation was more likely to be associated with growth. To the extent that payments went outside the county, CRP participation was more often associated with reductions in population and jobs. It is difficult to separate cause from effect here. CRP payments are more apt to contribute to local growth when the recipients are local. At the same time, areas prone to population loss and with few job opportunities may tend to have more absentee ownership. A third possibility is that absentee ownership itself (independent of CRP participation) leads to slower economic growth and outmigration. None of these explanations is completely satisfactory, however. They suggest a dampening of growth that would persist or even gain in importance in the long term. To the contrary, the negative relationship between outside payments and local growth, strong in 1985-1992, largely disappeared in 1985-2000.

Table 3.3—Summary of absentee CRP-landowner analyses

	Sign of coefficients							
	Positive		Negative		Positive		Negative	
	All	Significant	All	Significant	All	Significant	All	Significant
	CRP payments in county				*CRP payments out of county*			
Change in population								
1985-1992	6	0	2	0	0	0	8	0
1985-2000	8	1	0	0	4	0	4	0
Change in number of jobs								
1985-1992	4	0	4	**1***	0	0	8	**3**
1985-2000	6	**4**	2	1	3	0	5	0
Total (out of 32)	24	**5**	8	**2**	7	0	25	**3**

*Numbers in bold indicate that at least one coefficient was significantly different from zero at the .10 level.

Note: Counties with over 5 percent employed in mining in 1980 were excluded. The data refer to the sign and statistical significance of the in-county CRP payments and the out-of-county CRP payments regression coefficients in 8 different versions of the growth model, where the functional form and the list of independent variables vary across models. In each case, the dependent variable is the log of ratio of population or jobs at the end of the period relative to 1985 (when matched pairs are analyzed, the dependent variable is the difference in the population or jobs log-ratio in high- and low-CRP counties). Statistical significance is based on a 2-tailed t-test at the .20 level.

Source: Economic Research Service, USDA.

Given anecdotal evidence and the widespread belief that high levels of CRP enrollment have contributed to a decline in the population of nearby communities, it is somewhat surprising that we could find no convincing evidence linking the CRP to these declines.[34] As with any statistical analysis, it is possible that there are factors we did not account for that, if included, would have shown that CRP had an effect (either positive or negative) on population trends in some rural counties. However, given the breadth of factors incorporated into our models, this seems unlikely. A second explanation may have more credence. Our analysis is conducted at the county level (the smallest unit for which appropriate data are available), whereas much of the anecdotal evidence being reported concerns cities and towns. It is likely that the percentage of cropland enrolled in the CRP is much higher within small geographic areas than it is for the associated county as a whole. Therefore, individual towns may be affected as land is taken out of production and jobs shift elsewhere within the county.

High CRP participation was associated with lower net gains (or higher net losses) in jobs, but this pattern was largely confined to more densely settled rural counties—ones that typically have small agricultural centers—and did not persist in the long run (1985-2000). Apparently, the economies in these areas were able to generate alternative sources of employment over time. In general, more densely settled rural areas have been less prone to population and job loss than more thinly settled areas. CRP participation has not been a factor in low-density areas that have had the greatest problems with population loss.

[34] For example, in "Montana Town's Boys Are Its Last Gasp of Hope," Blaine Harden of *The Washington Post*, blamed CRP for depopulating small farming communities. The National Grain and Feed Association makes a similar claim in its 2001 white paper on farm policy issues.

Farm-Related Businesses

Our analyses of aggregate employment trends in high-CRP counties suggest that CRP generally had a small impact on employment which dissipated over time. Even so, the removal of a significant amount of cropland from production is likely to have had a major effect on one segment of the local economy—local farm-related businesses. Businesses supplying local farms with inputs and marketing services—farm machinery and input suppliers, grain elevators, and local trucking establishments, for instance—may have faced cutbacks that were masked in our analyses of overall employment change. There is ample literature arguing that the CRP reduces input use and, by implication, would reduce employment in businesses serving crop producers (Abel et al., 1994; Hyberg et al., 1991; Standaert and Smith, 1989; Taylor, 1988). And our analysis does show that CRP's impact on jobs appeared to be strongest in counties that were likely serving as local agricultural service centers where farm-related employment would have been relatively important.

Unfortunately, data limitations hindered our ability to assess CRP's industry-specific impacts. Confidentiality concerns make it difficult to access data on jobs by industry in small local economies.[35] The Census of Population has limited industry detail and is only available every 10 years, making it unsuitable for our purposes. Data for wage and salary workers are available annually from three sources: County Business Patterns (CBP), the Bureau of Labor Statistics' Covered Employment and Wages (CEW) data, and the Bureau of Economic Analysis' Regional Economic Information System (REIS). For all three, however, publicly released data are incomplete due to data suppression.[36]

The only county-level information available on detailed industries was CBP data on the number of establishments with at least one employee.[37] Since the number of establishments may decline due to industry consolidation as well as unfavorable business conditions, these data need to be treated cautiously. In particular, it is inappropriate to interpret a decline in establishments as necessarily indicating that employment declined. As firms consolidate into fewer establishments industry employment may not be affected. But at any point in time, the pattern of business closures among counties is likely to reflect, albeit imperfectly, differences in the business climate from one county to the next. To set the analysis of farm-related establishments in context, information on total nonfarm establishments and employment has been included here as well.

Farm-related enterprises were defined as agricultural services, farm suppliers, and most food processors relating to crops (see table A.4 in Appendix A). Since they would likely be less affected by CRP, establishments devoted exclusively to livestock, such as meat processors and veterinary services, were excluded from our count of farm-related establishments. In 1975, the first year for which data were available, on average there were 12 farm-related establishments serving high-CRP counties compared with about 15 in the other study counties. However, farm-related establishments constituted a larger proportion of *all* nonfarm establishments in high-CRP counties (10 percent) than in other study counties (5 percent) because high-CRP counties have less nonfarm activity.

[35] To protect confidentiality, industry data on employment and wages are not released for counties where the number of establishments is small or where there is one dominant employer.

[36] ERS has arranged to obtain unsuppressed CEW and REIS data for counties in States that give the Bureau of Labor Statistics permission to share the data (all but about 5 States have done so for 2000 data). However, ERS is only now receiving these data and was unable to use them for this report.

[37] In 1998, this data series switched from the Standard Industry Classification System to the North American Industry Classification System, so time-series comparisons can be made only up to 1997.

Table 3.4—Changes in nonfarm establishments and jobs, 1975-1997

Establishment type and period	High-CRP[1]	Low-CRP	All study counties
	Annualized growth rate (percent)		
Farm-related establishments			
1975-1985	-0.7	-0.2	-0.6
1985-1992	-1.1	-1.5	-1.3
1992-1997	-0.6	-0.2	-0.1
All nonfarm establishments			
1975-1985	0.7	1.2	2.0
1985-1992	-0.5	0.0	0.5
1992-1997	1.0	1.3	1.8
All nonfarm jobs			
1975-1985	0.7	1.2	1.9
1985-1992	0.4	1.3	1.6
1992-1997	2.2	2.4	2.8
1997-2001	0.6	1.0	1.1

[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. Low-CRP counties were selected from the study counties because of their similarity to high-CRP counties, but with relatively low payments-to-income ratios.

Source: Establishment data are from County Business Patterns and excludes public sector establishments. Job counts are from the Bureau of Economic Analysis REIS data file.

Rural counties have had a persistent loss of farm-related establishments since 1975 (table 3.4). The rate of loss was somewhat higher during 1985-1992 than either before or after. This period included some very difficult years for agriculture as well as a national economic recession. According to these data, the rate of loss of farm-related businesses was at least as great in low-CRP and other study counties as in the high-CRP counties during this period. But given their greater share of economic activity in high-CRP counties, the loss of farm-related businesses may have had a greater impact on employment in high-CRP counties.

From 1992-1997, the rate of loss in farm-related establishments was greater in high-CRP counties than elsewhere. This trend is masked somewhat in the overall trends because the total number of nonfarm establishments and the total number of nonfarm jobs both increased over this 5-year period. Thus, while the local economies in high-CRP regions are not strong by any measure, they have been able to replace the loss of farm-related establishments over time. The adjustment process may not have been easy for those involved, but the trends suggest that CRP's net impact was small given the consolidation trends buffeting farm-related industries over the past 25 years or more.

In addition to its impact on demand for farm inputs and services, CRP can affect population and employment through its impact on farming opportunities.

Beginning Farmers

Within the context of rural community development, the ability of young and beginning farmers to successfully acquire control of the assets needed to create viable businesses is important in farm-dependent areas. The continuing rise in the average age of farm operators suggests that young families may be unable or unwilling to stay in (or migrate to) communities that are heavily dependent on agriculture for jobs. The average age of farm operators increased one full year between 1992 and 1997 to 54.3 years. The rise in the average age of farmers reflects both the paucity of young operators entering farming and the aging-in-place of established farmers (Gale, 1993). From 1982 to 1997, the number of principal farm operators under 35 years of age fell 58 percent, while the number at least 65 years of age rose by over 25 percent**.**

Of course, beginning farmers don't have to be young. For purposes of qualifying for USDA targeted farm loan programs, the Agricultural Credit Improvement Act of 1992 defines a beginning farmer as an individual or entity who has owned or operated a farm or ranch for not more than 10 years.[38] While age and years of experience are highly correlated, beginning farmers come from all age cohorts. And whether young or not, beginning farmers can bring much needed vitality to farming communities. With few employment alternatives, if farming cannot support a stable population, many farming communities fear that depopulation is inevitable. Between 1982 and 1987, the proportion of farmers who had operated their farm for less than 10 years declined from 38 to 32 percent before stabilizing at 30 percent in the 1990s. The higher proportion of "short-tenure" farm operators when compared with young farmers may reflect the movement of older farm operators from one farm to another in response to urban sprawl, intergenerational transfers, the purchase of farms for retirement or as a lifestyle, and a host of other reasons. These farm location changes may involve inter-county migration in some instances, but in others they may simply reflect a reshuffling of available farmland.

Because the quantity of land is essentially fixed, one hypothesis is that land enrolled in the CRP reduces the supply of land available for agricultural production, putting upward pressure on farmland rental rates and purchase prices. This places beginning farmers, who may have limited financial resources, at a competitive disadvantage for control of available farm assets.[39] On the other hand, during much of the period we examine, CRP was enrolling less productive soils which may not have provided sufficient economic returns to support a viable farm operation.[40] When coupled with county enrollment limits, the decline and eventual elimination of commodity program land diversion requirements, and the ability to bring previously uncultivated land into production, it may be that CRP's impact on the availability of productive soils was too small to have much of an impact on local farmland markets.

The competitive position of beginning farmers is likely to be particularly sensitive to how land is enrolled in the CRP. Partial-farm enrollments are more likely composed of small plots of land that would not have been available for lease or purchase in the program's absence. These enrollments may have no direct effect on the availability of farmland for rent and could actually benefit beginning farmers who have such land enrolled in the program. Whole-farm enrollments, on the other hand, are more likely to involve tracts large enough to support viable operations. We therefore examine the impact of whole- and partial-farm enrollment on beginning farmers as well as examining CRP's overall impact.

As discussed earlier, our general approach is to examine the relationship between the ratio of CRP enrollment to total cropland and beginning farmer trends for various groups of counties. We have identified 194 "high-CRP"

[38] The Census of Agriculture has not explicitly requested information on beginning farmer status. However, it has requested information on the age of the senior operator and the length of time he/she has operated any part of his/her current farm. We use under 35 years of age (i.e., young) and under 10 years on the current farm (i.e., short-tenure) as proxies for beginning farmers.

[39] An analysis of Montana farm operator opinions about whether the CRP should be expanded showed that young operators were less likely to support expansion than were older farm operators, other things being equal (Saltiel, 1993).

[40] Highly erodible land is found across the productivity spectrum (Heimlich, 1989). However, the compensation system used until 1990 discouraged owners of more productive land from enrolling in the CRP.

counties based on the proportion of cropland enrolled in the program. Figure 3.4 details beginning farmer trends for high- and low-CRP counties and for the United States as a whole.[41]

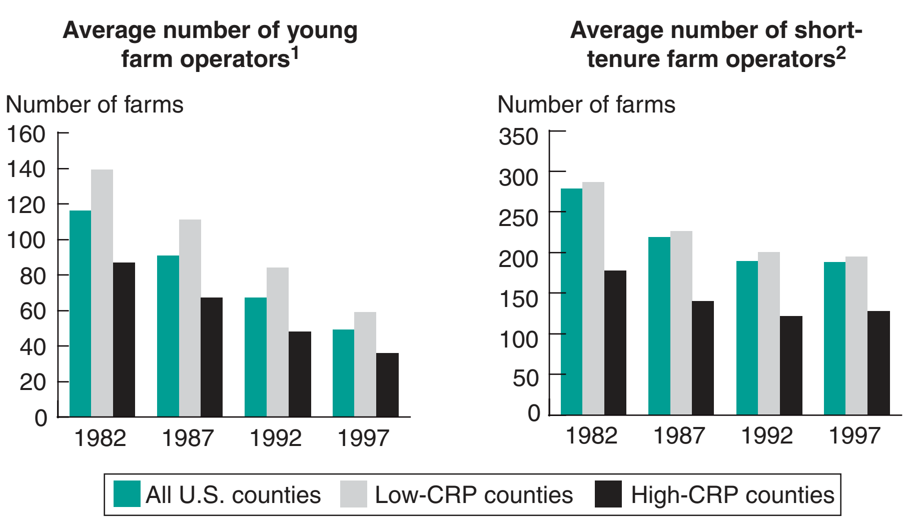
On average, high-CRP counties have fewer farms than low-CRP counties (presumably because of the former's concentration in the Plains), so it is not surprising that they also have fewer young and short-tenure farmers. On average, all counties experienced declines in the number of beginning farmers from 1982 to 1997, with low- and high-CRP counties following very similar trends to the United States as a whole.

A series of econometric models was estimated to determine the relationship between CRP enrollment and trends in the numbers of young and short-tenure farm operators. In addition to the ratio of acres enrolled in the CRP to acres of cropland (with CRP enrollment first estimated in the aggregate and then split into its whole- and partial-farm components), these models included other independent variables measuring the county's farm sector, economic, and demographic characteristics. The latter two categories of variables are identical to those in the population and employment models; the farm sector variables are discussed more fully at the end of Appendix A. Trends were measured over the years 1982-1997, spanning the years before the program began to the latest year for which Census of Agriculture data is available, as well as changes between each Census, (1982-87, 1987-92, and 1992-97). The principal results from a series of "difference-in-differences" equations based on 194 matched pairs of counties are reported in table 3.5.

Looking at trends from 1982 to 1997, it appears that there is no statistically significant relationship between the ratio of aggregate CRP enrollment to cropland and changes in the number of beginning farmers. However, when

[41] The 1,481 study counties are actually split among 3 groups: high-CRP counties (where CRP enrollment makes up more than 20 percent of cropland), low-CRP counties (where the CRP/cropland ratio is below 12.5 percent), and a middle group. For expositional ease, we ignore the middle group since it includes counties that are considered high-CRP based on other measures of the program's local importance, such as the ratio of CRP payments to income.

Figure 3.4
Beginning farmer trends, 1982-1997



[1] Young farm operators are principal farm operators under 35 years of age.
[2] Short-tenure operators have operated their current farm for less then 10 years.

Source: Census of Agriculture and CRP Contracts file. Low-CRP counties have less than 12.5 percent of their cropland enrolled in the CRP. High-CRP counties have more than 20 percent of their cropland enrolled in the CRP.

Table 3.5—CRP's association with young and short-tenure farm operator trends[1]

	Aggregate CRP model		Disaggregated CRP model		
Dependent variable	CRP/cropland Beta	R^2 (adj.)	Whole-farm Beta	Partial-farm Beta	R^2 (adj.)
Young farmers' growth rate					
1982-1997	0.105	0.28	**-0.217[a]**	**0.274****	0.30
1982-1987	-0.097	0.37	**-0.384****	**0.149[a]**	0.39
1987-1992	0.098	0.12	0.073	-0.030	0.11
1992-1997	**0.266****	0.23	0.051	**0.226***	0.23
Short-tenure farmers' growth rate					
1982-1997	0.029	0.28	**-0.386****	**0.295****	0.30
1982-1987	**-0.248****	0.35	-0.141	-0.145	0.35
1987-1992	**0.229****	0.16	0.104	0.134	0.16
1992-1997	**0.216****	0.21	**-0.259***	**0.467****	0.28

[1]Young farm operators are principal farm operators under 35 years of age. Short-tenure operators have operated their current farm for less then 10 years.

Note: Analysis of difference in trends between 194 high-CRP counties and their matching low-CRP counties. Results are first reported for the ratio of total CRP acreage to county cropland. The analysis is then redone with whole- and partial-farm payment ratios replacing the aggregate measure. Beta represents the standardized regression coefficient with the intercept constrained to equal zero. [a], *, and ** indicate that the regression coefficient is different from zero at the 10-, 5-, and 1-percent level of significance, respectively. Adjusted R2 indicates the portion of variation explained by the regression.

Source: Calculated from the Census of Agriculture, the CRP Contracts file, and the 1980 Census of Population.

CRP participation is divided into whole- and partial-farm enrollment, a striking pattern emerges. Beginning farmer trends are negatively associated with whole-farm enrollments and positively associated with partial-farm enrollments. Furthermore, when 1982-97 is broken into 5-year increments, *statistically significant* coefficients are always negative for whole-farm enrollments and are always positive for partial-farm enrollments. The partial-farm effect is strong enough to make the coefficient for total CRP enrollment positive in three of the four instances when statistically significant results were found. The only exception was 1982-1987, when sector-wide financial problems led to deteriorating beginning farmer trends.

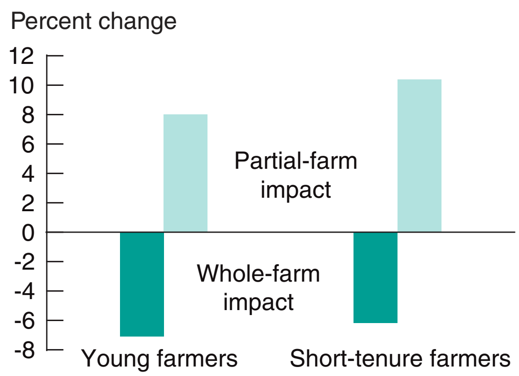
But what is the root cause of these patterns? Does whole-farm enrollment reduce the availability of farmland to the detriment of beginning farmers or does the absence of beginning farmers encourage landowners who no longer wish to farm their land to enroll as much land as possible in the CRP? While we don't have a definitive answer, the farm financial crisis of the 1980s likely had a particularly large impact on young and beginning farmers in areas of the country with less productive soils. Since rental rates were low in these areas and returns to farming were not particularly promising, enrollment in the CRP program may have been unusually high. If so, high CRP enrollment, particularly in the form of whole farms, was the result of unfavorable farming conditions which also discouraged new entrants.

During the period when CRP enrollments were highest, higher CRP enrollment, particularly when accomplished though partial-farm enrollments, appears to slow the local decline in the number of beginning farmers based on our comparison of high- and low-CRP counties. This could be because partial-farm enrollment provided all participants, including beginning farmers, with some much-needed financial assistance. On the other hand, if local economic conditions and agricultural opportunities were encouraging, demand for farmland by both established and beginning farmers would be high, increasing its rental value. Whole-farm enrollments would be less appealing in such markets, but partial-farm enrollments of marginal land would still be attractive since CRP enrollment reduces risk. Thus, CRP enrollment could be determined by demand for farmland by young and beginning farmers rather than affecting that demand.

When average CRP enrollment in 1991-93 is regressed against trends in the number of farmers (or beginning farmers) along with the other explanatory variables, statistically significant negative coefficients are consistently found for 1982-87 farm trends. For subsequent periods (1987-92 and 1992-97), the coefficients were positive. This is consistent with the view that the farm financial crisis of the 1980s encouraged CRP enrollment when the program became operational in 1986. Once established, heavy CRP enrollments then helped stabilize farm sector trends from 1987 to 1997.

To get a clearer idea of the relationship between CRP and beginning farmer trends *assuming the direction of causality goes from CRP participation to beginning farmer trends*, we use the estimated regression coefficients to calculate what would have happened to the growth rate of young and short-tenure farmers in the average low-CRP county had CRP enrollments been higher. Between 1991 and 1993, low-CRP counties had an average 4.8 percent of their cropland enrolled in the CRP: 1.6 percent as whole-farm enrollments and 3.2 percent as partial-farm enrollments. How might beginning farmer trends for these counties have differed if they had CRP enrollments comparable to the high-CRP counties? Figure 3.5 provides estimates of the growth rates for young and beginning farmers in the average low-CRP county between 1982 and 1997 if CRP enrollment had been at the high-CRP mean (26.8 percent of cropland: 11.1 percent in whole-farm and 15.7 percent in partial-farm enrollments).[42]

Figure 3.5
Estimated impacts of high levels of CRP enrollment



Note: Estimates represent the expected change in the growth rate of beginning farmers between 1982 and 1997 in the typical low-CRP county if the ratio of CRP enrollment to cropland increased to levels typical of high-CRP counties (i.e., increasing from 4.8 percent to 26.6 percent). Total CRP impacts are not significantly different from 0 at the .10 level.

Source: Economic Research Service, USDA.

Increasing the percentage of cropland enrolled as partial farms by 12.3 percentage points (to 15.7 percent) would have reduced the decline of young farmers by 8.5 percent in the average low-CRP county between 1982 and 1997. The impact on short-tenure farmers would have been nearly as great, resulting in a slower decline between 1982 and 1997. On the other hand, increasing the percentage of cropland enrolled as whole farms by 9.5 percentage points (to 11.1 percent) would have had the opposite effect on the rate of change of young and short-tenure farmers. While swings in CRP

[42] The measure of cropland used in this analysis is from the 1982 Census, so ratios greater than 25 percent are possible without requiring a waiver of the county enrollment cap if previously uncultivated land was brought into crop production after 1982.

usage of this magnitude are unusual, they may represent the experiences of high-CRP counties.

This analysis suggests that total CRP enrollment is not a major factor explaining declines in the number of beginning farmers in farm-dependent communities. Negative consequences associated with whole-farm enrollments are counteracted by the positive consequences associated with partial-farm enrollments. Absentee ownership of CRP land did not appear to affect beginning farmer trends.[43] Furthermore, relative to the consequences of technological advances, market trends, and other Federal policies, the impact of CRP on beginning farmer trends appears to be minor.

[43] When regressions were estimated to determine if the prevalence of absentee CRP landowners affects beginning farmer trends, no statistically significant relationships were found for young farmer trends, and only weak, inconsistent relationships were found for short-tenure farmer trends over 1982-87.

Summary and Caveats

Previous attempts to estimate CRP's socioeconomic impacts have relied on: (1) deterministic models of the local economy, most often based on input/output models; (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 can add valuable insight into the adjustment processes rural counties go through as they accommodate policy shocks, none can accurately evaluate what happened in response to changes in CRP enrollment. Input/output models are useful for predicting the local economic response to policy shocks *ex ante*, but they do not reflect actual *ex post* adjustments. Surveys of knowledgeable observers can provide a wealth of information about the local adjustment process, but respondents are seldom in a position to evaluate the simultaneous impacts of all changes affecting their communities. And econometric analyses of similar programs can provide hints about what might happen as land is enrolled in the CRP, but since program characteristics inevitably differ, the applicability of the results is always open to question. To our knowledge, this is the first systematic attempt to econometrically model the impact that CRP has had on rural counties nationwide based on observed data.

By looking at actual changes in socioeconomic indicators within a broad cross-section of rural counties, we have been able to identify the extent to which variation in CRP enrollment appears to be associated with several measures of community well-being. When statistical relationships were found, they tended to be most significant in the short run, with impacts dissipating over longer periods of time. Furthermore, our results suggest that the relationship between CRP enrollment and community well-being varies depending on community characteristics. For some types of rural counties, CRP appears to be associated with growth (or slower decline), while CRP seems to have the opposite effect in other areas.

This study has focused on areas of the country that are most likely to be affected by shifts in agricultural land uses—rural counties with at least a modest proportion of the workforce employed in agriculture. To isolate any potential impacts the CRP has, we further narrowed our attention to counties in which CRP enrollments or CRP payments were unusually large relative to the local cropland base or economy. Relying on fairly simple single-equation models to explain variations in growth trends and the difference in growth trends between high-CRP counties and matched "control" counties, we found generally consistent results. With respect to population change, there is no convincing evidence that a high ratio of CRP payments to income has a negative effect, but it may have a weak positive impact in sparsely populated areas of the country over the long run. A high ratio of cropland enrolled in the CRP appeared to dampen job growth in counties likely to have small agricultural centers (isolated rural counties with moderate population density). But these negative effects were largely confined to the short run. No statistically significant evidence was found suggesting that whole-farm enrollments had a differential impact on population and employment trends.

It seems clear that participation in the CRP is itself a function of community well-being in addition to any impact program participation may have on nearby communities, so causality is difficult to infer. While the logic backing up the presumption that CRP enrollment had an effect on employment (whether or not employment prospects had any effect on CRP participation) is generally accepted in the economic literature, no such consensus exists for the relationship between CRP enrollment and beginning farmer trends.

We found that whole-farm enrollments are associated with more rapid decline in the number of beginning farmers while partial-farm enrollments are associated with slower declines relative to what would have occurred in CRP's absence. But since whole- and partial-farm participation are likely to be strongly related to trends and characteristics of the local farm and nonfarm economies, the underlying cause of the CRP-beginning farmer relationship is far from clear. In fact, the causality could easily be that the number of new and young farmers affects the amount of whole- and partial-farm enrollment, rather than the reverse. In areas where agricultural and off-farm work opportunities are good, demand for farmland by young and beginning farmers could encourage more partial-farm enrollments. In areas where agricultural prospects are not good, the dearth of beginning farmers could encourage whole-farm enrollments. To the extent that this is the case, CRP participation is not the driving force behind beginning farmer trends, but is merely an outgrowth of those trends. But whether a driving force or not, our analysis suggests that the net result is that aggregate CRP enrollment is not a major factor explaining declines in the number of beginning farmers between 1982 and 1997.

Thus, based on our analysis of socioeconomic trends in rural counties before and after CRP was implemented, it does not appear that high levels of enrollment had a permanent affect on county growth prospects. This does not mean that no business or community was hurt by the CRP. Indeed, our results suggest that businesses in small agricultural service centers may have experienced sharp reductions in demand as farmland was retired. As a result, high-CRP regions of the country may have experienced a disproportionate loss of local businesses and employment in farm-related industries. And, individual cities and towns may have faced difficult adjustments as CRP enrollment in their areas removed large amounts of cropland from production. But rural economies, even those in undiversified farm-dependent areas, appear to have been resilient enough to adapt to shifting demands and opportunities. CRP had few systematic overall effects discernible at the county level, and those that we found were small, on average, and short lived.

Land-Use and Economic Implications of Expiring CRP Contracts

There are a number of ways of estimating the economic impacts of an ongoing land retirement program, such as the CRP, with secondary data. One is to examine local economic changes that accompany enrollment of cropland in CRP. That was the approach taken in the previous section, where we examined socioeconomic trends in farming communities before and after the CRP program was put in place. That approach has the benefit of hindsight but has the disadvantage of focusing on the past when policy decisions often require an assessment of what is happening now and what is likely to happen in the future.

A second approach to measuring CRP's economic impacts is to estimate what might happen if farmers were hypothetically released from their CRP contracts. That is, given the current distribution of CRP enrollment, rental payments, and ground cover, as well as prevailing commodity market conditions, public policies, and government regulations, what might happen if CRP contracts were suddenly all to expire without any additional enrollments? In doing so, we are not suggesting that cancellation of CRP contracts is a policy option to be explored. Nor do we attempt to model what will happen under the current timetable for the expiration of existing CRP contracts. Rather, our analysis of a hypothetical immediate expiration of contracts is merely a convenient way of measuring the economic impact of the program's continuation, given current conditions.[44] In this section, we use social accounting matrix (SAM) multiplier models to estimate what might happen to several regional economies with particularly high CRP enrollments should the program expire. The first question that comes to mind is whether an expiration of the program today would simply cancel the effects of its creation in 1985. If so, then a simulation model is redundant. But, since the CRP has changed over the years, as have many of the factors that influence land-use decisions, the short answer is no—the community effects of a hypothetical expiration of the CRP are not necessarily a mirror image of those associated with its creation. Then too, rural counties are different than they were 15 years ago—perhaps in ways that are not easily reversed.

The expiration of CRP could affect rural economies in several distinct ways. First, land currently enrolled in the CRP could switch out of conservation uses. Some of this land would be used to produce crops, livestock, and other agricultural goods. Some of the land leaving the CRP would be developed for nonagricultural uses, such as housing tracts, shopping malls, or industrial sites, and some would remain in conservation uses. Decisions about what to do with the land would affect not only demand for local farm inputs and services, but to the extent that they influence market prices for farm commodities, they could affect all market participants. Second, the environmental benefits generated by the CRP have been credited with increased public participation in outdoor activities such as hunting, freshwater fishing, wildlife viewing, and other forms of outdoor recreation. To the extent that decisions about the fate of land released from the CRP affect the quality of

[44] Our analysis compares an immediate release of all CRP contracts to a situation where the program continues indefinitely at its current level of enrolled acreage (i.e., the government will continue enrolling acres by exactly the amount of expiring contracts). In reality, existing contracts will expire over time and Congress will decide whether and at what level to enroll new acres. Comparing different scenarios of CRP continuation is beyond the scope of this study.

these outdoor activities, expenditures for recreational trips and their geographic distribution could change as well. Third, households that currently receive CRP payments would likely change their consumption expenditures as these payments cease, particularly if net income generated by land released from the CRP falls short of CRP rental payments.

To model the economic impact of CRP expiration, it is first necessary to model the disposition of lands currently enrolled in the CRP. With this information, changes in agricultural production can be estimated. Furthermore, expected changes in land use can be combined with information on rural outdoor recreation to estimate potential changes in recreational expenditures. This information can then be used to estimate the economywide impacts of CRP's expiration and, by implication, its continuation.

Land-Use Decisions

Normally, when a CRP contract expires, the enrollee can offer to re-enroll if that is an option, or CRP participation can end. Those whose land is not re-enrolled may choose to return land to crop production or grazing (either directly or by renting or selling their land to other farm operators), develop the land for nonfarm use, or keep their options open by leaving the land unused, presumably in either managed or unmanaged conservation cover.[45] The factors that will help determine which choice, or set of choices, an individual enrollee makes include expected returns from farming (or cash renting) the released land, the cost of converting conservation cover to other uses, demand for land for nonfarm purposes, and the goals and portfolio needs of the decisionmaker. It is not a foregone conclusion that all the land enrolled in the CRP will revert to its previous use when it drops out of the program.

To estimate land-use changes that would likely accompany a sudden expiration of CRP contracts, we use an econometric model based on data drawn from the 1992 and 1997 Natural Resources Inventory (NRI).[46] The model starts with approximately 21,000 NRI observations that were in the CRP in 1992. Between 1992 and 1997, about 2,800 of these observations dropped out of the CRP as a result of the enrollee's decision to either terminate a CRP contract early or to forego the option of extending an expiring contract. (Since all CRP enrollees had the option of extending expiring contracts for 1 year beyond the original termination date in 1996 and 1997, none of these parcels was forced out of the program because their 10-year CRP contract ended.) Of all land not currently enrolled in the CRP, these formerly enrolled parcels are expected to most closely resemble land currently enrolled in the CRP. By observing the uses these former CRP lands were put to, and modeling the decision process to determine why land was put to its new use, we can estimate what land uses would be adopted by the remaining CRP participants should they be dropped from the program.[47]

Table 4.1 provides information on the use of land in 1997 that had dropped out of the CRP after 1992. Roughly 63 percent of the 3.6 million acres that dropped out of the program was subsequently used to grow crops. Another 31 percent was used for pasture or rangeland, and the remaining 6 percent

[45] Even if an enrollee chooses the latter, he may be able to earn a return from hunting, fishing, or other recreational activities. As a result, leaving land idle need not be a complete drain on the enrollee's resources.

[46] NRI data is collected by USDA's Natural Resources Conservation Service. NRI data collects information from approximately 800,000 sample points scattered randomly across the private lands of the United States. Each point contains data on land use, soil type, and other biophysical variables. Our econometric model depends on CRP data from the NRI. In describing the NRI, Fuller (1999) writes "...administrative data on acres in the Conservation Reserve Program (CRP) for the years 1992 and 1997 are used as controls in the estimation process." He also notes that "...a procedure is used that makes the CRP acres close for each county, but the total control is imposed only at the state level." It is not clear how these adjustments influence the sample properties of the NRI and, by extension, our econometric estimates.

[47] The econometric model predicts whether a parcel of land in CRP will switch to either crop production or to a noncrop land use, after accounting for the decision to opt out of CRP in the first place. Lands predicted to switch to a noncrop land use are allocated to specific noncrop activities (i.e., pasture, range, forest, and urban uses) based on actual land-use patterns of parcels dropping out of the CRP between 1992 and 1997. For a more detailed description of the model and its development, see Lubowski and Roberts (2003).

Table 4.1—1997 use of lands that dropped out of the CRP after 1992

CRP contracted cover practice[1]	Units	Land use in 1997 Crops	Pasture	Range	Forest	Urban	Other[2]	Total
Grasses & legumes	1,000 acres	2,161.8	771.7	288.4	22.7	5.0	37.4	3,287.0
	Percent of all acres	65.8	23.5	8.8	0.7	0.1	1.1	100.0
	Percent standard error	0.6	0.4	0.3	0.1	0.0	0.1	
Trees & wildlife habitat	1,000 acres	76.1	37.8	8.8	161.7	2.3	3.5	290.2
	Percent of all acres	26.2	13.0	3.0	55.7	0.8	1.2	100.0
	Percent standard error	2.5	1.7	0.8	2.2	0.5	0.4	
All cover	1,000 acres	2,237.9	809.5	297.2	184.4	7.3	40.9	3,577.2
	Percent of all acres	62.6	22.6	8.3	5.2	0.5	1.1	100.0
	Percent standard error	0.7	0.4	0.3	0.3	0.2	0.1	

[1]These are general categories reported by the NRI that include the more specific practices contracted for under the CRP.
[2]Includes rural roads, water bodies, barren lands, and "other" farm and nonfarm lands, as designated by the NRI.

Source: Estimates are from the National Resources Inventory (NRI) based on 2,756 observations that dropped out of the CRP between 1992 and 1997. Percentages in each cell are of total acres dropping out from the specified contracted cover practice. Standard errors are based on the NRI's stratified cluster sampling design.

was left as forest or devoted to other nonfarm uses.[48] One factor that clearly influences the choice of post-CRP land use is the type of cover used when the land was in the program. CRP land planted to trees is far less likely to be converted to crop production upon the contract's expiration than is CRP land planted in grasses and legumes. But, as was mentioned previously, other factors likely to influence land-use decisions include the profitability of available land-use activities, which vary geographically and with market conditions, and the aspirations of the whomever controls the land, which vary by individual attributes, such as age, wealth, and tenure. While we do not have information on the ownership of specific CRP parcels or their profitability, we do have information on each parcel's erodibility, conservation cover, and location which can be used to estimate the profitability of alternative uses. As described in Appendix B, we use observation-specific data from the NRI and county data on the profitability of alternative land uses, to develop a model that estimates the probability that an NRI observation will switch from CRP to crop production or one of the other major land-use categories listed in table 4.1.

Previous studies suggest that characteristics of the participant (e.g. retirement status) and of the operation (e.g. size) also influence post-CRP land use (Skaggs et al., 1994; Johnson et al., 1997; Cooper and Osborn, 1998). We do not include such data in the model since they are ultimately based on decisions of the owner or operator. Over time, people and firms will presumably locate in particular areas based upon profit maximization. Given our focus on the longer term consequences of CRP expiration, we include only profit measures and fixed physical characteristics that determine the net returns to converting that land to alternative uses.

Since those who dropped out of the CRP between 1992 and 1997 did so voluntarily, we cannot assume their land-use decisions represent the decisions of those who remained in the CRP. The model described in Appendix B uses statistical techniques to correct biases that could arise due the nonrepresentativeness of the sample. Nonrepresentativeness arises partly from changes in enrollment criteria following early CRP signups and partly from factors particular to enrollees who chose not to remain in CRP. The

[48] Appendix B provides further detail on the land-use definitions from the NRI. "Pasture" is land managed for introduced forage for livestock grazing. "Range" is land under native or introduced forage suitable for grazing which, unlike pasture, receives only limited management.

model also uses mechanisms to allow for interactions between explanatory variables and to account for possible nonlinear relationships in their effects on land-use decisions. The coefficients generated by this econometric model are then used to predict what would happen to all land enrolled in the CRP if the program expired. These predictions are based on CRP contracts as of November 2002, as well as profitability data computed using 2001 prices and costs and 5-year lags of yields (as described in Appendix B). The net result is to assign all current CRP acreage to one of several alternative land uses: cultivated and uncultivated cropland, pasture, forest, range, and urban development.

Overall, the model predicts that 51 percent of land enrolled in the CRP would have returned to crop production within about a year if the entire program had expired at the end of 2002, but this percentage varies from one region to the next. Table 4.2 presents our model's predictions for the United States and three multicounty regions where CRP enrollment is high (fig. 4.2). Figure 4.1 presents information on the geographic distribution of CRP land converted to all of the major land uses considered. Land remaining in forest is concentrated in the Southeast while land converted to urban uses is concentrated around a few urban centers. The other uses of land are more geographically dispersed.

Predictions for multicounty regions or smaller units of geography are subject to a greater degree of uncertainty than are national predictions since the estimates from the land-use model reflect average patterns of behavior across the entire country. Because we only have data for land-use choices between 1992 and 1997, we cannot estimate separate regional models based on variation in explanatory factors over time. Instead, our estimates must rely on variation across space over a large geographic area. As a result, if cropland decisions in some relatively small regions are more or less sensitive than average to changing economic conditions (perhaps due to differ-

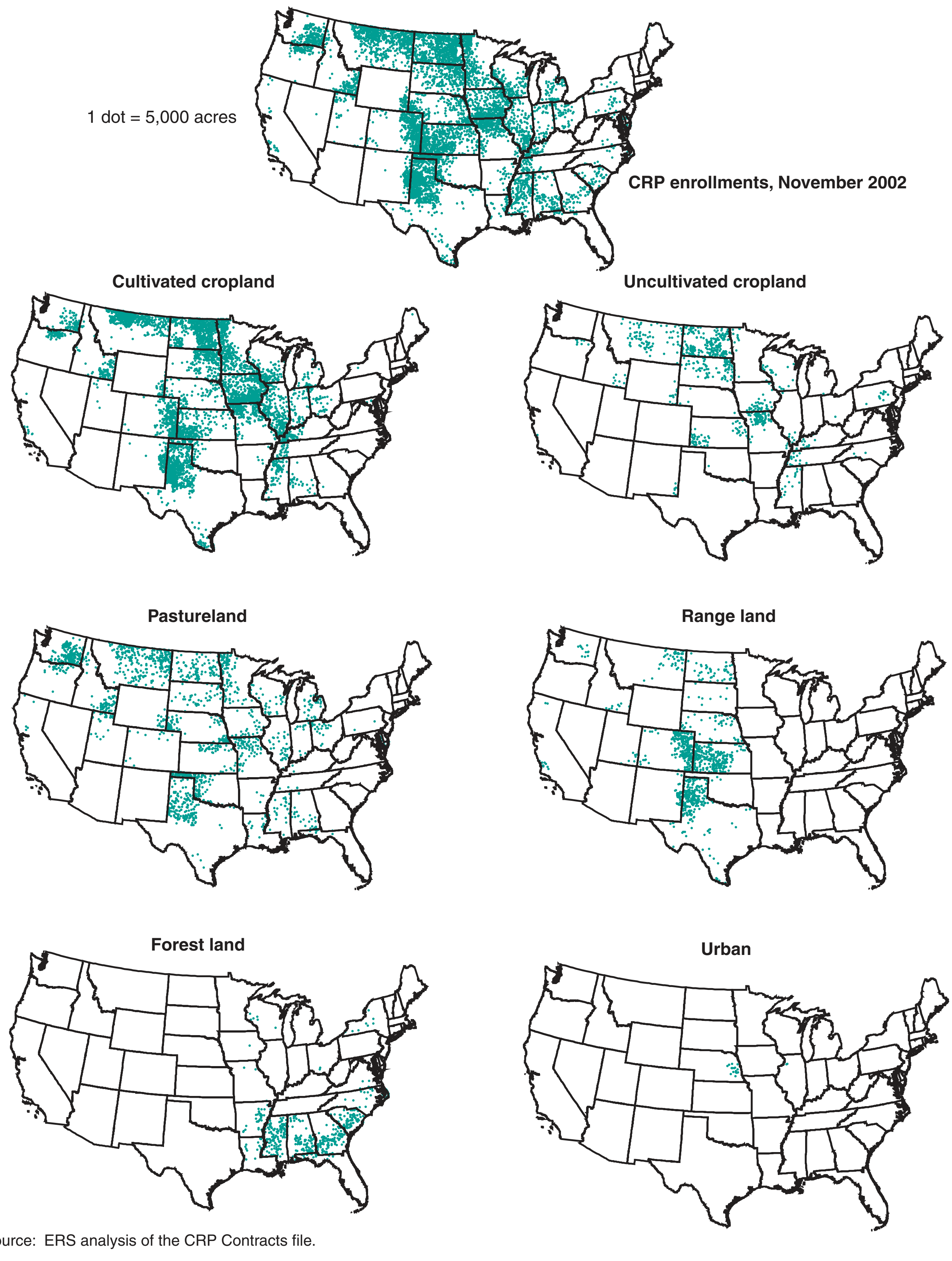
Table 4.2—Predicted share of CRP acres returning to crops, 2002

Region[1]	Land in CRP	Land returning to crops if CRP expires	
	1,000 acres	*1,000 acres*	*Percent*
48-State total	33,892	17,346	51
(95-percent confidence interval)		(13,670 - 21,425)	(40 - 63)
Northern Plains Crescent	8,327	5,732	69
(95-precent confidence interval)		(5,103 - 6,302)	(61 - 76)
Southern Plains Ellipse	8,543	3,816	45
95-percent confidence interval)		(2,715 - 4,616)	(32 - 54)
Southwestern Corn Belt[2]	1,859	1,533	82
(95-percent confidence interval)		(695 - 1,770)	(37 - 95)

[1]Regions are delineated in figure 4.2.
[2]The confidence interval for the Southwestern Corn Belt is skewed because the underlying distribution is skewed (binomial with a mean of 82 percent) and the sample size is small (much smaller than in the other regions), which makes the confidence interval less symmetric.

Source: FSA's CRP Contracts file as of November, 2002 with predictions of land returning to crops based on Lubowski and Roberts (2003).

Figure 4.1
Disposition of enrolled acreage under hypothetical CRP expiration



Source: ERS analysis of the CRP Contracts file.

ences in the proportion of marginally productive soils), reversion to crop production could be overestimated or underestimated in these small areas.[49]

In addition, predictions are based on prices in 2001 and prevailing government programs before 2002. Aside from relatively high loan rates for certain commodities such as soybeans, the production incentives present in 2002 are similar in nature to those present in 1996. Nonetheless, as market prices change, the amount of CRP land that would return to crops and other agricultural uses will vary.

Previous studies of post-CRP land-use choices—completed before land began dropping out of the program—generally predict higher percentages of land released from the CRP going into crop production. Using a linear programming model, De La Torre Ugarte et al. (1995) estimate that roughly 57 percent of CRP land would return to the production of major commodities if the program was not extended in 1996. The Soil and Water Conservation Society conducted national surveys of CRP participants in 1990 and 1993 to determine landowners' post-CRP land-use intentions (Nowak et al., 1990; Osborn et al., 1994). The 1990 survey indicated that 53 percent of acres would return to crop production after their contracts expired if CRP renewal was not an option. The 1993 survey, based on a larger sample, indicated that 63 percent of CRP acres would return to cropping upon contract expiration if re-enrollment was not an option, with wide variation depending on region, expected commodity prices, and CRP cover.[50] The estimates ranged from 58 to 78 percent, respectively, if future commodity prices were assumed to be 20 percent lower or higher than in 1993.

Our estimate that 51 percent of CRP land would return to crop production reflects, in part, differences in the assumed level of crop prices. Our econometric estimates may also reflect greater rigidities in land use than were apparent before CRP contracts started expiring and researchers could examine actual land-use decisions. Possible explanations for the persistence of CRP land retirements, at least in the short run, include rigidities in land-use change due to fixed costs of land-use conversion, which provide incentives to delay land-use decisions until more can be learned about the profitability of alternative uses.[51] In addition, the portfolio needs of CRP contract holders may obviate the active farming of their CRP land. Over one-third of CRP enrollees are residential farm operators who allocate most of their work time to off-farm pursuits. At least some of these participants may decide to leave their CRP land permanently idle in support of their chosen lifestyle. Whatever the explanation, these results suggest that there may be longer term environmental benefits associated with the CRP that could outlive the program itself.

Land-use decisions are important to rural economies because they have a direct bearing on farm production levels and prices, purchases of farm-related goods and services, and recreational spending.

[49] In particular, one reviewer expressed concern that our predictions for the Northern Great Plains overestimated the reversion to crop production.

[50] A series of additional surveys in States with CRP acres, conducted in 1993, generally found that about 60 percent of CRP acres would return to crop production if the CRP ended (see Diebel et al., 1998 for a review).

[51] Predictions of post-CRP land use are calibrated using parcels that opted out of CRP approximately 1 year prior to observing their subsequent use. It is possible some farmers intended to convert their land back to crops but had not yet done so. In certain areas, however, a large proportion of former CRP land did return to crops in this timeframe. This suggests enough time had elapsed for farmers to transition to their intended land use.

Recreational Spending

In addition to agricultural production, the distribution of land uses affects the natural environment. Removing land from the CRP, thereby increasing crop production, grazing, or putting the land to other uses, is likely to affect air and water quality, wildlife populations, and the aesthetic qualities of the rural landscape. These impacts may result in changes in outdoor recreational trips taken by the public (Feather et al., 1999). Changes in recreational spending can, in turn, affect rural economies (Beck et al., 1999; Siegel and Johnson, 1991). To investigate this issue, we consider freshwater- and wildlife-based recreation. Freshwater-based recreation includes fishing, swimming, boating, and shore-side activities. Wildlife-based recreation includes hunting and wildlife viewing.

Given the lack of data directly linking CRP to recreational expenditures, we generated estimates using two different methods. The first method combines survey data on recreational trip taking behavior with information on land uses; in particular, with information on the amount and distribution of CRP land. The second method combines information on expenditures by hunters with information on fee income received by farmers for recreational uses of their land. We use these two methods to estimate low- and high-end impacts that CRP's land-use requirements have on recreational expenditures.

As described in Appendix C, the first method (referred to as the "trips-based" method) uses data from the U.S. Fish and Wildlife Service's 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation (FHWAR) and the U.S. Forest Service's 2000 National Survey of Recreation and the Environment (NSRE). A travel cost model is developed that predicts where people visit, given the characteristics of the set of places they can visit. One of these characteristics is the geographic distribution of CRP land. Thus, as this distribution changes under alternative scenarios, including a "no CRP" scenario, we are able to predict changes in trip-taking behavior.

The second method (referred to as the "receipts-based" method) looks just at CRP's impact on hunting and wildlife viewing. The 2001 Agricultural Resource Management Survey includes data on the recreational receipts of about 800 farms with CRP acreage.[52] These data were used to estimate per-CRP-acre recreational receipts for each of the ERS Farm Resource Regions (see Appendix C).

Both methods require data on recreational expenditures. The trips-based method uses average per-trip expenditures obtained from the FHWAR and NSRE surveys. To derive measures of impact, these per-trip expenditures are multiplied by predicted changes in the number and location of trips due to changes in CRP. The receipts-based method uses regional estimates of expenditures derived from the FHWAR survey. Given that the overall average of recreational expenditures is proportional to recreational receipts received by farms with CRP land, measures of CRP's impact are derived by multiplying CRP acres by per-acre recreational receipts and an access-fee-to-overall-expenditures multiplier.[53]

Both methods group expenditures into the following categories: transportation and wholesale trade, eating and lodging, retail trade, and services.

[52] Farmers reported receipts for recreational uses of their land, including hunting, fishing, horseback riding, and other activities (Banker et al., 2001).

[53] This multiplier is derived on a regional basis, using expenditure data from the FHWAR.

Eating and lodging expenditures include hotel services and restaurant meals. Retail trade expenditures include equipment, supplies, and trip sundries, while service-sector expenditures cover government licenses and permits, site access fees, and guide services.

With the trips-based method, we find that the extent of CRP enrollment in a county and the overall erosion rate, which is strongly influenced by CRP, have statistically significant effects on participation in outdoor recreation. But the impacts are small, totaling about $7 million nationwide. With the receipts-based method, we estimate higher impacts, totaling about $290 million nationwide.

Given the estimated impacts of CRP on wildlife viewing and hunting reported by previous studies and reviewed earlier, the small impacts estimated by the trips-based method are surprising. One possible explanation for the discrepancy between our earlier estimates of the consumer surplus associated with wildlife viewing and the recreational travel expenditure predictions derived by the trips-based method is that expiration of the CRP would not reduce the total number of trips taken for recreational activities, but would instead influence where they are taken among the alternative sites available. This redistribution may affect the typical individual's enjoyment of recreational travel, thereby reducing consumer surplus, without affecting how much is spent on recreational travel.

The impacts estimated with the receipts-based method more closely agree with prior research (Bangsund et al., 2002). However the highly aggregated expenditure data used with this method require use of several simplifying assumptions, such as assuming a State-specific relationship between recreational receipts and overall recreational expenditures (Thigpen et al.). These assumptions, while reasonable, could not be tested. Therefore, we use both methods to provide a range of possible recreational travel expenditure impacts associated with the CRP. A more accurate measurement of how CRP affects recreational expenditures may require new sources of data along with more sophisticated statistical models.

Revenue Impacts Associated With Land-Use Changes

The analysis simulating what would happen if all CRP contracts expired in 2002 estimates the probability that each CRP contract would return to crop production if the program were no longer available. Multiplying these estimates by the acres in each contract and aggregating to the county level yields predictions for the amount of CRP land in each county that would return to production. For the purposes of estimating the economic impact of these changes, we first estimate associated revenue changes for the following land-use activities: grains, oilseeds, cotton, hay and pasture, and other crops. To do so, we allocate CRP lands predicted to return to crop production to specific crops based on the current use of cropland within each county.[54] We allocate other CRP lands to pasture based on actual land-use patterns of parcels dropping out of the CRP between 1992 and 1997. We then estimate changes in annual revenues by multiplying our predicted acreage changes by county-level estimates of expected 2002 revenues per

[54] The current crop mix in a county presumably reflects the current profitability of those crops. NRI parcels that returned to crop production in 1997 after dropping out of the CRP typically did not return to the same crop that was planted before the parcel was enrolled in the CRP. While the most profitable crop for each acre of CRP land exiting the program might differ from the county average due to unique land characteristics, the current crop mix in the county should be a reasonable proxy for crop allocation on acres exiting the CRP.

acre for each land use. To calculate revenues from crops we use 5-year average yields for each county, adjusted for the productivity of CRP acreage, and 2001 commodity prices. County-level revenue estimates for pasture and hay employed a similar approach (for details, see Lubowski and Roberts, 2003).

One potential shortcoming of this approach is that it does not allow the price effects of increased production to feed back into land-use decisions. That is, since land released from the CRP will increase production, we would expect commodity prices to drop, lowering expected revenue for all affected crop farmers and discouraging some farmers from planting a crop. If this happens, our national estimates of the production and revenue impacts of CRP expiration will be overstated and our regional estimated impacts may be over- or understated, depending on interregional shifts in cultivation. This is slippage in reverse. Over the years, researchers have argued that the production-control impacts of land retirement and diversion programs are reduced as rising commodity prices encourage uncultivated land into production. Slippage rates of 20 to over 50 percent have been reported, varying greatly by crop, land quality, and geography (see Leathers and Harrington, 2000; Love and Foster, 1990; and Wu, 2000). Others have found evidence suggesting that local slippage rates are much lower (Hoag et al., 1993; Roberts and Bucholtz, 2002). If reverse slippage follows a similar pattern, CRP land coming into production in one area may cause non-CRP land to drop out of production in other areas.

To check on the likely size of price effects as CRP land returns to production, the analysis was supplemented with an assessment of how the overall agricultural economy might change if CRP expired, based on the U.S. Regional Agricultural Sector Model (USMP; see House et al., 1999). As described in Appendix D, the USMP is a comparative-static market equilibrium model. While much more aggregated than the land-use model we estimated econometrically, as an equilibrium model it is able to capture the dynamic response of the agricultural economy as policies and programs change. For this analysis, the USMP model was constrained to force CRP land to return to production to determine the likely price and revenue impacts if CRP contracts expired.[55] The results suggest that as CRP acreage is released from conservation uses, crop production will increase and crop prices will fall. There is considerable variation among crops, with corn showing the greatest response with production increasing by 4 percent and market prices falling by about 6 percent.[56] As producers make further adjustments in response to these market conditions, one would expect fewer total acres to be planted, with prices moderating. But our concern is with the initial shock of eliminating CRP contracts, so we make no attempt to predict a new longrun equilibrium for farm commodity markets or the broader economy.

We estimated crop revenue impacts using two alternative scenarios: (1) no commodity price effects, which is consistent with early input-output modeling efforts; and (2) allowing prices to decline as predicted by USMP, but not allowing further slippage in planting intentions. The first case overestimates the revenue impact because it does not account for a reduction in revenue occurring on all cropland stemming from a fall in commodity

[55] The USMP model and the econometric model discussed previously are not strictly comparable and were not designed to work with each other. Furthermore, the USMP model only accounts for about two-thirds of the land in the CRP, so this simulation provides only rough estimates of what would happen if only 51 percent of CRP land returned to production.

[56] The price response for other crops ranges from close to 0 to about 4 percent. These production and price responses are similar in magnitude, but in the opposite direction of, those estimated when the CRP program was just

prices. The second case exaggerates the price response, and therefore underestimates the revenue impact, because total acres planted to crops will not increase one-for-one as CRP acres are returned to production. Together these two approaches should provide a reasonable range of revenue shocks associated with the expiration of all CRP contracts. We used the econometric model to estimate the changes in agricultural output and the social accounting matrix (SAM) model to analyze the effects of these changes on the linked sectors.

If CRP rental payments end, household expenditures would also be affected. Data from the Agricultural Resource Management Survey are used to apportion CRP rental payments going to low-, middle-, and high-income households, using farm operator wealth to measure permanent income.[57] The size of each of these economic shocks is estimated for the United States and for three multicounty regions likely to be most affected by expiration of the CRP. For the regional models, we assume that all transfer income is spent within the region. (CRP rental payments accruing to nonoperator landlords living outside the region represent expenditure leakages that diminish the regional impact of the CRP.)

Table 4.3 presents the changes in final demand affecting producers, households, and factor income flows for the Nation and the three regional economies used to define our two scenarios. Scenario 1 is called the "traditional scenario" because it assumes that agricultural price changes do not affect farm incomes—the traditional approach adopted by previous analyses. With no agricultural price effects accounted for, post-CRP shifts in land use generate $3 billion in increased agricultural production nationally. Partially offsetting this is a net reduction in outdoor recreational expenditures of $7 million (using a trips-based model) and the loss of $1.6 billion in CRP rental payments. Scenario 2 is called the "augmented scenario" because it allows for agricultural price changes to also affect farm enterprise incomes. In this scenario, post-CRP shifts in land use lead to a $7.46-billion reduction in the value of current agricultural production at the national level in addition to increasing agricultural production by $3 billion.[58] However, we assume that this reduction in farm enterprise income merely represents a transfer from the farm sector to the rest of the economy.[59] Hence, from a national perspective, the two effects offset each other.

Nevertheless, since the regional economies we will be examining later in the section are not closed economies, farm enterprise income losses are not likely to be offset by other consumer expenditures within the region. We therefore include the loss of farm revenue stemming from lower prices as part of the agricultural shock to these regions. We also include in the augmented scenario estimates a loss of $293 million in rural recreation expenditures (using the receipts-based model) and a loss of $1.6 billion in CRP payments to U.S. households.[60]

[57] Changes in household consumption patterns derive from changes in the perceived level of permanent income rather than transitory income which, particularly for farm households, can fluctuate widely from year to year. Low-income households with little net worth did not receive any CRP payments. This is consistent with information on the source of income among farm households categorized by the ERS farm household typology (fig. 2.5). Seventy-two percent of CRP funds accrue to farm households with moderate average incomes: retirement, residential lifestyle, and low-sales farming occupation farms. In contrast, 71 percent of total farm program payments accrue to farm households with high average incomes: high-sales farming occupation, large, and very large farms.

[58] The $7.46-billion decrease occurs on land that was in production while the CRP was in place. Inelastic demand for food (and our assumption that all cropland in production stays in production) means a small change in price leads to a substantial drop in revenue. The $3-billion dollar increase comes from land that was in the CRP but shifts to crop production. Therefore, farm income for the entire agricultural sector is down approximately $4 billion.

[59] We are assuming this income transfer stays within the United States. To be able to quantify the extent to which a portion of this $7.46 billion in consumer surplus accrues to foreign purchasers of U.S. agricultural products requires further study.

[60] In both scenarios, loss of CRP rental payments are treated as household income transfer losses. To treat them as value-added losses would be equivalent to assuming that they are linked to producer decisions at the margin. In fact the CRP program payments are decoupled from producer decisions at the margin.

Table 4.3—Initial shock: estimated revenue impacts of CRP's hypothetical expiration

Sector:	U.S. total	Region[1] Northern Plains Crescent	Southern Plains Ellipse	Southwestern Corn Belt	3-Region total
		Millions of 2001 dollars			
Agriculture with constant (2001) commodity prices:					
Total	3,019.9	748.5	466.0	159.7	1,374.2
Livestock[2]	72.8	5.1	22.1	5.2	32.4
Cotton	259.9	0	133.5	0	133.5
Grains	864.9	117.0	208.5	39.4	364.9
Hay & pasture	889.0	198.5	60.5	71.6	330.5
Other crops	162.6	10.8	41.5	0	52.3
Oilseeds	770.8	417.1	0	43.4	460.6
Loss of farm enterprise income from falling prices:[3]					
Total income	—	-169.2	-221.4	-55.2	-445.8
Labor income	—	-76.6	-90.6	-28.5	-195.7
Capital income	—	-92.6	-130.8	-26.7	-250.1
Rural recreation—trips-based model:					
Total	-7.3	5.9	-4.4	-3.9	-2.5
Wholesale trade & transportation	-1.5	0.8	-0.7	-1.2	-1.1
Retail trade	-0.9	3.7	-2.3	-1.0	0.3
Eating & lodging	-4.6	1.0	-1.1	-1.4	-1.5
Services	-0.2	0.4	-0.3	-0.3	-0.1
Rural recreation—receipts-based model:					
Total	-293.2	-104.2	-29.4	-33.8	-167.4
Wholesale trade & transportation	-87.6	-40.5	-10.5	-11.9	-62.8
Retail trade	-16.9	-6.7	-1.7	-2.4	-10.8
Eating & lodging	-101.1	-42.1	-11.4	-13.5	-66.9
Services	-87.6	-14.9	-5.9	-6.0	-26.9
Household CRP funds:[4]	-1,616.9	-287.8	-287.8	-137.1	-712.8
Middle-income	-1,439.0	-256.2	-256.2	-122.0	-634.4
High-income	-177.9	-31.7	-31.7	-15.1	-78.4

[1]The three regions refer to multicounty areas of the country with high levels of CRP enrollment and are delineated in figure 4.2.
[2] Livestock estimates are produced by the USMP model. The remaining agricultural revenue shocks were imputed based on the land-use projections from our econometric model.
[3] The national farm revenue loss of $7.46 billion is considered a transfer rather than a shock.
[4] Represents the loss of CRP payments with expiration of the program. Middle-income households have annual incomes of $20,000 to $77,000. High-income households are those with annual incomes over $77,000.

Source: Economic Research Service, USDA.

Modeling Economywide Impacts

To estimate CRP's effects on sector output, value added, household income, and employment, we use the 1996 Impact Analysis for Planning (IMPLAN) database[61] to develop a set of social accounting matrix (SAM) multiplier models for the Nation and three multicounty regions that cut across State boundaries. Unlike input-output models, the SAM framework allows us to capture precisely all of the endogenous linkages between production, labor and capital income, and household expenditures. The SAM presents a snapshot of the economy at a particular time. The strength of the SAM is its integration of industrial input-output flows with a set of household, government, capital, interregional, and international accounts in order to represent the complete set of revenue and income flows between production, income,

[61] The USDA Forest Service in the mid-1970s developed IMPLAN for community impact analysis. The current IMPLAN input-output database and model is maintained and sold by MIG, Inc. (Minnesota IMPLAN Group), http://www.IMPLAN.com.

consumption, investment, and trade (see Appendix E for a description of the SAM framework).

In estimating possible impacts of allowing CRP to expire, we use two different scenarios that encompass the choice of whether commodity prices are allowed to adjust or are held constant, and whether recreational travel expenditure impacts are estimated with the trips-based model or the receipts-based model. Traditionally, most input-output models have predicted the economywide impacts of increasing CRP enrollment assuming prices are fixed and ignoring recreational travel (e.g., Hyberg et al., 1991 and Dodson et al., 1994). To reflect this view, we construct a "traditional" scenario which holds prices constant and estimates recreational travel using the trips-based approach. However, because price effects matter within smaller regional economies and recreational travel might be important to rural economies, we also present the results of an "augmented" scenario which allows prices to fall as CRP contracts expire and estimates recreational travel using the receipts-based model. When estimating the national impacts of allowing CRP land back into production, the only practical difference between these two scenarios is that the augmented scenario reflects higher recreational travel expenditures than does the traditional scenario (because farm commodity price effects don't affect national land-use and output estimates).[62] But, as we will see, the two approaches can yield very different results for sub-national regions. Expiration of the CRP could increase agricultural production by as much as 1.3 percent nationwide (table 4.4). This increased production would stimulate demand for nonagricultural goods and services. The stimulus is partially offset by the loss of household expenditures from the $1.6 billion cut in CRP rental payments and reduced recreational travel expenditures of $7 million to $290 million. The net result is an increase of $1.3-$2.3 billion (0.01-0.02 percent) in nonagricultural production. The difference in estimated CRP impacts using the traditional and augmented scenarios is due entirely to differences in the size of the recreational travel expenditures associated with CRP's environ-

[62] We do not incorporate feedbacks on land use and output resulting from changes in prices induced by CRP land returning to crop production. As a result of falling prices, some CRP acres might not enter crop production and some cropland elsewhere might exit production. This implies that we slightly overestimate total crop acreage and output in the event CRP land returns to production.

Table 4.4—Two scenarios of short-term national impacts of CRP's hypothetical expiration

Economic measure	U.S. baseline	CRP-related stimulus: Traditional scenario		CRP-related stimulus: Augmented scenario	
	$ Billion	*$ Million*	*Percent*	*$ Million*	*Percent*
Output:	14,401	5,526	0.038	4,480	0.031
Agricultural	234	3,200	1.368	3,133	1.334
Nonagricultural	14,635	2,326	0.016	1,347	0.009
Value added (factor income):	7,704	2,598	0.034	2,034	0.026
Household income:	7,470	125	0.002	-283	-0.004
Low	1,146	104	0.009	80	0.007
Medium	4,341	-363	-0.008	-612	-0.014
High	1,983	383	0.019	249	0.013
	Million	*Thousand*	*Percent*	*Thousand*	*Percent*
Number of jobs:	152.3	181.7	0.119	151.2	0.099
Agricultural	2.9	117.4	4.073	115.1	3.993
Nonagricultural	149.4	64.3	0.043	36.1	0.024

Source: Vogel (2003). Value of output and income are in 2001 dollars. Nonagricultural industries include the manufacturing, construction, utilities, mining, trade and transport, and service sectors. Employment includes the number of full- and part-time jobs.

mental benefits. The higher recreational travel estimate of $290 million in expenditures that would be foregone if CRP were to expire results in a much smaller net boost to the nonfarm economy.

Changes in factor or value-added income include changes in wages, proprietors' income, and returns to property assets, and represent changes in gross domestic product. For the Nation, expiration of all CRP contracts would induce an increase in factor income of about 0.03 percent. With respect to employment, expiration of CRP could induce a net increase of 4 percent in agricultural jobs and a 0.1-percent net increase in the total number of jobs.[63] Recreational travel expenditures also affect these estimates; the effect of CRP's expiration would be smaller if CRP-induced recreational travel expenditures are large.

A central result is that changes in household income reflect impacts of both the loss of CRP transfer income and the gains in factor income associated with production increases. This reconciles the apparent discrepancy between the $2-$3 billion in factor income generated in production and much smaller changes in total household income (table 4.4). Because middle-income households would experience the largest drop in CRP transfers, their income would decline collectively by $363-$612 million. In contrast, income of low-income households would increase by $80-$104 million, while that of high-income households would increase by $249-$383 million. At the national level, these changes are smaller than typical quarterly fluctuation occurring in the economy.

Previous estimates of CRP's impact on the U.S. economy found generally similar results using input-output multiplier models based on IMPLAN data. If CRP enrollment had reached its initial 45-million-acre goal, Hyberg et al. (1991) estimated that agricultural output would have declined by almost 3 percent and total U.S. output would have declined by 0.17 percent. Although the size of these impacts is greater than we find, the program is now smaller than that initially envisioned, so our lower estimates are expected. As initial CRP contracts were about to start expiring, ERS estimated that allowing the program to lapse would add about 94,000 jobs nationwide, evenly split between farm and nonfarm jobs (Dodson et al., 1994). Adding induced effects to the direct and indirect effects of the traditional input-output multiplier model (used in Dodson et al., 1994) increases the job estimates of the latter by roughly 100 percent, which makes their estimate remarkably similar to that of our traditional scenario. Thus, while the size of the impacts vary depending on the research assumptions concerning exogenous shocks and the economic conditions, all three studies report that the nationwide impact of ending the CRP on jobs and income is likely to be quite small.

Regional Economic Impacts

Although CRP enrollments occur throughout the Nation, their impact on rural communities varies with program participation, community demographics, and the structure of the local economy. For example, large payments to farmers in a sparsely populated, agriculturally dependent county in the Midwest would be expected to yield more significant county-

[63] IMPLAN uses industry survey data to obtain national and regional statistics on the number of full- and part-time jobs (MIG, Inc., 1999). According to IMPLAN, there were 153 million full- and part-time jobs in the U.S. According to the Council of Economic Advisors (2003), the employed civilian labor force numbered 127 million people. Clearly the statistics on the number of full- and part-time jobs double count those holding two or more jobs, so care should be taken when interpreting the employment estimates reported in this section.

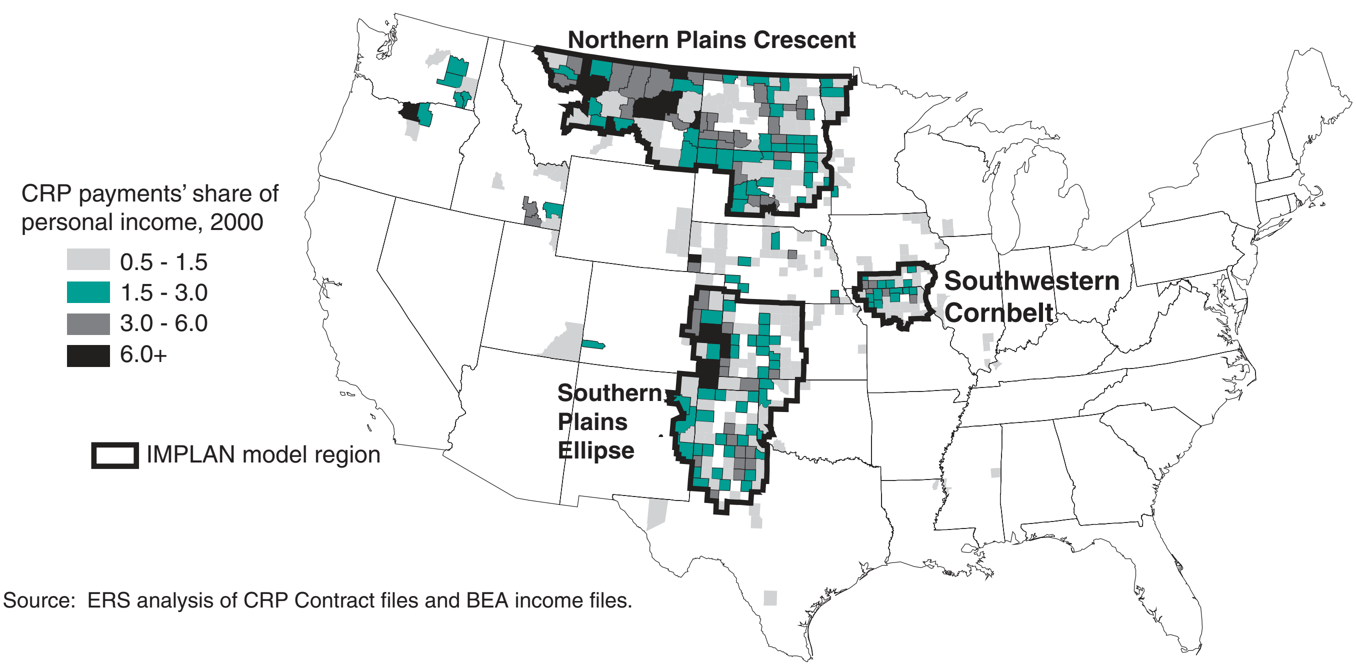
wide impacts than payments to producers in a more densely populated, economically diversified county in the eastern Corn Belt or in the South. To highlight CRP's impact on areas of the country most likely to be affected by the program, we select three multicounty regions for further study. As in the previous section, we measure CRP's local importance by the proportion of local income coming from CRP rental payments.[64] In figure 4.2, the black borders circumscribe 323 counties defining three large contiguous regional economies most significantly affected by CRP payments. These regions are defined across 6 States, and include 149 counties in which CRP rental payments comprise at least 1.5 percent of total personal income.

The Northern Plains Crescent region comprises 132 counties and forms a crescent extending from the eastern half of Montana to the northern half of South Dakota and ending along the North Dakota-Minnesota border. With a rural population density of 4.2 people per square mile, the Northern Plains Crescent represents one of the least-populated regions in the country. Its primary crops are wheat, other grains, and oilseeds. Bismarck, Fargo, and Grand Forks, ND are the region's urban centers.

As the largest of the three regional economies, the Southern Plains Ellipse comprises 142 counties that form a north-south ellipse encompassing the panhandles of Texas and Oklahoma, parts of eastern New Mexico and Colorado, and the western half of Kansas. In contrast to the Northern Plains Crescent and Southwestern Corn Belt, raising livestock is the largest agricultural activity in the Southern Plains Ellipse, with grains and cotton accounting for most of the crop farming. Amarillo and Lubbock, TX are the only urban centers found in this region, but there are a number of major metropolitan areas in close proximity.

[64] While the previous section was concerned with program impacts in the 1980s and 1990s, here we are concerned with today's impacts. As a result, we look at a 3-year average of the ratio of CRP rental payments to income during 1998-2000 as a guide when defining our regions.

Figure 4.2
CRP payments' share of personal income, 2000



Source: ERS analysis of CRP Contract files and BEA income files.

As the smallest of the three regions, the Southwestern Corn Belt comprises 49 counties that straddle the Iowa-Missouri border. The Southwestern Corn Belt is the most populous of the three regions studied, with a rural population density of over 24 people per square mile. The main crops are grains and oilseeds (primarily corn and soybeans), but livestock is also important, accounting for 40 percent of agricultural output. While there are no urban centers in the Southwestern Corn Belt, this region lies just to the south of Des Moines, IA.

Overall, these three regional economies are far more dependent on agriculture than is the Nation as a whole, both in terms of the value of output and the number of jobs (table 4.5). Even in the Southwestern Corn Belt (the most economically diverse of the three regions), agriculture produces one out of every nine dollars in sales. In contrast, nationally, one out of every 50 dollars in sales is derived from agriculture. Average household income is somewhat lower in each region than is the national average, but there is considerable variation among the three regions. The trade exposure measure reported in table 4.5 attempts to capture each region's dependence on interregional imports. A low measure implies that most of the goods and services produced in the region use local inputs. This measure is important since it partially explains why employment impacts vary from region to region.

In table 4.6, the regional impacts of allowing CRP to expire are presented for the traditional (i.e., no price effects and minimal recreation impacts) scenario and the augmented (i.e., price effects and sizeable recreational impacts) scenario. Earlier, we saw that CRP's economywide impacts were sensitive to assumptions about the size of the recreational travel response to changes in CRP enrollment. The nationwide output and jobs response to CRP's expiration was 19 and 17 percent lower, respectively, under the augmented scenario, which assumed recreational travel expenditures would decline by $290 million instead of the $7 million decline modeled by the traditional scenario.

Table 4.5—Regional and national population, income, and employment levels

		Region[1]			
Variable:	Units	Northern Plains Crescent	Southern Plains Ellipse	Southwestern Corn Belt	U.S. total
Population	Million	1.1	1.6	0.6	265.3
Rural population density	Per sq. mile	4.2	7.8	24.4	-
Household income	$ per capita	56,690	58,710	52,910	71,660
Total output	$ billion	54.7	87.0	27.5	14,635.8
Agriculture	Percent	18.3	17.3	10.9	1.6
Number of jobs[2]	Thousand	730.2	958.3	349.1	152,314.9
Agriculture	Percent	11.3	12.8	13.7	1.9
Trade exposure[3]	Percent	18.1	22.4	26.3	3.5
CRP enrollment	Million acres	8.3	8.5	1.9	33.9

[1]The three regions refer to multicounty areas of the country with high levels of CRP enrollment and are delineated in figure 4.2.
[2]Full- and part-time jobs.
[3]The ratio of total imports to total output, expressed as a percentage. In the SAM framework, imports of intermediate goods are part of the firm's total costs.

Source: SAM model files generated from the 1996 IMPLAN Database and the CRP contracts file. Statistics for household income and total output are adjusted to 2001 prices.

Table 4.6—Short-term regional impacts of CRP's hypothetical expiration under two scenarios

Scenario/sector:	Region[1] Northern Plains Crescent		Southern Plains Ellipse		Southwestern Corn Belt	
TRADITIONAL	*$Million*	*Percent*	*$Million*	*Percent*	*$Million*	*Percent*
Output:	1,088.9	2.0	549.4	0.6	151.0	0.6
Agricultural[2]	782.1	7.8	492.8	3.3	166.1	5.6
Nonagricultural	306.8	0.7	56.6	0.1	-15.1	-0.1
Value added (factor income)	502.8	1.9	134.6	0.4	70.2	0.6
Household income:	48.3	0.2	-206.8	-0.5	-94.4	-0.7
Low	38.2	0.5	8.7	0.1	5.4	0.1
Medium	-16.0	-0.1	-200.5	-0.9	-91.0	-1.1
High	26.1	0.7	-15.0	-0.3	-8.8	-0.6
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Number of jobs:	26,968	3.7	11,872	1.2	4,127	1.2
Agricultural	17,684	21.4	10,800	8.8	4,890	10.3
Nonagricultural	9,284	1.4	1,072	0.1	-762	-0.3
AUGMENTED	*$Million*	*Percent*	*$Million*	*Percent*	*$Million*	*Percent*
Output:	747.5	1.4	356.8	0.4	61.0	0.2
Agricultural[2]	772.3	7.7	477.5	3.2	160.5	5.4
Nonagricultural	-24.8	-0.1	-120.7	-0.2	-99.5	-0.4
Value added (factor income)	151.3	0.6	-180.9	-0.5	-31.8	-0.3
Household income:	-195.4	-0.7	-413.0	-1.1	-167.9	-1.2
Low	10.6	0.2	-14.5	-0.1	-3.8	-0.1
Medium	-189.9	-1.1	-340.8	-1.5	-144.2	-1.7
High	-16.0	-0.4	-57.8	-1.0	-19.8	-1.3
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Number of jobs:	15,492	2.1	6,838	0.7	1,501	0.4
Agricultural	17,482	21.1	10,484	8.5	4,743	9.9
Nonagricultural	-1,991	-0.3	-3,647	-0.4	-3,242	-1.1

[1]The three regions refer to multicounty areas of the country with high levels of CRP enrollment and are delineated in figure 4.2.
[2]The size of the agricultural output changes reported here are larger than the revenue shocks reported in table 4.3 because the initial shock stimulates increased agricultural as well as nonagricultural production.

Source: Vogel (2003). Value of output and income are in 2001 dollars. Nonagricultural industries include the manufacturing, construction, utilities, mining, trade and transport, and service sectors. Employment includes the number of full- and part-time jobs.

When the two scenarios are used to estimate regional impacts, the discrepancies between their estimated economic impacts are even larger. At the regional level, not only do recreational travel expenditures play a role, but we can no longer assume that a decline in farm revenue due to falling prices is offset by an increase in consumer expenditures within the region. Therefore, if CRP's expiration decreases farm commodity prices, the resulting drop in farm enterprise income tends to reduce the expansionary impact that increased planting has on a region's economy. By relaxing the traditional scenario's simplifying assumptions, the augmented scenario (presented in the bottom half of table 4.6) estimates regional output responses that are 30-60 percent lower than those predicted by the traditional scenario. The CRP's impact on jobs is even more sensitive to the price and recreational expenditure assumptions, falling by 43-64 percent once farm prices and recreational travel expenditures are assumed to decline.

Allowing CRP contracts to expire has a large enough impact on recreational travel and farm revenue in the augmented scenario that the impact on the nonfarm economy is negative. That is, the program's continuation has an expansionary effect on nonfarm output that partially offsets the impact that retiring environmentally sensitive cropland has on farm production.

By recognizing that expiration of the CRP might have a detrimental affect on others in addition to CRP participants (by reducing demand for recreational services and reducing farm enterprise income), the augmented scenario predicts that the income of nearly every household group identified would fall if all CRP contracts expired. The results of these two scenarios demonstrate how sensitive economywide and regional projections are to the price and recreational travel assumptions. We do not present either model as "the truth" since both encompass simplifying assumptions and ignore adjustments that farm operators and other economic agents would make when faced with shifting prices. However, these scenarios do provide a rough measure of the adjustments the economy might face if CRP contracts were to expire, and taken together or separately provide insight into the factors that influence the size of the economic response to a change in CRP enrollment.

For the remainder of this section, we compare the results of the augmented scenario for the three regions we have selected for closer study. This is done for expositional ease, since the same patterns emerge whether we look at the traditional or the augmented scenario. Furthermore, the factors that explain interregional differences in the economic response to changes in CRP enrollment also explain interregional differences between the relative size of the response from each scenario.

For the three regions, expiration of the CRP would have different impacts on industry output and jobs. The Northern Plains Crescent would experience the most pronounced effects, with agricultural production potentially increasing by up to 7.7 percent and the number of agricultural jobs increasing by about 21 percent. At the same time, nonagricultural output and jobs would decrease slightly. In contrast, the Southern Plains Ellipse and the Southwestern Corn Belt would experience more modest increases in agricultural and steeper declines in nonagricultural production and jobs. The large discrepancies between the estimated effects of expiration of the CRP on agricultural and nonagricultural sectors reflect the predicted decline of household spending out of farm enterprise and transfer income, as well as the drop in recreational travel expenditures as CRP rental payments end.

With respect to household and value-added income, the picture is also mixed. As a measure of regional well-being, value-added income is preferred to household income because it reflects the actual performance of industrial activities located in these regions. In contrast, the household income measure includes valued-added income as well as the loss of CRP transfer and farm enterprise income. Thus, in the Northern Plains Crescent, value-added income would increase by 0.6 percent while household income would decrease by 0.7 percent. In contrast, both value-added and household income would decline in the Southern Plains Ellipse and Southwestern Corn Belt regions. For households in these regions, the positive stimulus of increased agricultural production would not be sufficient to offset the negative effects of the loss of transfer and farm enterprise income. Middle-income households would be hit the hardest, with their income falling by 1.1 percent in the Northern Plains Crescent and by 1.5 percent or more in the Southern Plains Ellipse and the Southwestern Corn Belt.

The small output and employment effects on nonagricultural sectors reported in table 4.6 mask the differing regional forces at work. In each of these regions, the agricultural response (increased planting but lower revenue) would generate positive impacts in the farm and nonfarm economies, while the household expenditure response (loss of CRP payments and reduced recreational travel expenditures) would generate negative impacts almost exclusively in the nonfarm economy. Consequently, the net positive benefits to CRP expiration would be confined to the agricultural sectors alone.

The Northern Plains Crescent's strong nonfarm response (which shows up as the smallest overall decline in nonfarm output and jobs in table 4.6) is explained in a large part by its geographic isolation.[65] Having the lowest trade exposure of the three rural economies is an artifact of its isolation and low population density. As a consequence, the residents in the Northern Plains Crescent are more self-reliant with respect to producing goods and services within the region. Labor productivity in nonfarm production (output per worker) in the Northern Plains Crescent is $63,200 per worker versus $88,300 per worker for the United States as a whole. Lower productivity implies that firms substitute labor for more expensive capital goods imported from outside the region. Hence, the employment response would be larger because workers are less productive in terms of value added than the national average.

The Southern Plains Ellipse response to the expiration of CRP contracts would differ from that of the Northern Plains Crescent for two reasons. First, Southern Plains Ellipse producers would convert over half their CRP enrolled land to rangeland. Since producers do not add direct value to rangeland, the increased livestock production reported in table 4.3 captures any positive feedback from this conversion. Second, the dominant crops benefiting from CRP expiration in the Southern Plains Ellipse produce less revenue per acre than the dominant crops in the Northern Plains Crescent. According to National Agricultural Statistical Service (NASS) data for 2001, oilseed crops of all types produce the highest revenue per acre in the Northern Plains Crescent. In the Southern Plains Ellipse, cotton and grains are the dominant crops, both of which generate lower revenues per acre than oilseeds in the Northern Plains Crescent.

In the Southern Plains Ellipse, the agricultural response would generate proportionately smaller demands for nonfarm intermediate goods and services and nonfarm employment than in the Northern Plains Crescent because of the former region's greater linkages with the national economy and its higher labor productivity.[66]

As the smallest of the three regions, the Southwestern Corn Belt is a completely rural economy with the highest trade exposure, lowest labor productivity in agriculture, and moderate nonfarm labor productivity. Expiration of the CRP would induce agricultural producers to increase produc-

[65] The lack of proximity to a major metropolitan area enhances this region's economic isolation. The nearest metropolitan hub serving the entire Northern Plains Crescent regional economy is the Minneapolis-St. Paul urban area. It lies about 250 miles southeast of Fargo and 300 miles south-southeast of Grand Forks.

[66] If the Southern Plains Ellipse' trade exposure was as low as that in the Northern Plains Crescent, nonfarm production would increase 30 percent more than is projected. And if labor productivity of $78,800 per worker in the Southern Plains Ellipse were as low as that of the Northern Plains Crescent, nonfarm employment would increase 43 percent more than is projected.

tion of program crops (grains and oilseeds), hay, and pasture. The Southwestern Corn Belt's high trade exposure means that more nonfarm goods are imported rather than being regionally produced. Consequently, the employment spillover effect into the nonfarm labor market induced by the agricultural response is the smallest of the three regions.

The impacts on these three regional economies of allowing the CRP to expire illustrate how their different economic and geographic features would shape their response to a policy change. The Northern Plains Crescent is the most agriculturally dependent region, while the Southwestern Corn Belt is the least. The Southwestern Corn Belt is most reliant on imported goods and services, while the Northern Plains Crescent is the least. The Southern Plains Ellipse has the highest labor productivity, while the Northern Plains Crescent has the lowest. The varied regional responses to expiration of the CRP highlight the fact that places with very similar CRP enrollments, such as the Northern Plains Crescent and the Southern Plains Ellipse, can have very dissimilar responses to changes in program participation.

The regional impacts reported here demonstrate patterns similar to those found in earlier studies. In a 1994 assessment of the impact that elimination of CRP would have on several rural economies, job impacts ranged from 0.1 to 1.8 percent and income impacts ranged from 0.3 to 1.4 percent (Dodson et al., 1994). Pocatello, ID, an area neighboring the Northern Plains Crescent region, had the largest income and employment impacts of the locations studied. In a study of three counties in Oregon, countywide estimates of CRP's impact ranged from $1.2 million to -$3.6 million, depending on the local economic base (Martin et al., 1988). Other IMPLAN studies also report considerable variation in local economic impacts within States (Mortensen et al., 1990; Otto and Smith, 1996; Standaert and Smith, 1989) and between States (Hines et al., 1991; Hyberg et al., 1991). It is clear from this research that projected local impacts of CRP enrollment can be sizeable in some cases, but they are far from uniform and there are often winners and losers even when the national impact of the program is small.

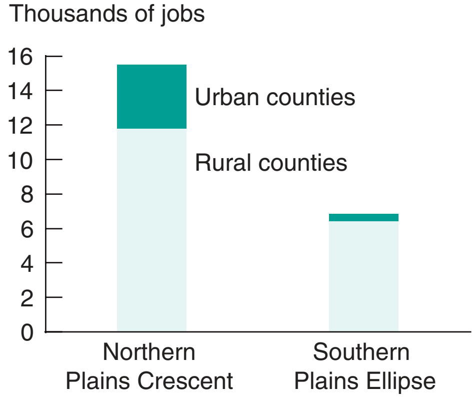
While most of the land enrolled in the CRP is located in rural America, it does not necessarily follow that expiration of the CRP would generate only rural jobs. At least some of the direct, indirect, and induced employment impacts are felt in urban counties.

Rural-Urban Impacts

Since both the Northern Plains Crescent and Southern Plains Ellipse include urban centers, this section looks at the rural-urban distribution of employment responses by simulating the expiration of the CRP in rural areas using a rural SAM multiplier model for these two regional economies.

The very low population density in the Northern Plains Crescent, together with the fact that no major metropolitan areas lie adjacent to it, supports the use of the hub-and-spoke metaphor to describe the economic landscape of this region. That is, the urban areas of Bismarck, Fargo, and Grand Forks, ND represent regional hubs of economic activity with transportation and infrastructure spokes extending out into the rural hinterlands. As a result, in the Northern Plains Crescent, about one out of every five jobs generated in the post-CRP environment is found in the urban counties (fig. 4.3). Almost 80 percent of these urban jobs are agricultural.

Figure 4.3
Rural-urban distribution of CRP employment impacts



Source: Vogel (2003)

Two factors explain the size of the urban impact. First, farmers in the region's urban counties received $13 million per year in CRP payments from 1998 to 2000 (about 5 percent of the region's total CRP payments). Ending CRP payments induces farmers in urban counties to increase their production, making a significant contribution to stimulating new jobs in these counties. Second, given the geography of the Northern Plains Crescent, some of the off-farm jobs created by an expanding agricultural sector in rural counties are located in the urban counties. Thus, on average, $1 million of additional agricultural output in rural Northern Plains Crescent counties creates 20 rural jobs and 2.9 urban jobs (including direct, indirect, and induced jobs). Urban "leakage" of jobs in the nonfarm economy in rural counties is smaller, with 1.5 urban jobs created for every 20 rural jobs.

The Southern Plains Ellipse has a higher population density and is adjacent to more major metropolitan hubs relative to the Northern Plains Crescent. A higher trade exposure means that more intermediate goods are imported into this region. Consequently, in contrast to the Northern Plains Crescent, the Southern Plains Ellipse does not experience the spatially imposed self-reliance on production of goods that could be easily imported.[67] Hence, the leakage of employment effects to urban areas in the Southern Plains Ellipse is about half that found in the Northern Plains Crescent. About 6 percent of jobs generated in the Southern Plains Ellipse occur in urban areas. For every 20 agricultural jobs created in rural counties, 1.2 indirect and induced jobs are generated in urban areas of the Southern Plains Ellipse. For every 20 nonfarm jobs created in rural counties, only 0.5 jobs are generated in the metro counties.

Summary and Caveats

If all CRP contracts were to immediately expire and there were no further enrollments, we estimate that roughly 51 percent of the land currently under contract would return to cultivation within about 1 year. The remainder would be used as pasture, rangeland, or forest, would be put to nonfarm uses, or would remain idle. As CRP land is brought back into production, the supply of agricultural output increases, reducing commodity prices. However, we estimate that the price effects would be modest—often less than 1 percent and never greater than 6 percent. Aggregate, nationwide impacts on recreational spending (as sedimentation and other forms of

[67] Essentially, the geographic isolation of the Northern Plains Crescent implies that it must produce a higher level of goods and services relative to the Southern Plains Ellipse and the Southwestern Corn Belt because of lower interregional imports.

pollution increase and wildlife habitat shrinks) vary considerably depending upon estimation procedures. Using a trips-based approach, recreational travel impacts are minimal, as travelers choose alternate destinations but do not reduce overall spending by much. However, a receipts-based approach to estimating the amount of recreational travel induced by CRP yields much higher estimates which reduce CRP's output and employment impacts by roughly 18 percent.

Increased farming activity increases demand for nonfarm goods and services, and both lead to higher demand for consumer goods and services as the number of jobs and household incomes rise. Counteracting this expansion is the loss of CRP rental payments (which reduces consumer demand by affected households), a drop in farm revenue, and possible decreases in CRP-induced recreational spending. The net effect of CRP expiration is likely to be a small positive impact on the U.S. economy as a whole, with varying impacts on local economies. With respect to the three regions we studied, expiration of the CRP creates a net positive economywide impact for all regions, with output increases ranging from 0.2 percent to 2.0 percent and the number of jobs increasing by anywhere from 0.4 percent to 3.7 percent. However, households suffer income losses of up to 1.2 percent as CRP transfer payments cease. Farm revenue could decline by up to $4 billion as increased production drives down farm commodity prices.

In interpreting these results, several caveats are in order. First, most of our assumptions were geared toward providing a reasonable upper-bound estimate of the economic impact of expiration of the CRP. For example, we assumed that as CRP land is returned to production, it does not encourage other marginal land to drop out of production. Second, as with all multiplier models, our estimated impacts assume the economy will move along a predictable path. But in areas heavily affected by a change in the status of CRP enrollment (or any other economic shock), the economy is very likely to react in unpredictable ways as prices, industrial structure, and preferences all change. Finally, employment gains in our models are induced changes in labor demand. Although these simulations project increases and decreases in labor demand, *ex post* changes in actual employment levels cannot be assessed by the SAM framework. The framework treats job gains/losses as permanent due to a perfectly elastic labor supply response, which overstates the estimated job gains reported here. Conditions of low unemployment would put upward pressure on regional wages, forcing firms to compete to fill their job vacancies. Hence, not all of the new jobs created by expiration of the CRP would be filled. Conditions of moderately high unemployment could also be indicators of a high level of disguised underemployment in the labor market. In this case, fewer workers would be needed to meet the new labor demands of the post-CRP environment.

Conclusions

In evaluating the economic implications of high Conservation Reserve Program (CRP) enrollment for surrounding rural communities we have used two very different approaches. For the first time, econometric models were used to estimate the statistical importance of various factors, including CRP enrollment, affecting economic trends immediately before and in the years after CRP was implemented in 1986. The second approach relies on a series of social accounting matrix (SAM) multiplier models to simulate the local economic impacts in regions with high levels of CRP enrollment had CRP expired in 2002. This extends approaches adopted by other researchers who attempted to predict CRP's impact on local economies with input/output models, such as IMPLAN.

While it may be tempting to compare the employment impacts generated by these complementary approaches, caution should be used. The two analytical approaches have their strengths and weaknesses, but each is fundamentally different.[68] The econometric models used in this report try to measure CRP's short and longrun impacts within the context of other local, regional, and global fluctuations that influence a community's development. In a sense, we examine how rural counties were faring 5 to 10 years after land was enrolled in the CRP and economic adjustments had been underway. The simulation models developed in this report assume these other factors will remain constant. Given fixed sector-to-sector relationships, as the size of the CRP changes, industrial sectors, workers, and landowners are expected to change in predictable ways to accommodate the CRP. As such, simulation models of the type developed here estimate the *potential size of the adjustments* that economies will face rather than the actual outcome of a policy change.

Both approaches are useful, but on their own give an incomplete picture of CRP's economic effect on rural America. By modeling industrial and geographic linkages that determine how national and regional economies might be affected by CRP's expiration, we show how large the potential adjustments might be, how impacts are distributed within the economy, and how they vary across geographic space. And since much of the previous empirical work concerning CRP's economic impacts has been based on similar types of simulation models, this also demonstrates how sensitive estimates are to assumptions about the initial policy shock. On the other hand, the econometric results provide evidence that rural economies can successfully adjust to the shifts in demand that accompany high levels of CRP enrollment. Even in areas that appear to be very sensitive to CRP enrollments, growth trend impacts appear to be transitory.

Both analytic approaches suggest that the economic impacts of CRP enrollment vary widely from one area to the next, but that the program's aggregate rural economic impacts have been modest. Factors other than CRP determine longrun population and employment trends in rural America and in most cases CRP plays a minor role in the economic and social trends observed in rural counties. Nonetheless, there are significant interactions between CRP's influence and these other economic drivers which can make blanket statements about CRP's effects misleading in specific cases.

[68] While econometric models attempt to capture and identify the effects of multiple statistical relationships, their weakness is a failure to explicitly account for the underlying economy-wide structure. Simulation models capture the economywide linkages at one point in time, but they hold these relationships constant when estimating the effects of subsequent changes.

Concerning employment impacts, we find that high CRP enrollment was associated with a net loss of jobs in some rural counties between 1986 and 1992, but this negative relationship did not persist throughout the 1990s. In particular, farm-related businesses, such as input suppliers and grain elevators, continued contracting throughout the 1990s, but other business expansions eased the community impact. Our research suggests one likely source of job growth in areas with high levels of CRP enrollment. CRP's effects on wildlife and water quality led to an increase in outdoor recreational expenditures of as much as $300 million per year, adding a significant stimulus to rural economies.

This report demonstrates that CRP's employment impacts are a function of the local economy's role as a source of goods and services. We find evidence that rural counties with small agricultural service centers were likely to be far more sensitive to CRP enrollment than were counties that lacked such centers. On a different scale, we also found that multicounty regions that were less reliant on the national economy (and so, served as their own "service center") were more sensitive than regions with stronger interregional ties.

Despite concerns to the contrary, CRP's population impacts were slight at the county level, if present at all. When county characteristics are taken into account, post-1985 population trends in rural counties were largely unaffected by high levels of CRP enrollment. The CRP did have an effect on the structure of farm ownership and operation. We found that the relationship between the level of CRP enrollment and changes in the number of beginning farmers is sensitive to the way land is enrolled in the program. Whole-farm enrollment was negatively associated with changes in the number of beginning farmers, but this was offset by a positive association between beginning farmer trends and partial-farm enrollment. We found no statistically significant evidence that CRP participation encourages absentee ownership.

Three cautionary notes should be raised regarding the interpretation of our estimates. As was discussed earlier in this report, our analyses do not address small-area impacts of CRP enrollment. Rather, we examine both countywide growth trends and CRP's likely effects within multicounty areas. It seems likely that if CRP enrollment is heavily concentrated within specific subcounty areas (such as towns and minor civil divisions), the associated economic impacts within these smaller areas might be more significant than those found for counties and multicounty areas.

Second, our models, like virtually every other attempt to model the economic impact of the CRP, do not adequately reflect the value of associated environmental consequences. As these models currently stand, they are not equipped to do so. This limitation is largely due to the uncertain spatial distribution and nonmarket nature of environmental benefits, but it also derives from the models' structural focus on jobs and income as measures of economic health.

From an economic development perspective, job and income growth tend to be viewed as signs of economic progress. But it does not necessarily follow that every policy that leads to new jobs furthers societal goals. CRP was initiated to provide environmental benefits to surrounding communities and to the Nation as a whole. In addition, if CRP reduces erosion, sedimentation, and windblown particulates, its expiration could force households, firms, and governments to increase expenditures to counteract these effects. Paradoxically, doing so could increase employment and income in an effort to maintain the previous level of well-being. To the unemployed or underemployed, job growth holds out the prospect of being able to earn a decent living. But from an economic development perspective, it is important to ask whether resources are being put to their best use. As measures of economic progress, revenue, income, and jobs are incomplete.

For example, we model CRP payments as income transfers. An alternative view is that CRP enrollees provide nonmarket environmental services for which they are being paid (Siegel and Johnson, 1991). Then, CRP farmers who choose to return to crop production when their CRP contract expires are merely changing jobs (from conservationist to producer) rather than filling new jobs. Viewed in this way, our approach might overestimate the number of jobs created if CRP expired.[69]

Finally, the econometric analyses do not correct for spatial autocorrelation or attempt to rigorously model the adjustment process. In an effort to match high-CRP counties with control counties having similar socioeconomic and agricultural characteristics, matched pairs were often selected from the same geographic area. This raises the possibility that spillover effects could blur the distinctions between high-CRP economies and their low-CRP counterparts. For example, environmental benefits (and any associated jobs) from CRP enrollment are likely to be distributed over a large area, making it more likely that comparisons of high-CRP and adjoining low-CRP counties show significantly different trends. Then too, as we have seen, high CRP enrollment may have a particularly large effect on counties that serve as agricultural service hubs. If these happen to be low-CRP counties adjacent to high-CRP areas, our analyses may understate the effect of CRP enrollment on job trends. Finally, to the extent that CRP increases farm commodity prices, the benefits of higher net farm income will accrue to areas with fewer enrolled acres. Taking the spatial relationship between high- and low-CRP counties and their neighbors into account could shed light on the potential seriousness of such problems.

To accommodate local economic adjustments, we assessed the short and longrun relationship between CRP enrollment levels and socioeconomic trends. However, no attempt was made to rigorously determine the direction of causality or to study the lags involved in this adjustment process or the role of specific industries. Does CRP act as a driver in determining local socioeconomic trends or does it merely reflect those trends? If there is a causal relationship between CRP enrollment and job growth, how fast does the local economy adjust to having cropland retired from production? Is the initial loss in economic vitality focused on farm-related businesses, as one would expect? Is the longer term recovery (or return to trend) due to increased recreational activity, as has often been surmised but never explicitly demonstrated? These questions are left for future research.

[69] Whole-farm CRP enrollees returning to farming could potentially generate a minor double-counting of new jobs created in agriculture. Based on our earlier estimate of the 142,000 whole-farm CRP enrollees, 51 percent, or 72,000 farmer operators would likely allow their land to return to cropland (based on our earlier estimate). Since most whole-farm enrollees are retired and lifestyle farmer operators, most are likely to rent their farmland to existing farm operators rather than operate it themselves. If 80 percent of whole-farm enrollees rent out their land, roughly 14,000 whole-farm CRP enrollees might return to cropland production if CRP expired, reducing the number of jobs created by CRP's hypothetical expiration by nearly 8 percent. However, if 100 percent of whole-farm enrollees rented out their land instead of farming it themselves, the double-counting issue raised by Siegel and Johnson (1991) would not apply. Only a survey of farm households in a post-CRP environment would resolve this issue.

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Appendix A: Modeling Rural County Socioeconomic Change

We measure population and job growth as the natural log of the ratio of the number of people (jobs) in each county in 1992 or 2000 relative to 1985.[70] In modeling rural 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.

A series of demographic variables captures the effects of race, ethnicity, age, educational attainment, and population density on the community growth process. All were from the 1980 Census of Population, with all but population density expressed as a percentage of the total. Population density entered the equations in log form. To measure scenic attractiveness, the presence of high mountains (0/1 dummy variable), the prominence of surface water (in log 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 (McGranahan, 1999). For the matched-pair analysis, these amenity measures were replaced by the "natural amenity scale" developed by McGranahan to combine all of these factors into one measure. Table A.1 provides the mean values of the employment, demographic, and amenity variables considered.

Measures of initial industry structure are ubiquitous in studies of job growth. 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. Somewhat unique rural industrial expansion in the 1980s was from casinos, prisons, and large meatpacking plants. To take account of the sometimes dramatic changes accompanying these developments, dummy variables were included to reflect whether a county had any of these industries in 2000.

Local labor market and locational characteristics could also affect community growth. Higher employment rates and higher incomes (in log form) might encourage migration, but might discourage new employers. The attractiveness of an area is a function of its access to services and other amenities, measured by whether the county was adjacent to a metropolitan area in 1983 (represented as a 0/1 dummy variable). 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 Great Plains.

[70] We considered modeling net migration, but intercensal net migration estimates are not available. Furthermore, the small populations of counties studied make the reliability of any intercensal population estimates suspect. Independent measures of elderly and children were included in the population change analysis to reflect their influence on population trends due to age structure and fertility.

Table A.1—Mean values of demographic and employment trends and amenity variables

Variable description	Unit	Study counties	High-CRP[1]	Matched counties
Dependent variables				
Post-CRP population change:				
1985-1992 (short run)	Percent	-1.5	-9.0	-5.9**
1985-2000 (long run)	Percent	5.3	-9.8	-4.1**
Post-CRP employment change:				
1985-1992 (short run)	Percent	5.6	-3.7	1.4**
1985-2000 (long run)	Percent	23.9	7.6	13.4**
Explanatory variables				
Pre-CRP population and employment change:				
1970-1982 population	Percent	11.3	-3.2	3.3**
1982-1985 population[2]	Percent	-0.3	-2.3	-1.3**
1970-1982 employment	Percent	17.6	1.6	13.5**
1982-1985 employment[2]	Percent	2.6	-1.7	0.3**
Demographic characteristics:				
Black population, 1980	Percent	7.1	0.6	0.4
Hispanic population, 1980	Percent	4.2	4.4	6.9
Native American population, 1980	Percent	1.5	3.3	1.9
Population under 18, 1980	Percent	29.7	29.8	29.3
Population over 62, 1980	Percent	18.2	19.3	19.7
Under 12 years of school, aged 25-44, 1980	Percent	23.4	17.2	16.5
College grads, aged 25-44, 1980	Percent	14.1	16.9	17.4
Population density, 1980	P/sq mi	24	5	10**
Natural amenity characteristics:				
High mountains dummy variable	0/1[3]	7.4	5.6	10.8
Water/total area (x 10)	Log	-2.1	-6.5	-6.2
Land in forest	Percent	26.7	3.7	8.5**
January days with sun (x 10)	Z-score[4]	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

[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.
[3]Set to one if mountains are present. The data represent the proportion of observations coded "1."
[4]Z-scores are the number of standard deviations an observation differs from the mean (across all observations).
Source: BEA Income files, 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.

Because CRP primarily affects farming-dependent areas, several agricultural variables in addition to employment were included in the analysis. Most of these are from the 1982 Census of Agriculture. 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. Mean values of the industry and farm structure variables are presented in table A.2.

Our database includes over 45 measures that have been associated with population and job change or that reflect local agricultural conditions. While these explanatory variables should capture the independent effects of many county characteristics potentially related to population or employment

Table A.2—Mean values of industrial, labor market, and farm structure variables

Variable description	Unit	Study counties	High-CRP[1]	Matched counties
Local economic characteristics:				
Agricultural employment, 1980	Percent	16.7	31.7	24.7**
Manufacturing employment, 1980	Percent	17.6	5.7	8.4**
Mining employment, 1980	Percent	2.5	2.2	2.3
Business services employment, 1980	Percent	4.2	3.9	4.2*
Recreation employment, 1980	Percent	4.1	4.1	4.5*
Special development dummy variables[2]:				
Prison county	0/1	2.6	1.0	0.0
Casino county	0/1	0.9	0.0	1.5
Meatpacking plant county	0/1	1.4	0.5	1.0
Labor market and location characteristics:				
Civilian employment, age 15-64, 1980	Percent	62.7	64.9	65.6
Working outside the county, 1980	Percent	19.0	10.9	12.9*
Median household income, 1979	$	12,840	12,620	12,936
Adjacent to a metropolitan area, 1983	0/1[2]	41.3	15.9	22.6
Great Plains county	0/1[2]	27.1	80.0	59.5**
Agricultural characteristics:				
Cropland/all land, 1982	Percent	40.5	46.7	45.1
Irrigated farmland, 1982	Percent	4.5	4.3	8.5**
Grain/total sales value, 1982	Percent	29.5	38.4	31.5**
Wheat/total sales, 1982	Percent	8.8	25.2	12.2**
Livestock/total sales, 1982	Percent	56.2	51.5	61.6**
Govt. payments/total income, 1981-83	Percent	1.6	6.0	2.6**
CRP enrollment/cropland, 1991-93	Percent	8.0	21.3	5.1**
CRP payments/income, 1991-93	Percent	1.3	6.7	0.8**
Farm sales/household income, 1980	Percent	0.8	1.9	1.4**
Farms w/ sales over $250,000 in 1982	Percent	4.7	5.3	5.8
Farms w/ sales under $20,000 in 1982	Percent	51.5	35.7	38.9*
Farmers working off-farm 200+ days, 1982	Percent	28.0	17.9	21.0**

* 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.

Source: 1980 Census of Population, 1982 Census of Agriculture, BEA Income file, and CRP Contracts file.

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 is used to narrow the set of explanatory variables.[71]

For the matched-pair analysis, two versions of the model were estimated using a subset of explanatory variables. In the first, CRP measures were excluded from the equation, leaving the constant term to capture CRP’s impact on the difference in growth trends between high- and low-CRP counties. We estimated a second set of regressions with the difference in the CRP measure between matched pairs included as an independent variable, with the constant constrained to equal zero, to capture the impact that varying levels of CRP participation had on socioeconomic trends.

[71] In this procedure, the socioeconomic measure with the least statistical significance is removed and the analysis is repeated until all remaining measures are statistically significant. In using this procedure, we exempt the CRP measures from possible elimination and exclude other measures not significant at the 10-percent level. This approach biases the analysis in favor of finding a significant relationship between CRP use and socioeconomic trends.

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 helped clarify the relationship between community development and CRP, since variations in mining added a lot of statistical “noise” to the data.

Much of the employment-migration literature recognizes that population and employment growth rates are endogeous phenomena to be modeled simultaneously. The focus of this literature has been on whether employment growth is stimulated by the in-migration of people drawn to an area by quality of life considerations. In our analysis, we are not concerned with the mechanisms through which the CRP program might have affected population or employment; we are concerned with overall effects. Recognizing the inherent simultaneity, we use the same independent measures in both the employment and population equations. Our analyses are therefore equivalent to a reduced form equation from a simultaneous equation model.

The benefits of the matched-pair approach are its intuitive appeal, transparency, and the fact that it is less dependent on assumptions regarding functional forms of structural models or even reduced-form relationships.[72] That is, because the matched pairs are relatively “close,” there is less need for controls; and the use of a linear model to control for potentially convoluting factors should give a reasonable approximation of even nonlinear effects, because the differences in explanatory variables are relatively small.

The quasi-experimental control group approach we adopt builds on analysis of experimental data in that it attempts to assess the impact of a “treatment” by developing an appropriate counterfactual. When the treatment is randomly distributed within the population being studied, the “control” group is implicitly all observations that haven’t been treated. But when the treatment is not randomly distributed, selection of a control group indicating how treated observations would have developed in the absence of treatment becomes a little more difficult. In such cases, the development of all nontreated observations may not be the appropriate counterfactual.

Developing an appropriate control group is at the heart of quasi-experimental control group analysis. There are many ways to operationalize the control group concept – matches can be one-to-one, one-to-many, or many-to-many; they can be based on nearest neighbor, by an *ad hoc* comparison of one or two key characteristics, or by using a statistical measure of similarity, such as a propensity score or the Mahalanobis distance. We have adopted the matched-pair (one-to-one) technique based on minimizing the overall Mahalanobis distance used by Isserman and Rephann (1995) because of its flexibility and its intuitive appeal. By applying a difference-in-differences analysis to observations that have been matched on the basis of growth factors, the approach adopted here should highlight CRP’s potential impacts on economic trends (Blundell and Diaz, 2000).

The most complicated growth model estimated for this report examines the interaction between population density and CRP enrollment. The model attempts to explain differences in job growth trends between high-CRP counties and their matches as a function of differences in a series of explanatory variables, based on counties where mining accounted for 5

[72] By comparison, recovering the structural components of a simultaneous equations model is much more difficult and requires much stronger assumptions. To do so, one needs to be able to justify both the functional form and at least two exclusionary restrictions: what exogenous variables influence employment growth but do not influence population growth (or net migration), and vice versa. These “instruments” would also need to be uncorrelated with unobservable variables affecting the other equation.

percent or less of employment in 1980. This analysis was used to construct the CRP impacts presented in figure 3.3 in the text. Table A.3 presents the regression results for the full model explaining job growth (neither CRP nor its interaction with population density were significant in the population growth model, so the results are not reported). The backward stepwise regression results were very similar, although a couple additional control variables were identified as having a statistically significant impact on job growth (all the significant variables from both the full and backward stepwise regressions are in bold in table A.3).

Finally, farm-related enterprises were identified to explore the extent to which this group of businesses was particularly susceptible to changes in CRP enrollment. Table A.4 lists the 3- and 4-digit SIC codes for industries

Table A.3—Interaction between population density and CRP's impact on job growth

Explanatory variables (low-CRP minus high-CRP value)	Unit	Short-term job growth (1985-1992) Beta	Short-term job growth (1985-1992) t-statistic	Long-term job growth (1985-2000) Beta	Long-term job growth (1985-2000) t-statistic
CRP payments to income ratio	Percent	0.085	0.735	**0.236**	**1.923[a]**
Population density, 1980	log	0.011	0.069	0.195	1.134
Density x CRP ratio	Percent	**-0.216**	**-2.169***	-0.075	-0.715
Employed in ag, 1980	Percent	**-0.455**	**-3.369****	-0.161	-1.125
Density x Percent ag emp.	Percent	0.079	0.683	-0.030	-0.243
Population, 1982/1970	log	-0.081	-0.716	0.161	1.340
Population, 1985/1982	log	0.108	1.456	0.062	0.794
Employment, 1982/1970	log	-0.055	-0.556	**-0.216**	**-2.069***
Employment, 1985/1982	log	-0.071	-0.981	-0.076	-0.981
Under 18 years of age, 1980	Percent	0.193	1.378	0.178	1.195
Over 62 years of age, 1980	Percent	-0.098	-0.712	0.010	0.069
American Indian, 1980	Percent	-0.002	-0.020	0.104	0.999
Black, 1980	Percent	**-0.181**	**-2.676****	**-0.230**	**-3.212****
Hispanic, 1980	Percent	-0.044	-0.419	0.091	0.810
Cropland, 1982	Percent	-0.180	-1.545	-0.156	-1.262
Livestock/total sales, 1982	Percent	-0.031	-0.450	0.023	0.314
Govt payments/income, 1981-83	Percent	0.005	0.039	-0.122	-0.981
Wheat/total sales, 1982	Percent	-0.134	-1.530	-0.069	-0.744
Less than high school, 1980	Percent	-0.006	-0.051	-0.130	-1.010
College, 1980	Percent	0.119	1.520	0.044	0.526
Civilian employment rate, 1980	Percent	0.004	0.046	0.059	0.663
Median household income, 1979	Dollars	**-0.198**	**-1.899**[a]	-0.079	-0.712
Natural amenities index	Z-score[1]	0.036	0.462	-0.039	-0.464
Land in forest	Percent	0.066	0.664	**0.261**	**2.482***
Great Plains county	0/1[2]	**-0.156**	**-1.885**[a]	-0.139	-1.585
Employed in mining, 1980	Percent	**-0.199**	**-2.999****	-0.072	-1.021
Employed in recreation, 1980	Percent	0.019	0.256	0.031	0.394
Commuting outside county, 1980	Percent	0.018	0.239	0.062	0.773
Meat packing plant county	0/1	0.052	0.843	0.026	0.398
Casino county	0/1	0.027	0.470	0.069	1.117
Prison county	0/1	-0.052	-0.832	-0.022	-0.332
Adjusted R-squared		0.41		0.34	

[a], *, and ** indicate the regression coefficient is statistically different from 0 at the .10, .05, and .01 level of significance, respectively. Bold indicates variables that were significant at the .10 level or lower in this or the backward stepwise regressions. Beta represents the standardized regression coefficient. Adjusted R-squared indicates the portion of variation explained by the regression.
[1]Z-scores are the number of standard deviations an observation differs from the mean (across all observations).
[2] Dummy variables with a "0" or a "1" value.

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. Matched pairs exclude counties with more than 5 percent employed in mining. The constant term was constrained to equal 0.

Table A.4—Agricultural services industries

SIC code[1]	Description
071	Agricultural services: Soil preparation services
072	Agricultural services: Crop services
076	Agricultural services: Farm labor and management services
1542	Construction: Nonresidential construction, NEC
203	Food products: Canned, frozen, and preserved fruits, vegetables, etc.
204	Food products: Grain mill products
2061	Food products: Cane sugar, except refining
2062	Food products: Cane sugar refining
2063	Food products: Beet sugar
2074	Food products: Cottonseed oil mills
2075	Food products: Soybean oil mills
2076	Food products: Vegetable oil mills
4212	Transportation: Local trucking, without storage
4221	Transportation: Farm product warehousing and storage
4449	Transportation: Water transportation of freight, NEC
4731	Transportation services: Freight and cargo
5083	Wholesaling: Farm and garden machinery and equipment
5153	Wholesaling: Grain and field beans
5159	Wholesaling: Farm-product raw material, NEC
5191	Wholesaling: Farm supplies
8699	Services: Membership organizations, NEC

[1]Standard Industrial Classification System 3- or 4-digit industry code.
NEC is "not elsewhere classified."

we defined as being "farm-related." These include agricultural services, farm suppliers, and most food processors relating to crops. Since they would likely be less affected by CRP, farm-related establishments devoted exclusively to livestock, such as meat processors and veterinary services, were excluded from this definition.

Beginning Farmer Model

In modeling the beginning farmer response to CRP enrollment, CRP's local importance was measured as the proportion of county cropland enrolled in CRP. Using this measure, we selected a group of high-CRP and matching counties which was different from the one used in the population and employment analysis. As a result, even though we used many of the same explanatory variables discussed above, the means of the high-CRP and matching counties differ slightly from those reported in tables A.1 and A.2. Nonetheless, for expositional ease they will not be reported.

The full list of explanatory variables considered for the beginning farmer models includes all of the demographic variables discussed above: the percent of population Black, Hispanic, Native American, under 18 years of age, or over 62 years of age. Many of the labor market and economic variables also enter the basic equation, in one form or another: the log of 1970-

80 population change; the log of 1980 population density; the percent of 1980 employment in agriculture, business services, manufacturing, mining, and recreation; percent of the civilian workforce employed in 1980; percent working outside the county; and median household income in 1979. Of the agricultural characteristics discussed earlier, the beginning farmer models included the proportion of sales going to very small farms (under $20,000 sales) and large farms (over $250,000 sales) and the proportion of farm operators working off-farm over 200 days a year.

Farm-sector variables not discussed earlier include the proportion of cropland in acreage reduction programs, the proportion of cropland not planted or diverted from production, the proportion of farm operators over 65 years of age, the number of farms in the county (which enters select models in log form), the proportion of farmland in crops, and the proportion of county land area devoted to farming. The basic equations also included the percentages of 1982 farm sales coming from specific commodities. For expositional ease, these data are not reported here. All farm-sector variables are from the 1982 Census of Agriculture. The dependent variables for the results reported in the text include the ratio of the number of young or short-tenure farm operators in 1997 relative to their numbers in 1982. These were further divided into ratios for each 5-year segment between 1982 and 1997. Identical models were estimated with the change in the share of all farmers that were young or short-tenure over this period as the dependent variable (not reported in the text for expositional ease). Descriptive statistics for each of these variables are reported in table A.5.

With over 35 possible explanatory variables, we used a backward stepwise regression procedure to narrow the set. Regressions were first estimated with the aggregate CRP-enrollment-to-cropland ratio. This variable was then replaced with similar ratios for whole- and for partial-farm acres.

Table A.5—Mean values of variables unique to the beginning farmer models

Variable description	Unit	Study counties	High-CRP[1]	Matched counties
Beginning farmer measures:				
Young farmers, 1997/1982	Percent	45.2	45.8	44.7
Short-tenure farmers, 1997/1982	Percent	69.7	74.0	73.4
CRP measures:				
CRP acres (1991-93)/cropland, 1982	Percent	8.0	26.8	4.8**
Whole-farm acres/cropland	Percent	3.0	11.1	1.6**
Farm and farm operator characteristics:				
Diverted acres/cropland, 1982	Percent	1.6	3.1	1.9**
Cropland not planted or diverted, 1982	Percent	29.4	30.3	29.2
Cropland/farmland, 1982	Percent	56.2	47.3	50.6**
Farmland/all county land, 1982	Percent	69.1	75.9	75.2
Number of farms, 1982	Number	720	476	667**

** 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 acres-to-cropland ratio for 1991-93 exceeding 20 percent. Of the 1,481 study counties, 194 were high-CRP by this definition.

Source: 1982-1997 Census of Agriculture and the CRP Contracts file. In addition to the variables listed above, the models also included the proportion of total sales in 1982 from the full range of farm commodities (not reported for expositional ease).

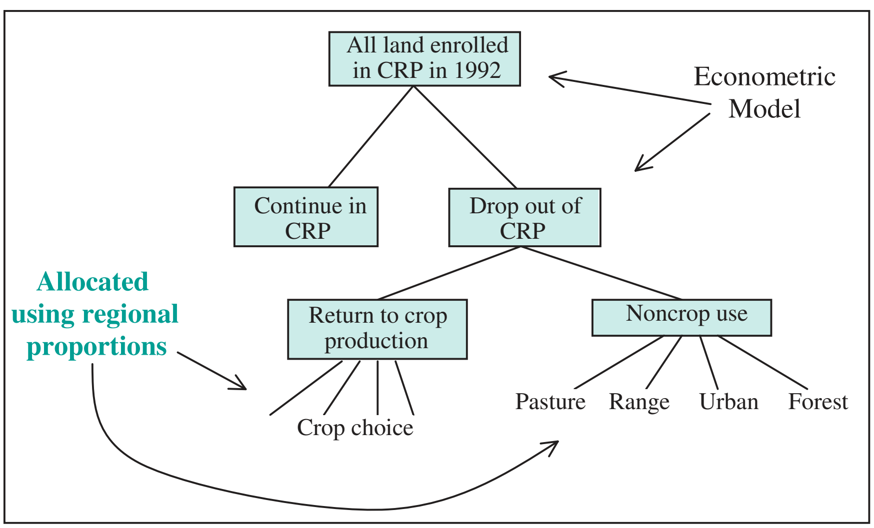
Appendix B: Predicting Land-Use Changes

This appendix describes the econometric model used to predict land uses of CRP parcels after contracts expire. Following traditional discrete-choice studies on land-use change, the model draws on rent theory to simultaneously predict parcel-level CRP re-enrollment and post-CRP land use using county-level profit measures in five broad categories of land use: urban, range, forest, pasture, and crops. The model is calibrated using observation-level land-use data from USDA's Natural Resources Inventory (NRI) and county-level profit estimates constructed from a variety of sources. The model estimates the likelihood a parcel enrolled in CRP as of 1992 continues in CRP through 1997, and, if not, the likelihood it returns to crop production. To predict post-CRP land uses of all parcels enrolled as of November 2002, we extrapolate from this calibration using more recent data on profit and land currently enrolled in CRP. The basic structure of the model is illustrated in Figure B.1.

We condition our estimates on interactions between parcel attributes and county-level profits and profit changes. Specifically, we include a measure of parcel erodibility and indicator variables of land cover while under contract with CRP.[73] Including these variables and interactions should account for some within-county variation in land-use rents as well as variation in the costs of converting land from the CRP cover to another use. Our model also includes regional averages of land-use change to proxy for unobserved land-use determinants correlated across space. Specifically, we include the shares of CRP parcels in each crop district that opted out of the program and the shares returning to crop production conditional on dropping out. In this way, we account for some unobserved factors correlated across space that may affect the rent for crop production relative to other land-use alternatives.[74]

Figure B.1

The structure of the econometric model



Source: Economic Research Service, USDA.

[73] The NRI includes many land characteristics. We use only these two because they are the only variables that have matching counterparts in our prediction data set: the 2002 CRP contract file. For in-sample prediction using the NRI, additional land characteristic variables have little influence over the predictions.

[74] This approach differs from an approach common in the literature on spatial econometrics, which uses a spatially autocorrelated error structure (e.g., Anselin, 1988). We do not employ these methods due to the computational burdens of implementing a spatial error structure in a discrete-choice framework.

A Binomial Probit Model

We estimate the likelihood each CRP land parcel is converted back to crop production using a subset of observations from the NRI enrolled in CRP in 1992 and not enrolled in 1997.[75] The NRI is a panel survey conducted at five-year intervals (1982, 1987, 1992, and 1997) that provides information on land use, land characteristics, and conservation practices for about 800,000 points of non-Federal land in all counties of the contiguous United States plus Hawaii, Puerto Rico, and the U.S. Virgin Islands. Each NRI point represents a different number of acres according to an acreage weight that is inversely proportional to the sampling intensity for that location and land use.

We hypothesize that the probability a parcel will be converted to crop production upon exit from CRP depends on the profits associated with cropping activities compared with noncropping activities, which vary geographically. The decision also depends on the cover in place while the parcel was enrolled in CRP. For example, land planted with trees may be more costly to convert to cropland than land planted with grass.

We assume the decision to crop a land parcel is tied to a latent variable Y that is a continuous function of observed profit measures, cover type, and erodibility, plus a normal distributed error which encapsulates unobserved factors. The variable Y may be interpreted as the excess profitability of planting crops as compared to the next most profitable alternative. If $Y > 0$, the land is converted to cropland; otherwise, it is not.

Specifically, we assume:

$$Y = f(\mathbf{X}) + e \qquad (1)$$

where $\mathbf{X}$ is a vector of explanatory variables and ε a normal-distributed error uncorrelated with $f(\mathbf{X})$. Thus, if we denote the normal distribution function by Φ,

$$Prob\ (Y > 0) = \Phi(f(\mathbf{X})). \qquad (2)$$

This is a general characterization of a binomial probit.

After examining several functional forms for $f(\mathbf{X})$, we chose a linear model that considers all possible second-order interactions between our county-level rent proxies and parcel-level variables—erodibility and cover.[76] We examine these interactions because lands with different attributes may be more or less likely to convert to crops for a given set of rent measures, especially because these measures are based on relatively coarse county-level data (described below).[77] We begin with a model that includes interactions between all county-level rents and rent changes with both parcel-specific attributes. We then drop and add terms from this more general model in order to minimize the Akaike (1974) information criterion (AIC).

[75] Observations (points) from the NRI are used to model what happens to land that leaves the CRP. To predict what would happen to all CRP land, the coefficients from this model are then applied to parcel data from the CRP contract file.

[76] A longer technical appendix, available online, describes this selection process in greater detail (see http://www.ers.usda.gov). In this selection process, we compared the model described here to a simpler linear model and a more flexible nonparametric model.

[77] A reviewer suggested that CRP rental rate is a sufficient estimator for excess land profitability. We included the additional predictors described for several reasons. First, CRP rental rates (and the county-level profit proxies) do not encapsulate conversion costs, which may include fixed components (for example, cutting down trees). Furthermore, CRP rental rates do not necessarily equal the returns to converting land back to crops. Although CRP rental rates are likely greater than or equal to the rents associated with other land-use alternatives at the time of signup, rents to other land uses change over time, and the bidding process is structured in a way that may allow some farmers to obtain surplus rents by enrolling in CRP. In addition, our CRP rental rate estimate, like our profit estimates, is at the county level, not parcel specific. For these reasons, we include proxies for alternative land-use profits, changes in these profits since initial signup, and specific land attributes as additional predictors.

Let i index the parcel-specific elements of **X**, which we denote by x_i^S; and let j index our county-level rent measures (and differences), denoted by x_j^C. For this specification, we can define $f(\mathbf{X})$ as:

$$f(\mathbf{X}) = \beta_0 + \Sigma_i \beta_i^S x_i^S + \Sigma_j \beta_j^C x_j^C + \Sigma_i \Sigma_j \beta_{ij} x_i^S x_j^C. \quad (3)$$

Our goal is to use the econometric model to predict the likelihood that each current CRP contract will return to crop production if the program were to end. Because the observations (from the NRI) that dropped out of CRP between 1992 and 1997 were not randomly assigned, predictions of this kind can be biased if we extrapolate our model to current CRP parcels. In other words, *un*observed factors may jointly affect the decision to remove a parcel from CRP and convert it back to crops if it has exited.

Decisions to exit CRP and to plant crops if exiting are likely determined jointly. For example, land relatively more profitable in crop production is probably more likely to exit and to be converted to crop production. It is unclear, however, whether or not our model and explanatory variables capture these joint determinants. If unobserved factors jointly determine the likelihood a parcel drops out of CRP and the likelihood it returns to crop production given it is no longer enrolled in the program, there is a sample selection problem.

We deal with this problem using Heckman's two-step procedure (Heckman 1978, 1979). Effectively, this procedure jointly models the decision to exit CRP with the decision to return a parcel not re-enrolled in CRP to cropland production. In practice, we do this in two steps.[78] In the first step we predict whether or not a parcel with an expiring CRP contract will re-enroll in CRP. We denote with the estimated value of a latent variable to which the probability a CRP parcel drops out of CRP is linked. We then calculate the predicted "odds ratio" that each parcel will drop out of CRP. That is,

$$\text{odds ratio} = h = \frac{\phi(\hat{D})}{\Phi(\hat{D})}, \quad (4)$$

where $\phi(\hat{D})$ is the value of the normal density function at $\hat{D}$ and $\Phi(\hat{D})$ is the probability that a parcel drops out of CRP (the cumulative normal density at $\hat{D}$). We use the same structure described above to estimate the first-stage CRP dropout.[79] We then construct the odds ratio and include it as a predictor in the second-stage estimates—the model described above for whether land not re-enrolled in CRP returns to cropland production. This procedure provides consistent estimates in the second stage even when the error in the first stage is correlated with the error in second stage.

[78] One can also estimate these two equations simultaneously using full-information maximum-likelihood. At present, this approach is infeasible for projection pursuit regression, a non-parametric method we used to check the fit of the simpler parametric models reported. We used the two-step procedure for all specifications to provide a consistent basis for comparison between candidate models.

[79] We do not report estimates of these first-stage models. These estimates are available upon request.

Data

As described above, we use an in-sample data set for our estimation and an out-of-sample data set to predict post-CRP uses of lands currently enrolled in the program. The in-sample data set contains observations of CRP re-enrollment and land-use choices as well as parcel-level observations of erodibility and CRP cover from the NRI. More recent data on current CRP acres were obtained from the Farm Service Agency (FSA). The FSA data contain information on total county acres in CRP and observations of erodibility and cover practice for each CRP contract.

The data set used in the first stage includes all NRI observations enrolled in CRP in 1992 and/or 1997. The data set used in the second stage includes all lands enrolled in 1992 but not enrolled in 1997. The first-stage sample includes 21,172 observations and the second-stage subsample includes 2,756 observations. These observations span 1,599 counties in 42 States and 762 counties in 39 States, respectively.

We consider six land use categories, designated by the NRI, that exhaust the non-Federal land base: crops, pasture, forests, urban, range, and other.[80] The NRI also provides an extensive set of variables on land characteristics including two we incorporate into our model: erodibility and land cover. Land cover is classified into two categories: grasses and/or legumes and trees and/or wildlife practices.[81] In 1992, approximately, 85 percent of total contract acres were in grass/legumes and 15 percent in trees/wildlife. In total, 19,785 NRI points, representing 34,042,100 acres, were reported in the CRP in 1992 with 91 percent of acres under grass/legumes and just 9 percent in trees/wildlife cover. Of these 1992 CRP acres, approximately 11 percent were no longer enrolled in CRP by 1997. The estimated mean dropout rates for lands in the grasses/legumes was slightly higher than for lands under trees/wildlife cover, with 11 percent and 9 percent of acres dropping out from each cover type, respectively.

Of the land that dropped out of the CRP between 1992 and 1997, about 63 percent returned to crop production. This percentage was sensitive to the type of cover, with land in trees and wildlife substantially more likely to continue under forest rather than in crop production or grazing. Although 56 percent of acres in trees/wildlife were covered in forest as of 1997, less than 1 percent of lands in grass/legumes were planted or naturally regenerated with trees after dropping out of CRP.[82]

To make predictions regarding post-CRP land use on currently enrolled acres, we use data obtained from FSA on 589,932 CRP contracts, representing all 33.3 million acres enrolled as of November, 2002. This data set contains data on acreage enrolled, county location, erodibility, and CRP cover practice for every CRP contract.

Besides erodibility and land cover, our key explanatory variables are county-level profit proxies for five alternative land uses: crops, pasture, forest, urban, and range. Using county-level data derived from various sources, we construct measures of revenues less variable costs for each of these five land-use activities.

We assume landowners and operators base their expectations of future land-use returns using current levels of prices and, when relevant, the average value of yields over the previous 5 years. In this way, we smooth over idiosyncratic weather shocks that affect yields in particular years. We use the current commodity price because time-series of most commodity prices show a strong degree of autocorrelation—price shocks are far more persistent than yield shocks. Data on cash costs as a percentage of revenue at the State and regional level, respectively, are from the Census of Agricul-

[80] Our data on land use is from USDA National Resources Inventory (NRI). “Croplands” include row and close-grown crops, fallow, pasture and haylands in rotation with crops, permanent haylands, vineyards, orchards, and nurseries. “Pasture” includes land managed for introduced forage for livestock grazing. “Range” includes land under native or introduced forage suitable for grazing which, unlike pasture, receives only limited management. “Forests” are areas at least one acre in size and 100 feet in width that are least 10-percent stocked with trees with the potential to reach 13 feet at maturity. From an aerial perspective, this definition equates to a canopy cover of at least 25 percent. “Urban lands” include areas in residential, industrial, commercial, otan areas, as these are separately identified by the NRI.

[81] While the NRI distinguishes between trees and wildlife covers, we group these two into one category given the small number of observations.

[82] NRI's forest classification can include lands with early evidence of natural forest regeneration.

ture and USDA's Economic Research Service (ERS). County acreage data from NASS and the Census of Agriculture provided weights for averaging across individual crops. County-level estimates of total Federal program payments per acre are from the Census of Agriculture and include receipts from deficiency payments, support price payments, indemnity programs, disaster payments, and payments for soil and water conservation projects. Since we cannot observe the exact year in which a land-use decision is made between NRI surveys, we use 1996 prices in our econometric estimation of re-enrollment decisions following contract expiration over 1996-1997. For the out-of sample predictions, we use 2001 prices, the latest year for which all of our data are available.

Using these levels of prices and yields, we construct measures for each county in the contiguous United States of the expected per acre annual net returns that can be expected from the major land-use alternatives. We estimate net returns to continuing in CRP, to returning to crop production, and to the four major noncrop land uses (pasture, forest, urban, and range). For our measure of returns to re-enrolling in the CRP, we use county-average CRP rental rates per acre obtained from FSA's data on individual contracts. The estimates for returning to crop production include the net returns from market sales as well as government farm program payments, excluding payments for cropland retirement under the CRP and the Wetlands Reserve Program (WRP), which are jointly reported in the Census of Agriculture. These land-retirement programs are excluded because we separately model the decision to reenroll in the CRP. Returns to forests and urban uses are initially calculated as the net present values of a perpetual stream of timber harvests and rents from housing development, respectively, and then annualized with an assumed private discount rate of 5 percent.

For all CRP contracts as of November 2002, crop returns (and changes in returns) are lower than in the total in-sample, with values of $58 ($22) and $90 ($53), respectively. This reflects the decline in crop prices from 1996 to 2001. Returns to pasture (and changes in returns) are also slightly higher for the NRI observations that drop out of CRP, compared to the NRI points that stay in CRP. Total pasture returns (but not changes in returns) are also higher in the total out- versus in-sample.

Lastly, our explanatory variables include regional averages of land-use change to proxy for unobserved land-use determinants correlated across space. Specifically, we include the shares of CRP parcels in each crop district that opted out of the program and the shares returning to crop production conditional on dropping out. In this way, we account for some unobserved factors correlated across space that may affect the rents from crop production relative to other land-use alternatives.[83]

County-Level Estimates of Annual Net Returns

Cropland Net Returns: Estimated annual cropland net returns per acre consist of two components: a weighted average of the net returns per acre for 21 major crops based on prices, yields, costs, and acres, and total Federal farm program payments per acre, excluding conservation payments for cropland retirement. We used State-level marketing-year-average prices

[83] Technically, the regional proportions on the right-hand side of the regression are endogenous. However, because there are a relatively large number of observations in most crop districts, this should not affect regression estimates. The average number of NRI CRP points in a crop district is 81. This number ranges from 1 to 742, with 75 percent of districts having more than 10 observations.

and county-level yields from the National Agricultural Statistics Service (NASS) for all crops (barley, all dry edible beans, corn, cotton, flaxseed, alfalfa hay, other hay, oats, peanuts, potatoes, rye, rice, sorghum, soybeans, sugarcane, sugar beets, sunflowers, tobacco, winter wheat, durum wheat, other spring wheat).

Pasture Net Returns: Annual net returns per acre for pasture were estimated using pasture yields from the National Cooperative Soil Survey (NCSS), averaged for each county using NRI soils and acreage data. We multiplied these yields by the State price for "other hay" from NASS and subtracted costs per acre for hay and other field crops from the Census of Agriculture.

Range Net Returns: Annual net returns per acre for rangeland were estimated using forage yields from NCSS, weighted with NRI soils and acreage data and multiplied by State-level per head grazing rates for private lands from the ERS database on cash rents. Costs for range management are assumed to be borne by the tenant and thus reflected in the grazing rates.

Forest Net Returns: We estimate annual forestry net returns per acre by annualizing at a 5- percent interest rate the net present value of a weighted average of sawtimber revenues from different forest types based on prices, yields, costs, and acres. State-level stumpage prices were gathered from a variety of State and Federal agencies and private data reporting services. Regional merchantable timber yield estimates for different forest types were obtained from Richard Birdsey of the U.S. Forest Service. Regional replanting and annual management costs were derived from Moulton and Richards (1990) and Dubois, et al. (1999). The net present value of an infinite stream of forestry revenues for each forest type was calculated using an optimal rotation age determined with the Faustmann formula, assuming forests start at year zero in a newly planted state. County acreage and sawtimber output data from the U.S. Forest Services's Forest Inventory and Analysis (FIA) and Timber Product Output (TPO) surveys provided weights for averaging across individual forest types and species, respectively.

Urban Net Returns: Annual urban net returns per acre are estimated as the median value of a recently developed parcel, less the value of structures, annualized at a 5-percent interest rate. This measure corresponds to the average annual rents from an acre of improved bare land and is based on the value of land for construction of single-family homes, which is the primary use of developed land at the national scale. Median county-level prices for single-family homes were constructed from the decennial Census of Population and Housing Public Use Microdata Samples and the Office of Federal Housing Enterprise Oversight (OFHEO) House Price Index. Regional data on lot sizes and the value of land relative to structures for single-family homes were obtained from the Characteristics of New Housing Reports (C-25 series) and the Survey of Construction (SOC) microdata from the Census Bureau. Further details on the construction of the urban net returns are provided in Plantinga, et al. (2002).

More complete descriptions and citations of data sources are provided in Lubowski (2002) and are available from the authors upon request.

Empirical Results

Table B.1 summarizes the estimates of the two parametric models, equations 3 and 4, both with and without Heckman's sample-selection correction. The variable names denote the crop-district-level crop share variable; the parcel-level measures of erodibility and cover type (grass/legumes and trees/wildlife); and the county-level CRP rental rates and measures of net returns to alternative land uses. The best linear model with interactions (determined by minimization of the AIC) explains 31.6 percent of the deviance. When we include Heckman's odds ratio to correct for sample-selection bias, the fit improves to just 31.7 percent of the deviance. The model implies that crop profits, cover type, the spatial variable, erosion, and the CRP rental rate are the most significant explanatory variables explaining conversion back to crops. The greater crop profits and crop profit growth, the greater the likelihood a parcel will return to cropland. When interaction terms are considered, the significance of these variables is most evident via their interaction with the other variables and with each other. Forest and pasture profits reduce the likelihood that CRP parcels are converted to cropland, but they are not individually statistically significant. Wildlife cover and especially tree cover reduce the likelihood of conversion to crops compared with grass or legume covers. These interactions suggest that the effects of both profits and cover types can be different depending on the erodibility of the land.

Heckman's odds ratio is statistically significant in all the models and implies, conditional on observable characteristics, that parcels that continued in CRP are less likely than those having dropped out to be converted to crop production upon contract termination. This seems consistent with economic intuition that the better the cropland, the greater the enticement to take land out of CRP and place it back into crop production. This effect, however, is small. Regardless of whether or not we use the Heckman correction, the average predicted probability that a parcel will be converted to crop production is lower for parcels that did not drop out of CRP compared with those that did. Indeed, the average probabilities are quite similar, which suggests that our explanatory variables capture most of the differences between parcels that dropped out of CRP and those that did not.

The linear model implies that crop rents, cover type, location (the spatial surface), and the prime farmland indicator are the most statistically significant explanatory factors predicting conversion to crop production. The greater the net returns from cropping and the growth in these returns, the greater the likelihood that a parcel will revert to crop production upon exiting CRP. In the larger model with interaction terms, the significance of the different variables is partially evident through their interaction with the other variables and with each other. Due to the many interactions in the larger model, one cannot easily discern marginal effects of each variable from a casual inspection of coefficients. Insight into the average marginal effects of the net return variables can be obtained by examining how the predictions change when adding and subtracting 50 percent to one variable at a time, holding all other variables static. Results from these simulations are reported in Table B.2. Increases in crop net returns, including government payments, (and decreases in range and urban net returns) modestly increase the predicted likelihood that the average parcel will convert to

Table B.1—Summary of parametric probit models

Explanatory variable	Model: Simple linear model		AIC minimum		Heckman two-step	
	Estimate	Standard error	Estimate	Stamdard error	Estimate	Standard error
INTERCEPT	**-1.051**	0.120	**-0.853**	0.244	**-1.691**	0.3905
CROPSHARE	**2.015**	0.109	**1.977**	0.113	**2.011**	0.1146
ERODIBILITY	**-0.007**	0.002	-0.011	0.006	-0.010	0.0061
URBAN	0.000	0.000	0.000	0.000	0.000	0.0000
RANGE	0.000	0.003	-0.016	0.011	-0.016	0.0110
CROPS	**0.002**	0.001	0.001	0.002	0.0001	0.0019
FOREST	-0.004	0.006	0.004	0.007	0.003	0.0072
PASTURE	-0.0003	0.0030	**-0.011**	0.004	**-0.012**	0.0041
Δ URBAN	0.0000	0.0001	0.000	0.000	-0.0001	0.0002
Δ RANGE	-0.0002	0.0133	0.035	0.045	0.034	0.0454
Δ CROPS	**0.002**	0.001	**0.007**	0.002	**0.008**	0.0019
Δ FOREST	0.001	0.008	-0.004	0.011	-0.0004	0.0111
Δ PASTURE	-0.003	0.002	**-0.008**	0.003	-0.005	0.0035
RENT	**0.004**	0.001	0.000	0.004	0.002	0.0045
COVER-T	**-0.591**	0.141	0.584	0.366	0.390	0.3704
COVER-W	**-0.393**	0.173	0.375	0.393	0.345	0.3932
EI*CROPS			**-0.0002**	0.0001	**-0.0002**	0.0001
EI*PASTURE			**0.0008**	0.0002	**0.0008**	0.0002
EI*Δ RANGE			**0.0021**	0.0010	**0.0021**	0.0010
EI*Δ FOREST			**-0.0007**	0.0004	**-0.0007**	0.0004
URBAN*RENT			0.0000	0.0000	0.0000	0.0000
RANGE*RENT			**0.0004**	0.0002	**0.0004**	0.0002
RANGE*COVER-T			**-0.0598**	0.0255	**-0.0572**	0.0256
RANGE*COVER-G			0.0271	0.0243	0.0274	0.0244
CROPS*RENT			**0.0001**	0.0000	**0.0001**	0.0000
FOREST*COVER-T			-0.0300	0.0163	-0.0221	0.0164
FOREST*COVER-G			**-0.0727**	0.0264	**-0.0634**	0.0264
Δ URBAN*RENT			0.0000	0.0000	0.0000	0.0000
Δ RANGE*RENT			**-0.0018**	0.0009	**-0.0019**	0.0009
Δ CROPS*RENT			**-0.0001**	0.0000	**-0.0001**	0.0000
Δ PASTURE*RENT			0.0001	0.0001	0.0001	0.0001
Heckman odds ratio					**0.4087**	0.1475
Percent deviance explained	29.3	31.6	31.7			
AIC	2,685.8	2,621.6	2,615.5			

Bold indicates statistical significance with 5-percent confidence.

Source: Economic Research Service, USDA.

crops upon exiting CRP. Because crop prices increased markedly between 1986 and 1996, the estimates suggest that a smaller share of exiting CRP lands would have returned to crop production if net returns had not increased. Similarly, a larger share would have returned to crop production if government payments had not decreased during this period. The predicted likelihood of returning to crops was not sensitive to the simulated changes in either forest or pasture net returns.

Table B.3 compares the in-sample (NRI parcels that dropped out of CRP) and out-of-sample (NRI parcels still enrolled in CRP in 1997) predictions. All models predict that between 61.2 and 61.3 percent of in-sample acres return to cropland and that between 52.2 and 53.4 percent of out-of-sample

Table B.2—Sensitivity of predictions to changes in net returns variables

Scenario		Predicted acres returning to crop production in 1997[1]					
		In-sample (exited CRP)			Out-of-sample (in CRP in 1997)		
Variable	Change in 1996 level[2]	All parcels	Grass or legume cover	Trees or wildlife cover	All parcels	Grass or legume cover	Trees or wildlife cover
		Percent					
Original results		61	64	26	53	56	31
Crop net returns	+50	66	69	29	58	61	35
(*CROPS*)	-50	56	59	22	48	51	27
Pasture net returns	+50	60	63	25	52	55	30
(*PASTURE*)	-50	62	65	27	55	57	32
Forest net returns	+50	60	63	23	52	55	28
(*FOREST*)	-50	63	66	30	55	58	34
Range net returns	+50	58	61	23	52	54	27
(*RANGE*)	-50	64	66	32	56	57	38
Urban net returns	+50	56	59	24	50	53	30
(*URBAN*)	-50	65	68	28	56	59	32

[1]Predictions are estimates from the Heckman two-step model based on the linear model with interactions.
[2]Predictions based on the indicated percentage change in the 1996 levels of a particular variable (e.g. CROPS) as well as on the corresponding new values for the 1986-1996 change in this variable (e.g. Δ CROPS).

Source: Economic Research Service, USDA.

Table B.3—Predicted acreage returning to crop production

Model	In-sample (dropped out of CRP)	Out-of-sample (in CRP in 1997)
	Percent	
Actual (see table 4.1)	62.6	N/A
Simple linear	61.2	52.2
Linear with interactions (AIC minimum)	61.3	52.5
Heckman two-step	61.2	53.4

Source: Economic Research Service, USDA.

acres enrolled in CRP in 1997 would have returned to cropland had their contracts been terminated.

To make predictions about post-CRP use of land remaining in CRP, we utilize parameter estimates derived mainly from data on parcels that dropped out of CRP. Because these parcels are somewhat different from the parcels that continued in CRP, we must extrapolate.

Table B.4 reports the AIC-selected model's predictions for the 2002 CRP contract file, taking into account changes in our profit measures between 1997 and 2002. We made separate predictions for each contract based on the parcel's cover and erodibility, and our profit estimates. We then aggregated these predictions to obtain State-level and nationwide predictions. The table reports the number of CRP acres enrolled in each State as of November 2002 and the predicted number and share of acres returning to cropland if the program were to end, ranked by the amount of land in the CRP (column 2). The 95-percent confidence interval for the predicted percentage of each

Table B.4—Predicted share of CRP acres returning to crops upon program expiration, 2002

State	CRP land (acres)	Predicted land returning to crops (acres)	Predicted share returning to crops (95-percent confidence interval)
Iowa	1,857.6	1,631.9	88 (55- 99)
Kentucky	312.5	271.4	87 (53 - 96)
Louisiana	203.9	15.3	8 (1 - 24)
North Dakota	3,331.8	2,616.5	79 (73 - 86)
South Dakota	1,431.1	1,118.8	78 (64 - 86)
Tennessee	246.1	186.4	76 (42 - 91)
Illinois	963.2	709.0	74 (37 - 96)
Missouri	1,542.5	1,091.0	71 (43 - 87)
Nevada	0.2	0.0	7 (3 - 20)
Pennsylvania	118.9	82.3	69 (43 - 87)
Wisconsin	634.2	396.3	62 (54 - 72)
Oregon	455.5	281.4	62 (28 - 87)
New Mexico	593.0	355.9	60 (32 - 82)
South Carolina	217.7	12.4	6 (1- 16)
New Hampshire	0.2	0.0	6 (0 - 58)
Florida	86.7	4.9	6 (0 - 31)
Minnesota	1,695.3	1,004.2	59 (45 - 77)
Wyoming	277.8	159.2	57 (45 - 77)
Indiana	294.0	166.3	57 (19 - 84)
Montana	3,407.4	1,720.5	50 (42 - 66)
New York	59.3	25.8	44 (27 - 64)
Texas	4,031.0	1,749.0	43 (29 - 57)
Ohio	295.2	121.2	41 (24 - 67)
Kansas	2,656.0	1,070.5	40 (35 - 50)
North Carolina	113.3	45.6	40 (16 - 58)
Colorado	2,203.1	880.9	40 (15 - 71)
Idaho	789.4	305.5	39 (15 - 71)
Virginia	56.2	21.7	39 (15 - 64)
Vermont	1.1	0.4	39 (12 - 74)
Mississippi	871.4	334.4	38 (15 - 58)
Maine	24.1	8.5	35 (21 - 64)
Michigan	306.1	101.0	33 (17 - 59)
Georgia	308.6	9.6	3 (0 - 15)
California	144.4	37.9	26 (1 - 61
Nebraska	1,135.9	288.8	25 (10 - 60)
Maryland	66.8	16.1	24 (9 - 67)
Massachusetts	0.1	0.0	2 (0 - 71)
Alabama	482.6	90.8	19 (7 36)
New Jersey	2.3	0.4	19 (5 - 64)
Oklahoma	1,023.9	174.7	17 (12 - 29)
Arkansas	164.8	26.4	16 (3 - 41)
Washington	1,276.6	192.7	15 (3 - 59)
West Virginia	1.6	0.2	13 (1 - 54)
Utah	201.1	19.8	10 (3 - 37)
Connecticut	0.3	0.0	0 (0 - 20)
Delaware	6.9	0.0	0 (0 - 13)
48-State total	33,891.7	17,346.0	51 (40 - 63)

Source: CRP Contracts file as of November, 2002

State's CRP land returning immediately to crops if CRP contracts were to expire is reported in parentheses.

Nationwide, the model predicts that 51 percent of the land enrolled in CRP would return to crop production if the program expired at the end of 2002. This number is slightly less than our 1997 out-of-sample predictions. Most of this difference stems from the decline in commodity prices between 1997 and 2002. To a lesser extent, this difference stems from differences between the 1997 NRI sample of CRP parcels and the November 2002 contract file, which occur due to new CRP signups since 1997 and sampling error in the NRI.

Appendix C: Description of the Recreation Models

This report uses two methods to compute the CRP's impact on outdoor recreational expenditures. The "trips-based" method uses data on outdoor recreational trips taken by individuals. The "receipts-based" method uses information on money paid to farmers for recreational uses of their land. Both methods also use information on trip-related expenditures, such as expenditures on food, lodging, and transport.

The Trips-Based Method

The trips-based method uses survey data on the American public's participation in outdoor recreation. This data comes from the 2000 National Survey of Recreation and the Environment (NSRE2000) and the 1996 Fishing, Hunting, and Wildlife Associated Recreation Survey (FHWAR96). In addition, land-use data from the 1992 Natural Resources Inventory (NRI) is used to describe the sites visited by individuals.

Ideally, the actual sites visited by survey respondents, and the physical attributes of these sites, would be used in an econometric model. However, for a number of reasons (survey restrictions, difficulty of matching reported site names with actual sites, and limited biophysical data) we use an indirect measure of site location. In particular, individuals reported the distance and direction to visited sites.[84] When combined with the respondent's zip code, this distance and direction information identifies the subcounty region visited. In addition, the NSRE2000 and FHWAR96 data provided respondent attributes, such as income and age.

[84] Respondents reported one of the eight cardinal directions: North, Northeast, East, Southeast, South, Southwest, West and Northwest.

These subcounty regions were the "choices" available to each respondent. Formed from the intersection of county boundaries, major land resource area boundaries, and eight-digit hydrological unit code boundaries, these regions are likely to be relatively homogeneous.

The NRI points falling within each of the subcounty regions are used to describe the attributes of each of these recreational site choices. Since the research focused on the impacts of the Conservation Reserve Program, a reduced-form set of variables was used. That is, instead of attempting to identify the various attributes that outdoor recreationists actually care about (such as the number of birds spotted, or the clarity of the stream water), measures of land use within each region were used as proxies for these attributes.

To explicitly account for site attributes, a discrete-continuous model was used to estimate trip-taking behavior.[85] The first stage of the model (the discrete component) is used to predict the probability of visiting different sites (given that a trip is taken). A multinomial logit model is used, with the probability of an individual visiting the j^{th} site (out of J total sites):

[85] This discrete/continuous model is similar to the version used in Feather et al., 1999.

$$P(j)= \exp\{V_j)\} \Big/ \Sigma_m \exp\{V_m\},$$

$$V_j=\beta_1*TC_j + \beta_2*\ln(M_j) + \beta_3*X_{1j} .. + \beta_k*X_{kj}$$

The individual specific set of j=1..J available sites are the subcounties within 100 miles of a zip code's centroid. β are parameters to be estimated, and $X_1 \ldots X_k$ are site attributes. M is an aggregation correction that controls for the size of the counties.

The second stage estimates total trips taken by the respondent. A Poisson count model is used that includes an "inclusive value," computed using data and coefficients from the first stage. The probability of an individual making q total trips:

$$Prob(Q=q) = \exp(-\lambda) * \lambda^q / q!$$

$$\lambda = I*\mu + Z\theta$$

$$I= \ln(\Sigma_j \exp\{V_j\})$$

I is the inclusive value, computed using β and site attributes from the first stage of the model. Z are individual socioeconomic characteristics, and θ and μ are parameters to be estimated.

The discrete/continuous models were estimated for several different types of activity (hunting, fishing, swimming, boating, and other water-based recreation). Tables C.1 and C.2 illustrate the results obtained for wildlife viewing (using data from the FHWAR96 survey).

These results indicate that increasing the percent of CRP (in a subcounty area) increases the probability of that subcounty being visited. Furthermore,

Table C.1—First stage (multinomial logit) results for wildlife viewing

Variable	Coefficient	t-statistic
Distance to site	-0.041	-213.5
CRP (percent)	0.527	2.3
Cultivated cropland (percent)	-1.02	-16.8
Non-cultivated cropland (percent)	-0.311	-1.91
Pasture (percent)	-0.10	-1.18
Range (percent)	-1.55	-24.8
Forest (percent)	-0.28	-5.7
Urban (percent)	0.99	17.55
Urbanization index (0=urban to 9=totally rural)	-0.011	-3.3

Number of observations=3,345. Log-likelihood = -93458.7.

Source: Economic Research Service, USDA, using NSRE data.

Table C.2—Second stage (Poisson) results for wildlife viewing

Variable	Coefficient	t-statistic
Constant	0.12	0.65
Inclusive value	0.195	9.3
Income	-0.0063	-2.1
Male dummy (1 if male)	-0.120	-7.0
Years of schooling	-0.020	-7.03
Age	0.0093	20.0
Race dummy (1 if white)	0.094	2.6

Number of observations=3,029. Log likelihood=-21252.7.

Source: Economic Research Service, USDA, using NSRE data.

an increase in CRP will increase the inclusive value, which will have a positive impact on total number of wildlife viewing trips taken.

To compute the CRP's impact on recreational expenditures, the CRP percent variable is set to zero, and other land-use variables are adjusted (using the land-use prediction model described in Appendix B). Then, using the coefficients from both steps, the predicted number of recreational trips is computed. The difference between the observed number of trips and the predicted number of trips is then multiplied by per trip expenditure data (that was gathered as part of the FHWAR96 and NSRE2000 surveys).[86] This product, after suitable weighting (using sample-to-population weights included in both surveys) is the "trips-based" estimate of the CRP's impact on recreational expenditures. As noted in the text, the net result was quite small, with a national value of about $7 million.

Although this methodology is grounded in actual observations on recreational trip-taking, along with data on actual land uses, this methodology suffers from a number of problems. In particular, the use of "subcounties" as destinations will introduce aggregation bias. Hence, our predicted impacts are not likely to be robust, and may be highly biased.

The Receipts-Based Method

As an alternative to the empirically based, but possibly biased, trips-based method, a receipts-based estimate is also constructed. This uses information on money received by farmers as payment for recreational access to their land.

The following question from the 2000 ARMS survey is used:

> "In 2000, what was the total income received by you for recreation, such as hunting, fishing, petting zoos, horseback riding, on-farm rodeos, etc."

Of 10,309 ARMS respondents in 2000, 1,139 had some CRP land. After applying population weights, this subsample of 1,139 represents:

- About 100 million acres of land, including approximately 33 million acres of CRP land.
- Recreational receipts of about $39 million (out of about $750 million received by all farmers)

Dividing recreational receipts by CRP acres yields approximately $1.20 per acre.

The next step is to account for expenditures other than for access fees. One measure can be derived by assuming that the average hunter will spend money on access fees in fixed proportion to expenditures on all other hunting-related goods and services. Using the FHWAR96 data, average expenditures by small game and migratory waterfowl hunters were computed for several sectors: food and lodging, transportation (public and private), trade goods (cooking fuel and ammo), and services (lease payments, guide payments, equipment rentals, boating costs). Sector-specific expansion factors are computed as the ratio of sector expenditures

[86] More precisely, several categories of per trip expenditures are used, including food, transportation, lodging, special equipment, and guide services. Some classes of expenditures, such as purchases of guns and other equipment, are not included on the assumption that hunters would purchase these things even if CRP did not exist.

over access fees. For example, if total access fee expenditures for a region were $2 million, and expenditures on food and lodging were $5 million, then the regional "food and lodging expansion factor" would be 2.5. These data are used to compute sector expenditures on a per county basis, using:[87]

Sector-expenditures = crp-acres * access_fee_receipts_per_acre * sector_specific_expansion_factor

Summing sector expenditures for the entire nation and all sectors yields a value of about $146 million. However, this only accounts for hunting and does not consider wildlife viewing. To more fully capture the impacts of CRP, we double this amount, yielding a "wildlife-related" impact of approximately $290 million.

This doubling is based on the following:

- FHWAR96 data indicate that about 75 percent of hunting trips occur on private lands. Therefore, fees for access to private lands should capture a component of most hunting trips—or, more precisely, average fees will capture a component of a representative hunting trip.
- Conversely, about 80 percent of wildlife watching occurs on public lands. Thus, access fees paid to private landowners are less likely to be an important component of wildlife-watching trips.
- This does not mean that CRP is unimportant for wildlife watching, since wildlife viewed on public lands may depend on nearby CRP lands.
- From FHWAR data, about one-quarter of all small-game hunting trips are for pheasant hunting.[88]
- According to Feather et al. (1999), the positive impact of the CRP on pheasant hunting was about one-quarter of CRP's impact on wildlife viewing ($80 million versus $347 million).
- Thus, if CRP's impact on all small-game hunting trips is similar to CRP's impact on pheasant hunting, then the expenditures on wildlife viewing due to the CRP will equal the expenditures on small-game hunting.

There are a number of factors that may bias the receipts-based method. These include factors that may lead to underestimates or overestimates. Since water-based recreation impacts are not accounted for, the receipts-based method underestimates CRP's impact on recreational spending. Furthermore, hunters who are given free access to CRP land are not explicitly accounted for (even though they, too, will be spending money on food, lodging, etc). On the other hand, the receipts-based method attributes all recreation expenditures to farmers who have any CRP land to their CRP acres, even though CPR accounts for less than half of their land. This may overestimate CRP's importance. Furthermore, all recreational receipts are assumed to be a function of CRP enrollment even though some activities, such as corn mazes, may not depend on having land retired from production.[89] Finally, activity substitution is not accounted for—it is assumed that if the CRP were terminated, then all related recreational expenditures (such as for gas and transportation) would cease. Since a substantial percentage of the recreational fees collected by farmers are probably from local hunters and recreationists, this assumption probably leads to overstated CRP impacts.

[87] The (average) per acre access fees and the sector-specific expansion factors are computed for each of the 10 census regions.

[88] Earlier work also suggests that one-quarter of CRP's small-game benefits are from pheasant hunting (Ribaudo et al., 1990).

[89] Evidence from a North Dakota survey of farmers suggests that about three-fourths of farmer receipts from recreationists are from hunters (Hodur et al., 2002).

Appendix D: U.S. Regional Agricultural Sector Model

As CRP acreage is released from conservation uses, crop production would increase with subsequent decreases in crop prices. The U.S. Regional Agricultural Sector Model (USMP; see House et al., 1999) simulates potential adjustments in production and prices to this policy. This model is a multi-commodity, spatial equilibrium approach of the type described in McCarl and Spreen (1980). The USMP model has been applied to various issues, such as the regional effects of trade agreements (Burfisher et al., 1992), climate change mitigation (Peters et al., 2001), water quality (Ribaudo et al., 2001), ethanol production (House et al., 1993), wetlands policy (Claassen et al., 1998), and sustainable agriculture policy (Faeth, 1995).

USMP allocates production practices regionally based on relative differences in net returns by region. As such, USMP simulations of changes in farm programs are manifest as a spatial equilibrium across 10 main production regions (*r*) and 45 subregions (*u*) delineated by erosion class (highly erodible and non-highly erodible). Commodity price and production levels are simulated for 44 agricultural commodities and processed products at the regional level, which are integrated into the flow of final commodity demand and stock markets. USMP accounts for production of the major crop (corn, soybeans, sorghum, oats, barley, wheat, cotton, rice, hay, and silage) and confined livestock (beef, dairy, swine, and poultry) categories comprising approximately 75 percent of agronomic production and more than 90 percent of livestock production.

Production levels, land use, land-use management (e.g. crop mix, rotations, tillage, and fertilizer practices), and program participation are endogenously determined spatially according to a constrained optimization approach, maximizing consumer and producer welfare, $\mathcal{L}$:

(1) $Max\ \mathcal{L}$:

$$\equiv \mathbf{Z'A^d} - \frac{\mathbf{Z'B^dZ}}{2} - \mathbf{P'A^s} - \frac{\mathbf{P'B^sP}}{2} - \mathbf{Y'W_Y} - \mathbf{INP'_VA^S} - \frac{\mathbf{INP'_VB^SINP_V}}{2} - \mathbf{INP'_FW_{INP}};$$

subject to

(2) $\mathbf{pp'_{cr}X_{cr}} + \mathbf{pp'_{liv}X_{liv}} + \mathbf{pp'_yY} - \mathbf{Z} \geq 0$ (commodity balancing);

(3) $\mathbf{pp'_{inpcr}X_{cr}} + \mathbf{pp'_{inpliv}X_{liv}} - \mathbf{INP_v} \leq 0, \forall r$ (regional input balancing);

(4) $\alpha_{p,u}\left(\Sigma_b \delta_{b,u} s_{p,b,u} RAC_{b,u}^{-p^{p,u}}\right)^{-\frac{1}{p^{p,u}}} - C_{p,u} \leq 0, \forall p,u$ (regional crop balancing);

(5) $\alpha_{b,u}\left(\Sigma_t \delta_{b,t,u} X_{b,t,u}{}^{-Pb,u}\right)^{-\frac{1}{p^{b,u}}} - RAC_{b,u} \leq 0, \forall b,u$ (regional rotation balancing);

and

(6) $\mathbf{Z, Y, X_{cr}, X_{liv}, INP_v, INP_F, RAC, C} \geq 0$ (nonnegativity constraints).

Matrix **Z** represents consumer demand for produced commodities, matrix **P**, across markets and regions. Matrices **A** and **B** are the intercept and slope coefficients for product and market demand (superscripted "d") and supply (superscripted "S"), respectively. Matrices $\mathbf{X_{cr}}$ and $\mathbf{X_{liv}}$ represent cropping and livestock activities across regions and management practices. Vectors **Y** and $\mathbf{W_y}$ represent processing activity levels and net costs of process, respectively. Matrix **INP** represents variable (subscripted "V") and fixed (subscripted "F") inputs into production of primary and processed goods. $\mathbf{W_{INP}}$ represents cost per unit of fixed inputs. The output parameters per share of crop, livestock, and processing activities are represented by matrices $\mathbf{pp_{cr}}$, $\mathbf{pp_{liv}}$, and $\mathbf{pp_y}$, respectively. The input-output parameters for crop and livestock production activities are represented by matrices $\mathbf{pp_{inpcr}}$ and $\mathbf{pp_{inpliv,}}$ respectively.

Substitution among the cropping activities is represented using nested constant elasticity of transformation (CET) functions (4 and 5). The crop and rotation balancing equations ensures that the supply of land ($C_{p,u}$) in subregion (u) allocated to a crop (p) is at least as great as the demand for it, given by the sum of rotational acres ($RAC_{b,u}$) multiplied by the share of each crop grown in that rotation ($s_{p,b,u}$) subject to nonlinear CET distribution ($\delta_{b,u}$), shift ($\alpha_{p,u}$), and substitution ($\rho_{p,u}$) calibration parameters. Similarly, the allocation of land to various tillage practices (t) used in a crop rotation (b) must be no greater than the amount of land in that rotation, also subject to CET distribution ($\delta_{b,t,u}$), shift ($\alpha_{b,u}$), and substitution ($\rho_{b,u}$) calibration parameters. The nonlinear CET equations imply that there is a declining marginal rate of transformation between land used in one crop rotation and land used to produce the same crop as part of another rotation, and between one tillage activity in a particular rotation and land used in other tillage activities used with the same rotation.

The initial crop production and price data for this analysis are calibrated to the 2001 agricultural baseline (USDA, 2001). Given the shortrun nature of the analysis, all land previously enrolled in the CRP is constrained to return to active crop production, which provides an upper bound on the price and production adjustments.[90] Moreover, because the livestock and poultry sectors are linked integrally to the crop sectors through the intermediate feed sector, decreases in crop commodity prices are expected to increase returns for the livestock sector. This would induce increases in livestock production and decreases in livestock commodity prices. Therefore, the impacts of removing the CRP are estimated for both the crop and animal production sectors.

[90] The USMP does not explicitly include range or pasture lands. Consequently, the total quantity of cropland enrolled in CRP for 2001 in this model is approximately 20.6 million acres. If all of this returns to production, crop acreage would increase by 18.9 million acres with the remaining 1.7 million acres in a fallow rotation.

Appendix E: The Social Accounting Matrix (SAM) Multiplier Framework

For the regional (and national) economies, a social accounting matrix (SAM) presents a snapshot of a regional (or national) economic equilibrium. It is the accounting framework in matrix form that underlies the elaborate circular flow diagrams of economic activity found in basic economics texts. The strength of the SAM is the integration of the input-output table with a set of household, government, capital, rest-of-the-U.S. (ROUS), and rest-of-the-world (ROW) accounts in order to represent the complete set of revenue and income flows between production, income, consumption, investment, and trade.

As a double-entry accounting framework of debits (expenditures) and credits (receipts), the column sum of expenditures made by each account is equal to the row sum of its receipts. For the firm accounts (in Figure E.1), total costs is the column sum of purchases of intermediate goods and services from other firms (**A**), wages paid to labor and profits paid for services rendered by owners of financial and real property assets (**F**), indirect business taxes ($\mathbf{T_{IB}}$), and purchases of imports (**M**). Firms' total costs equal the row sum of total sales of their output made to other firms (**A**), households (**C**), government (**G**), investment purchases of capital goods by businesses and government (**I**), and exports outside of the region or outside of the country (**E**). Total factor income paid by businesses (**F**) is redistributed to households (**Y**), to government as social security payments and taxes on profits ($\mathbf{T_F}$), and to the capital account as business savings in the form of depreciation and retained corporate profits ($\mathbf{S_B}$). For households, the column sum of total expenditures on consumption goods and services (**C**), taxes ($\mathbf{T_H}$), and savings ($\mathbf{S_H}$) equals the row sum of total income received in the form of wages and property income (**Y**), remittances from other enterprises

Figure E.1
The social accounting matrix

Account:	Production	Factors	Households	Other institutions	Total
1. Production	**A**		**C**	**I, G, E**	Total sales
2. Factors	**F**				Factor income
3. Households		**Y**	**R**	$\mathbf{G_T}$	Household income
4. Other exogenous institutions	$\mathbf{T_{IB}}$, **M**	$\mathbf{T_F}$, $\mathbf{S_B}$	$\mathbf{T_H}$, $\mathbf{S_H}$	$\mathbf{S_G}$, $\mathbf{G_G}$, $\mathbf{S_F}$	Savings, tax revenue, imports
Total	Total costs	Factor income	Household expenditures	Investment, government outlays, exports & foreign savings	

Source: Economic Research Service, USDA.

and households (**R**), and government transfers (**G_T**). For State/local and Federal governments, the row sum total of tax receipts from all sources (**T_{IB}, T_F**, and **T_H**) is equal to the column sum total of government expenditures on goods and services, government transfers to households and firms (**G_T**), transfers among the different levels of government (**G_G**), and any budget savings (**S_G**). For the capital account, investment purchases (**I**) equals the row sum total of savings from all sources (**S_B, S_H, S_G**, and **S_F**). Finally, equilibrium in the ROUS and ROW accounts means that the row sum of imports purchases (**M**) is equal to the column sum of exports out of the region (**E**) plus capital inflows or "foreign savings" (**S_F**).

The SAM framework possesses an extraordinary flexibility enabling us to tailor the dimensions of the SAM to the problem at hand. Our SAMs focus on those sectors most affected by CRP enrollment changes: agriculture, spending on outdoor recreation, and household expenditures out of transfer income. For our regional SAMs, we aggregate the 478 sectors in the IMPLAN database into 12 industrial accounts (13 accounts for the national SAM). These SAMs have five agricultural sectors: livestock, grains, oilseeds, hay & pasture crops, and other crops. For the Southern Plains, cotton replaces oilseeds as a sector; for the national SAM, the cotton sector is added to the set of agricultural sectors. The seven nonagricultural sectors are agricultural inputs, food processing, industry, wholesale trade and transportation, retail trade, eating and lodging establishments, and services. The "industry" sector itself is an aggregation of manufacturing, mining, energy, and utilities sectors. Outdoor recreation expenditures are broken down into expenditures on eating and lodging, retail trade (e.g., household purchases of equipment and supplies), and services (e.g., household expenditures on permits, fees, guide services).

In our SAMs, we aggregate the nine income classes of households in the 1996 IMPLAN database into three classes. "Low income" or poor households receive less than $20,000 in income from all sources. This income cutoff serves as a good aggregate approximation for households living below the poverty threshold. "Middle income" households receive between $20,000 and $70,000 in income. "High income" households receive income greater than $70,000. The purpose for this household disaggregation in our SAMs is to quantify the different expenditure patterns exhibited by each household group. Low-income households spend more out of every $1 of income on consumption goods than do middle- and high-income households. Thus, income transfers targeted to different household groups will yield distinct results by household class on consumption, taxes, and savings.

The national model, together with models for each of the three multicounty areas we study, require four separate SAMs. In addition, in order to determine the urban-rural distribution of economic impacts within each region, we also construct rural SAMs for the Northern Plains Crescent and the Southern Plains Ellipse regions. These rural SAMs exclude the metropolitan counties located in each region. In this way we can assess the extent to which direct impacts occurring in these regions' rural areas also generate indirect impacts on output and jobs in their urban areas.

The SAM Multiplier Model

The SAM also serves as the basic building block for the SAM multiplier model. We use the SAM multiplier model to assess the direct and indirect impacts of abolishing CRP funding on the national economy and the three regional economies. The SAM multiplier model completely captures the interlinkages among revenue, income, and expenditure flows made by households and firms. The matrix multiplier obtained from the SAM captures not only the direct and indirect effects in production but, also induced effects. In production, direct effects represent the initial impacts of an outside shock on a particular sector. Indirect effects refer to a particular sector's demands for intermediate goods. Induced effects refer to those demands for goods and services made by households spending their new income derived producing new output induced by the outside shock. In addition and even more importantly, the SAM multiplier also captures the direct and indirect effects associated with exogenous shocks to households. In figure E.1, the submatrix **A** contains just the intermediate purchases among firms that are characterized by input-output multipliers, whereas the dotted rectangle contains *all* of the endogenous flows among households, factors, and firms embedded in the SAM multipliers. At the same time, the SAM multipliers account for the leakages and injections occurring at their proper entry points in the circular flow.[91]

To obtain the SAM multiplier matrix, we begin by transforming the SAM as a 23x23 matrix of expenditure shares $\mathbf{\Gamma}$. The elements in each column of $\mathbf{\Gamma}$ sum to 1. The i^{th} column in $\mathbf{\Gamma}$ represents the percent of account *i*'s outlays accruing to each of the other accounts in the SAM. Since the elements of a 1x23 vector of column totals (**y**) and a 23x1 vector of row totals (**x**) of the SAM accounts are equal, we can express the SAM as,

$$\mathbf{\Gamma} \cdot \mathbf{x} = \mathbf{y}' \qquad (1)$$

Given our shares matrix $\mathbf{\Gamma}$, let **B** be the matrix of the subset of these coefficients comprising the endogenous accounts contained in the dashed rectangle in figure E.1: production activities, factors, and households. The exogenous, government, capital, and the rest-of-the-world accounts are excluded. We express a condition for an accounting equilibrium as the vector of total output and income flows (**z**) that supports the vector sum of endogenous household and firm demands (**B·z**) plus the vector of row sums of exogenous demands (**w**),

$$\mathbf{z} = \mathbf{B} \cdot \mathbf{z} + \mathbf{w} \qquad (2)$$

Note that **z** is a subset of row totals **x** for the entire SAM corresponding to the endogenous accounts defined in **B**. The vector **w** is the subset of row sums of the exogenous demands placed on the endogenous accounts defined in **B**; it does not include exogenous flows among the exogenous accounts themselves. In equilibrium, the SAM multiplier is easily obtained,

$$\mathbf{z} = (\mathbf{I} - \mathbf{B})^{-1} \cdot \mathbf{w} = \mathbf{M} \cdot \mathbf{w} \qquad (3)$$

where M = [m_{ij}]. Each sectoral multiplier, m_{ij}, represents the induced income flow to account *i* for services performed for account *j*, as a result of

[91] For example, social security payments are treated as taxes on factor income, not as household income. Hence, this leakage is subtracted from the flow of factor income disbursed to households. The SAM framework treats factor income paid outside of the region as a leakage from factor income, not household income. Accounting for these leakages out of factor income explains why household income multipliers differ from factor income multipliers.

one unit of exogenous expenditure placed on (or one unit of exogenous income transferred to) sector *j*. The j^{th} column vector of multipliers $\mathbf{M_j}$ captures the impacts of an exogenous shock to the j^{th} account on all endogenous accounts in the SAM. The diagonal multiplier m_{jj} measures the direct impact of the shock to the initial sector *j*. The other off-diagonal multipliers m_{ij} represent the indirect impacts of the shock affecting the other industries, the returns to factors, and household incomes by type of household. Keeping in mind the graph of the circular flow of economic activity found in basic economics texts, the SAM multiplier model is able to account for the effects of an exogenous shock at all the different points in the endogenous circular flow, regardless of whether the shock first affects a particular firm, factor, or household (or set of firms, factor, or households).

Sectoral labor requirements for the production activities in the SAM are calculated as

$$\mathbf{l} = \mathbf{L} \cdot (\mathbf{M_A} \cdot \mathbf{w}) \qquad (4)$$

where **l** is the Hadamard product of **L**, the vector of sectoral labor/output ratios, and ($\mathbf{M_A} \cdot \mathbf{w}$), the vector of sector outputs supporting equilibrium in equation (3).[92] Elements in **L** are expressed as the number of jobs required to produce $1 million worth of output for each production activity in **A**; $\mathbf{M_A}$ is the 13x19 submatrix of interindustry, factor income, and household expenditure multipliers in **M** that affect 13 production activities.[93, 94]

Given the accounting equilibrium in equations (3) and (4), equations (3′) and (4′) express the endogenous responses to the exogenous shock $\Delta\mathbf{w}$: [95]

$$\Delta\mathbf{z} = \mathbf{M} \cdot \Delta\mathbf{w} \qquad (3')$$

$$\Delta\mathbf{l} = \mathbf{L} \cdot (\mathbf{M_A} \cdot \Delta\mathbf{w}) \qquad (4')$$

Strictly speaking, $\Delta\mathbf{l}$ represents the induced changes in labor demand. Although these simulations project increases or decreases in labor demand, *ex post* changes in actual employment levels cannot be assessed by this framework.

The SAM multiplier model in equations (1)-(4′) represents the most general case of fixed-coefficient, linear multiplier models. It is considered as the benchmark multiplier model. Extended input-output models (such as Type II, Type III, and Miyazawa multiplier models) represent partial closures of multisectoral equilibrium (Pyatt, 2001). These latter models either do not capture the full impacts, or, depending on the parameters used, produce approximations that may understate or overstate the impacts (Holland and Wyeth, 1993).

Finally, the results from our simulations must be interpreted with some caution. As a member of the family of fixed-coefficient linear multiplier models, the SAM model assumes that the supply response is perfectly elastic. This assumption describes an economic environment without scarcity. That is, there always exist unemployed resources sufficient to meet the new demands projected by our simulations. Moreover, if there exists an input supply bottleneck in the regional economy, then the industry is

[92] If $\mathbf{A} = (a_{ij})$ and $\mathbf{B} = (b_{ij})$ are each *m*x*n* matrices, their Hadamard product is the *m*x*n* matrix of elementwise products $\mathbf{A} \cdot \mathbf{B} = (a_{ij}b_{ij})$.

[93] The dimensions of **M** are 19x19 for the national SAM and 18x18 for each of the three regional SAMs.

[94] The SAM production multipliers include induced effects and, therefore, are larger than Leontief input-output multipliers. One can use the Pyatt-Round decomposition to recover the input-output multipliers from the SAM production multipliers (Pyatt and Round, 1979).

[95] The vector $\Delta\mathbf{w}$ could easily represent a matrix in which each column $\Delta_{\mathbf{wj}}$ represents a single scenario. In this case, each column of the matrices $\Delta\mathbf{z}$ and $\Delta\mathbf{l}$ represents the results of a single simulation.

assumed to be able to costlessly import the good from outside the region. This assumption means that we interpret our output and job estimates represent at best as upper bounds of a positive endogenous response and lower bounds of a negative endogenous response.[96] In an economywide framework that allows for scarce inputs to flow to their most profitable uses, the estimates of the impacts of abolishing the CRP would be lower.

Modeling Urban-Rural Differences

We decompose the regional results into impacts on the urban economy versus the rural economy for the Northern Plains Crescent and the Southern Ellipse. Given our regional SAM models, we construct "rural" SAM models that just include the nonmetro counties embedded the regional models and exclude the metro counties. Then, we analyze the effects of removing the CRP using these two rural models. The differences in employment and output between the two models represent the urban impacts of removing the CRP in these two regional economies. We use the job/output coefficents for the regional and rural models to construct the job leakage statistics reported in Figure 4.3 (see Vogel, 2003).

[96] Another assumption that prices do not change in response to an exogenous shock is quite appropriate for the models of the regional economies, since prices are determined outside their borders. The fixed-price assumption does not cause undue harm to simulations using the national model, since the size of the CRP shock is less than 0.01 of 1 percent of aggregate national income. If the shock were larger, the policy analyst would anticipate larger price changes creating larger effects in output and factor markets that could not be captured in this framework.