# Policy Interactions at the Farm Level: An Evaluation of Participation in the Conservation Reserve Program and Related Policy Decisions*

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**Abstract**

We evaluate participation in the Conservation Reserve Program and its relationship with time allocation and farm structure. We do not find a statistically significant link between enrollment of acreage in the CRP program and off-farm work effort. We do find important linkages among time allocation and farm structure.

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# Policy Interactions at the Farm Level: An Evaluation of Participation in the Conservation Reserve Program and Related Policy Decisions

The U.S. federal government offers a very wide array of policy instruments intended to address a number of perceived problems and issues in agriculture while, at the same time, providing substantial support to agricultural producers. Individual policy instruments within this array do not always operate in consistent ways. In particular, some policies may lead to one effect while other policies have the opposite effect. A good example involves many of the conservation programs. Policies such as the Conservation and Wetlands Reserve Programs address conservation concerns by taking farm assets out of production while many other programs tend to encourage production. This problem may be intensified in areas with higher production and yield risk, since such higher risk is commonly believed to coincide with more fragile production conditions. In particular, conventional wisdom maintains that those areas with the highest production risk also tend to be the most susceptible to soil erosion and land degradation.

The potential for such policy conflicts has not gone unnoticed in the empirical literature. Goodwin and Smith (2003) considered the particular case of crop insurance, disaster relief, and the conservation reserve program. They argued that crop insurance, disaster assistance, and other production-oriented programs tended to encourage cultivation in areas sensitive to soil erosion while the Conservation Reserve Program (CRP) worked at opposite goals. However, their results tended to suggest that, although conventional price supporting programs tended to have large production effects, crop insurance and disaster assistance had relatively small direct impacts on soil erosion. Goodwin, Vandeveer and Deal (2004) considered the acreage effects of crop insurance programs and found that the effects were very modest in the Corn Belt but more moderate in the Upper Great Plains.

Existing work has largely focused on aggregate analysis-typically at the county level. Important policy interactions may be difficult to identify in such an analysis. In addition, the policy landscape has changed substantially in recent years. The 1996 and 2002 Farm Bills brought about significant changes in policies, including production flexibility and a shift toward conservation efforts on working operations. In addition, the 2000 Agricultural Risk Protection Act (ARPA) significantly expanded crop insurance offerings. This paper utilizes farm-level data from the Agricultural Resource Management Survey (ARMS) project to consider policy interactions at the farm level. We focus on the 2002-2005 period, during which agriculture was governed by the terms of the 2002 legislation. We utilize farm-level data over this period to jointly model production decisions (acreage and crop choice), conservation activities (conservation investments, land set-aside, and participation in conservation programs), and participation in other programs including the federal crop insurance program. These data are combined with county-level data on several important variables, including yields and farm program payments, collected from NASS and the FSA.

The CRP program was established by the 1985 Food Security Act. Over its first few years of existence, the CRP program removed about 34 million acres of "highly-erodible" farmland from production. Eligibility for participation in the CRP program requires that the land satisfy an "Environmental Benefits Index" (EBI), which ranks land according to its sensitivity to erosion as well as other environmental factors such as wildlife and air quality. Enrollment has been limited to be no more than 25% of the total cropland in a given county. Nationwide, about 240 million acres of cropland is eligible for participation in the CRP. Enrollment has remained fairly constant at about 35 million acres since the program's inception. However, the program has come under scrutiny in recent months as bio-energy and ethanol incentives have raised questions about land retirement programs. Corn acreage is predicted to rise by 12.1 million acres in 2007, exceeding 90 million acres nationwide. High corn prices and the significant expansion in acreage has led many to question land retirement programs. These issues will undoubtedly play an important role as the 2007 Farm Bill is deliberated.[1]

The objective of this paper is to consider policy interactions at the farm level. In earlier

[1] CRP and corn acreage statistics taken from unpublished USDA data.

research, Goodwin, Mishra and Kimhi (2006) considered the interactions of farm-level policies, farm structure, and the time allocations decisions of farm operators and their spouses. As they note, existing theoretical and empirical research addressing the effects of farm policy has largely focused on the *farm business* as the relevant unit of analysis rather than the *farm household*. Indeed, this myopic view has characterized many dimensions of the farm policy discussion. The decision-making framework may become much more complex and thus the implications more clouded when one broadens the consideration of policy impacts to include those impacts on the nonagricultural segments of the farm sector. It is, of course, the farm household that is the relevant decision-making unit and thus considerations of the effects of farm policies or other exogenous shocks must consider the household as a whole rather than focusing only on the farm business. It is widely recognized that a substantial share (the majority for most farms) of farm household income comes from off-farm sources. Off-farm labor earnings are an important component of the typical farm household's total income. To the extent that wealth and income changes affect an individual's labor decisions, one avenue by which direct wealth transfers, a common component of "decoupled" farm programs, may influence agricultural production is through their effects on the allocation of time among on-farm labor, off-farm labor, and leisure. An understanding of farm household labor allocation decisions is central to any consideration of the effects of farm policies on the overall structure of the agricultural sector.

Goodwin et al. (2006) suggested important implications for the effects of farm policies on the structure of farms. However, although their research identified an important mechanism by which coupled and decoupled farm programs may affect output, they neglected to consider one important dimension to U.S. farm policy—conservation programs. Rather than changing the scale of a farming enterprise as a result of policy benefits, farmers operating in today's policy environment may instead choose to place their land in conservation reserve programs.

Our objective is to extend the earlier research of Goodwin et al. (2006) to include a consideration of conservation reserve programs. We use a a multi-equation, semi-structural model that includes farm structure equations, time allocation, and participation in the CRP program. Our overarching goal is to consider the extent to which participation in farm asset retirement programs such as the CRP has effects on the time allocation decisions of farm operators and their spouses. One might expect that farmers who place their land in the CRP have more incentive to work off-farm and, likewise, that farm operators who work off the farm are more likely to place their land in set-aside programs.

# The U.S. Farm Policy Environment

The CRP program was established by the 1985 Farm Bill. As noted, the program has removed approximately 34 million acres of U.S. farm land from production. Landowners are given an annual rental payment in exchange for enrolling the land in the program. In addition, other financial incentives, including cost sharing for conservation improvements, are provided to landowners enrolling in the program. The program has undergone modest changes in recent years but has survived through succeeding farm bills. Sullivan, Hellerstein, Hansen, Johansson, Koenig, Lubowski, McBride, McGranahan, Roberts, Vogel and Bucholtz (2004) point out that the CRP program may provide important incentives for farmers to leave production agriculture and thus may have negative consequences for the financial wellbeing of rural farm communities. In particular, they note that the CRP program may make it easier for farmers to retire from farming and potentially to relocate to another area. This, in turn, may lead to a drop in rural populations and a resulting loss of rural infrastructure, which could lead to even greater migration away from farming communities. Figure 1 illustrates CRP enrollment patterns for 2004—the most recent year for which data are available. Note that participation appears to be concentrated in the Great Plains states.

As we have noted, other policy effects on the structure of farm households and rural communities are possible. The provision of government support for removing assets from production may be to encourage another form of migration off the farm—a reallocation of labor effort into off-farm employment. This aspect of reallocating resources away from farming may have very different implications for rural communities. Rather than bringing about an exodus of population, increased participation in off-farm employment may actually benefit rural communities.

Other aspects of recent farm legislation also have important implications for the structure of U.S. agriculture. Several specific provisions of the 1996 FAIR Act brought about significant changes in U.S. agricultural policy. Perhaps the most significant change involved the elimination of production constraints (and acreage base requirements) and the concomitant movement toward direct support that was not tied (or "coupled") to production decisions. In theory, such decoupled support was believed to be less distorting to markets in that there was no production requirement to be eligible for the payments. The intended "transition to the market" was reflected in a series of direct payments, which were based upon historical production and were not tied to market conditions or current production. In a manner that reflected their supposed role in policy reform, these payments were referred to as "Agricultural Market Transition Act" or AMTA payments. A schedule of payments was established for each program crop and the payment rates were set to decline each year through the end of the legislation in 2002.

A full appreciation of the policy environment of the time as well as that which followed requires consideration of the general state of agricultural markets and the U.S. agricultural economy as the FAIR Act was being deliberated and implemented. Figure 1 illustrates the development of real ($2005 terms) net farm income less total direct government payments—a measure of net returns from the market (with an adjustment having been made for government payment receipts).[2] Note that, in the early 1990s, despite a degree of year-to-year volatility, net income remained strong and robust. Figure 1 also presents total direct government payments as a proportion of net farm income from the market. The diagram also illustrates the fact that government payments, as a percentage of total farm income, remained relatively low in the years leading up to the 1996 FAIR Act.

Several events in the latter half of the decade brought about some rather significant changes in the views of U.S. agricultural policymakers. Demand for U.S. agricultural exports fell significantly over the latter part of the decade, due in part to the Asian financial

[2] The statistics presented in Figure 1 were taken from the *Economic Report of the President, 2006*.

crisis and relatively strong growing conditions elsewhere in the world. The U.S. agricultural trade balance fell from $26.8 billion in 1996 to only $10.7 billion in 1999.[3] This general collapse of agricultural markets and overall malaise in the U.S. agricultural economy made the reform rhetoric of just a few years previous much less palatable to U.S. policymakers. Congress quickly retreated from the market reforms implied by the 1996 legislation and instituted a number of ad-hoc measures intended to direct funds to U.S. farmers. Much of this support was conveyed through "market loss assistance" payments, which were ad-hoc, direct payments made to producers as compensation for the financial losses brought about by weak markets. Figure 1 illustrates the substantial increases in government support for U.S. farmers in the latter part of the 1990s. Between 1997 and 1999, the ratio of payments to net market income rose from under 0.10 to over 0.45. Some debate ensued as to the extent to which these ad-hoc payments were decoupled. Market loss assistance payments were based upon the decoupled market transition payments and thus did not require current production in order to be eligible. However, the payments were deemed to have been triggered by low market prices and thus, under the terms of the Uruguay Round WTO Agreement, were considered to be tied to markets and thus "amber-box" support.

The extent to which the FAIR Act actually constituted a change in U.S. farm policy became especially questionable with the implementation of the 2002 Farm Bill. The 2002 Farm Bill, which was signed into law on May 13, 2002, provided generous increases in support and extended the fixed, decoupled AMTA-type payments for another six years. Not only were the payments extended under the 2002 Act, producers were also given the opportunity to update their base acreage and yields which determine the payments and, perhaps more important, to include historical soybean acreage in their base. Provisions for updating this historical base led many to question the extent to which fixed, direct payments are actually decoupled. In the end, the 2002 Farm Bill provided generous support, which was scored by the Congressional Budget Office at over $190 billion for the ten-year period which follows the Act. The 2002 Act, which currently governs U.S. farm policies, provided

[3] Unpublished data taken from USDA sources.

three primary mechanisms for support—fixed, direct (decoupled) payments; counter-cyclical payments (which are largely analogous to the ad-hoc market loss assistance payments which preceded the 2002 Act); and loan-deficiency (coupled) payments, which are paid on a per-unit basis and thus are directly tied to production.

## Time Allocation and Farm Structure: Conceptual Issues

An extensive literature has addressed issues pertaining to the time allocation decisions of farm households. This line of research has taken on new importance in recent years in light of an increasing focus on the economic status of the entire farm household and the ever-increasing dependence of farm households on non-farm employment opportunities. The general line of enquiry undertaken in these studies parallels that which characterizes the wide body of research evaluating the determinants of labor supply. Individuals choose to allocate their time among competing work and leisure activities according to the relative returns offered by each activity. These returns, in turn, are determined by an individual's talents and abilities, preferences, wealth, risk attitudes, and other factors pertinent to utility maximization choices. Of course, when one considers choices among multiple job opportunities, more time spent in one activity usually implies less time available for others. In the case of agricultural households, more time spent working off the farm or in consuming leisure generally will imply that less time will be spent in farming.

This shift in time (and potentially other) resources away from farming may have important implications for structural aspects of any individual farm. For example, the gradual shift in population and labor out of the farm sector has corresponded to a concomitant increase in average farm sizes and greater specialization in farm enterprises.

A number of studies have considered the relationship of individual farm and operator factors to the allocation of time by farm households. Schultz (1990) noted that off-farm employment was an important mechanism by which farm households could diversify their income. Mishra and Goodwin (1994) confirmed this role and found that farmers with significant farm income risk were more likely to pursue off-farm employment opportunities. A number of studies have considered various demographic factors that are relevant to the time allocation decisions of farm operators and their spouses. Factors such as age, farm and non-farm work experience, education, and household size have been found to be significantly related to the extent of off-farm work (see, for example, Mishra and Goodwin (1997), Goodwin and Mishra (2004), Kimhi (1996), Goodwin and Holt (2002), Furtan (1985), Huffman and Lange (1989), Lass and Gempesaw (1992), and Sumner (1982)). In addition, a number of farm characteristics have been demonstrated to be significantly related to off-farm work decisions. Factors such as farm size, tenancy, enterprise choice, diversification, and financial leverage have all been found to be related to time allocations decisions.

The potential for farm structure and other characteristics of farming operations to be endogenous to off-farm labor decisions has received considerably less attention in the empirical literature. Goodwin and Mishra (2004) considered the possibility that farming "efficiency" could be endogenous to the off-farm labor choice. Although they acknowledged the difficulties associated with measuring farming efficiency, they found that farms with operators that tended to devote considerable time to off-farm work also tended to be "less-efficient," where efficiency was measured using a ratio of revenues to costs. Ahituv and Kimhi (2006) found that farm activity and non-farm work effort were jointly determined and that farmers that had increased the scale of their operation have tended to work less of the farm. In contrast, farms that had downsized the scale of their farm operation had tended to work more off the farm. Ahituv and Kimhi (2002) found that the capital holdings of farmers tended to be endogenous to their off-farm work decisions. McNamara and Weiss (2005) found that farm enterprise diversification and the diversification of on-farm and off-farm earnings for a sample of Austrian farmers tended to be affected by the same general household, farm, and operator characteristics. This implies that the diversification of a farm could be jointly determined with labor allocation decisions. Fernandez-Cornejo, Gempesaw, Elterich and Stefanou (1992) investigated scope and scale economies for a sample of German dairy farms and found that the scale of land and other inputs tended to be important determinants of economies of scale and scope. Their analysis, however, stopped short of considering the relationship of scale and scope with time and labor allocation decisions.

## Empirical Analysis and Results

Our analysis is conducted using individual farm data collected under the Agricultural Resource Management Survey (ARMS) project by the National Agricultural Statistics Service of the USDA. The ARMS data are collected annually by means of a survey of individual farmers. The ARMS data represent the USDA's primary source of information about U.S. agricultural production conditions, marketing practices, resource use, and economic well-being of farm households. We focus on data taken from 2003 and 2004. These two years were characterized by a common policy environment—the 2002 Farm Bill. In addition, the ARMS surveys collected detailed data regarding off-farm employment by farmers and their spouses, as well as many operator characteristics conceptually related to off-farm work. Although the ARMS data provide a rich and valuable set of detailed farm household data, the database does have an important limitation—the lack of repeated sampling on individual farms. That is, the sample is taken randomly each year and it is thus impossible to observe the same farm in more than a single year. This implies an important reliance on cross-sectional variability and prevents one from conditioning observed events on the preceding year's experience or on fixed farm effects. In addition, identification issues may be complicated by an inability to condition on variables that are clearly predetermined (i.e., observed in previous time periods).

A variety of other sources were used to collect data pertinent to farm structure and labor market conditions. County-level unemployment rates were collected from the Bureau of Labor Statistics (BLS). Opportunities for off-farm employment will be reflected in this measure of local labor market conditions. We collected annual, county-level measures of total farm sales (cash receipts from marketings) and total production expenses from the Bureau of Economic Analysis (BEA) Regional Economic Information System (REIS). From these data, we calculated implied market rates of return to farming (measured as the log of the ratio of the sum of gross sales to the sum of total costs) for the period covering 1990-2002. We also calculated the standard deviation of this measure of farming returns over the 1970-2002 period to represent the inherent volatility (and riskiness) of agriculture in the county.

A key focus of our analysis involves the role of government policy on farm structure and off-farm labor supplies. We collected farm program payment data for each county from unpublished Farm Service Agency (FSA) sources for the period covering 1990-2002. We grouped the payment data into three aggregated categories—coupled payments, direct (decoupled) payments, and all other payments. Table 1 presents a listing of the specific programs and our categorization. In general, coupled payments included deficiency and loan deficiency payments and marketing loan gains. Direct payments included AMTA payments, direct payments, and ad-hoc market loss assistance payments—all of which have no direct production requirements for eligibility. Finally, all other farm program payments including disaster relief were grouped in a residual category. It is important to acknowledge that payments made under some programs may be difficult to classify. For example, market loss assistance and counter-cyclical payments are decoupled in that they do not have production requirements but are of a coupled nature in that they are triggered by low market prices.

Our intent is to capture payment expectations—which should be the primary factor influencing producer decisions. In that realized farm program payments vary substantially from year-to-year, receipts in any single year may not be representative of the expected value of payments. We sum payment receipts in each category over the 1990-2002 period and then use farm acreage for the county reported in the 2002 *Agricultural Census* to place the payments on a per-acre basis. CRP rental payments and incentives were placed on a per-CRP-acre basis by dividing through by the 2005 enrollment statistics collected from the FSA.

We used the 1997 and 2002 *Agricultural Census* data to construct a number of county-level measures representing the aggregate structure of the agricultural sector in each county. This included shares of the total value of production for various product groups, the scale of agriculture (in terms of the total value of sales) in the county, and changes in the structure of agriculture in the county from 1997 to 2002. All financial values are converted to real terms by dividing by the consumer price index.

A number of important econometric issues underlie our empirical analysis. An important characteristic of the ARMS data relates to the stratified nature of the sampling used to collect the data. Two estimation approaches have been suggested for problems such as this involving stratification. The simplest involves a jacknife procedure, where the estimation data are split into a fixed number of subsamples and the estimation is repeated with each subsample omitted. An alternative approach involves repeated sampling from the estimation data in a bootstrapping scheme. Ideally, rather than random sampling from the entire estimation sample, an appropriate approach to obtaining unbiased and efficient estimation results involves random sampling from individual strata (see, for example, Deaton (1997)). In the ARMS data, however, this is not possible since the strata are not identified. The database does, however, contain a population weighting factor, representing the number of farms in the population (i.e., all U.S. farms) represented by each individual observation. This can be used in a probability-weighted sampling scheme whereby the likelihood of being selected in any given replication is proportional to the number of observations in the population represented by each individual ARMS observation. We utilize a probability-weighted bootstrapping procedure.

The specific estimation approach involves selecting $N$ observations (where $N$ is the size of the survey sample) from the sample data. The data are sampled with replacement according to the probability rule described above.[4] The models are estimated using the pseudo sample of data. This process is repeated a large number of times and estimates of the parameters and their variances are given by the mean and variance of the replicated estimates.[5]

[4]To be precise, if observation $i$ represents $n_i$ farms out of the total of $M$ farms in the population, the likelihood that observation $i$ is drawn on any given draw is $n_i/M$. It should be acknowledged that our approach may result in less efficient estimates than would be the case were sampling from individual strata possible. This could occur in cases where inferences are being made about variables used in designing the stratification scheme in that such information is being ignored by not drawing from individual strata. To the extent that this is relevant to our analysis, the t-ratios reported below represent conservative estimates.

[5]We utilize 1,000 replications in the applications which follow.

An important econometric issue also involves the fact that a censoring issue underlies several of the individual equations to be estimated in our analysis. In particular, our measure of farm scope—an index of diversification—is censored at zero for single-enterprise farms. In addition, CRP participation is censored for zero for farms that do not participate and off-farm labor supply is censored at zero for individuals who do not work off the farm. Procedures for estimating simultaneous equation models with censored endogenous variables have been proposed by Amemiya (1979), Nelson and Olson (1978), Lee, Maddala and Trost (1980), Newey (1987), and Vella (1993). Nelson and Olson (1978) suggested a simple two-stage procedure where the endogenous right-hand side variables are replaced by the $X\beta$ index implied by standard maximum likelihood Tobit estimates of a first-stage regression of the censored variable on an instrument set. However, Nelson and Olson's estimator understates the true variance associated with the second-stage parameter estimates in that it ignores the uncertainty associated with estimation of the first-stage. Maddala (1983) notes that an analytical solution for the exact covariance matrices of the second stage estimates may be very complex. We instead utilize our probability-weighted bootstrapping procedures to derive covariance estimates of the second stage parameter estimates.

Our specific empirical analysis consists of a four-equation simultaneous equations system. The first two equations represent off-farm labor participation decisions for farm operators and their spouses. Note that our analysis was limited to only those farm households with both an operator and a spouse. We hypothesize that off-farm labor supply is related to education, age, farming experience, local labor market conditions (unemployment), the mean and standard deviation of returns to agricultural production, household size, farm program payments, and the size and scope of the agricultural operation.[6] Size and scope are the structural variables which we allow to be endogenous to one another and to off-farm labor supplies. We also allow the farm operator's off-farm labor supply to be endogenous to the spouse's labor decisions and vice versa. We measure the overall scope of a farming operation in terms of its diversification across alternative crop and livestock enterprises. In particular,

[6]Note that the reporting of age for spouses was incomplete and thus we use the operator's age in both the operator and spouse equations.

we adopt a Herfindahl-based index of diversification, given by

$$H_i = 1 - \sum_{j=1}^{J} w_{ij}^2, \tag{1}$$

where $w_{ij}$ is the share of the total value of output accounted for by enterprise $j$ on farm $i$. For a farm of a single enterprise, $H_i$ will be zero. However, $H_i$ approaches one for very diversified farms. Note that this measure of scope is censored from below at zero and thus also requires estimators that recognize such censoring. We assume that farm scope for an individual farm will reflect government program payments at the county level, a measure of the overall diversification of agriculture in the county (which represents environmental and local market conditions that influence the potential and profitability of diversification on a farm), and the overall production patterns (represented by shares of production value accounted for by certain commodity categories at the county level).

As a measure of farm scale, we utilize the total acres operated on the farm. We are assuming that total land holdings will be adjusted in response to changes in the relative returns to alternative agricultural and non-agricultural enterprises. In light of the substantial prevalence of rental arrangements in U.S. agriculture, farm size is likely to be frequently adjusted in response to changes in policies and other exogenous factors.[7] It is also possible however, that total farm size is relatively fixed in the short-run and that farm owners and operators may choose simply to idle land and other resources. In addition, the ARMS survey considers land that is enrolled in conservation set-aside programs and land that is otherwise idled to still be part of a farm operation. Finally, acreage operated may not be an ideal measure of the overall scale of a farm operation for some farms—especially in the case of livestock operations, which utilize land resources in ways that differ from crop farms.

As an alternative, we also consider a second analysis that is limited only to crop farms. Farms are classified according to the value of their production as being primarily crop or livestock operations. Of our sample of 12,935 farms, 6,809 were defined as crop farms. We utilized the number of crop acres *harvested* in each year as a second measure of scale. This

[7] The 2002 *Agricultural Economics and Land Owners Survey* determined that approximately 45% of U.S. farmland is operated by a tenant.

provides a more direct representation of the short-run scale of an individual operation. In addition, whereas holdings of farm acreage may be relatively hard to adjust in the short-run, crop acreage can be easily idled in response to market conditions, policies, or non-farm alternatives. We assume that farm scale is influenced by factors pertinent to the profitability of agriculture in the county (both mean and standard deviation), the average scale of farms in the county, output per acre in the county, farm program payments, farm diversification, and off-farm labor market participation by operators and their spouses.

## Results

Table 2 presents variable definitions and summary statistics for the complete sample, which consists of 2,778 farm households consisting of a farm operator and a spouse. The sample was selected from the wider ARMS sample on the basis of the completeness of survey responses. In particular, a limiting factor for many surveys involved incomplete responses for characteristics of the spouse. We limited our sample to crop farms and dropped any farms in counties for which the implied CRP payments per acre exceeded $1,000 in 2004. The average farm in our sample consists of 1,264 acres and the average operator was 53 years of age, with 24 years of farming experience, and came from a household with 3 family members. Farm operators worked an average of about 519 hours per year while the spouses worked an average of about 1,025 hours in off-farm employment activities over a year.

Table 2 presents bootstrapped parameter estimates and summary statistics for the CRP acreage enrollment equation. Only about 17.7% of the farms enrolled to some extent in the CRP program. The results indicate that larger farms are more likely to enroll in the CRP program. This reflects a scale effect (larger farms necessarily have more acres). Surprisingly, there does not appear to be any statistically significant relationship between off-farm work by operators and their spouses and enrollment in the CRP program. In both cases, hours worked do not have a significant effect on acres enrolled in the CRP program. We do find that the share of farm sales accounted for by livestock commodities (in the 2002 *Agricultural Census*) do tend to correspond to more enrollment in the CRP. Livestock operations are more highly concentrated in less productive crop regions and thus this likely reflects the lower productivity of land on such operations. As expected, a positive relationship exists with respect to CRP incentives and payments—higher payments trigger greater incentives to enroll.

Table 3 presents bootstrapped parameter estimates and summary statistics for the off-farm labor supply equations for farm operators and spouses taken from all farm types and the entire sample. In most cases, the estimates are highly significant and conform to expectations. In both the operator and spouse cases, off-farm work by one individual tends to be correlated with an increased off-farm work effort by the other individual. This is consistent with expectations in that spouses tend to share similar attitudes, opportunities, and constraints regarding off-farm employment. Participation in off-farm labor markets appears to diminish significantly with age, especially in the case of farm operators. Off-farm work is positively related to education, reflecting the improved opportunities and higher wages available to individuals with more education. The education variables, which represent different categories of increasing levels of education, show that off-farm work rises with each level of education, with the highest levels of participation being realized for farm operators and spouses with graduate degrees. The effect of education appears to be substantially stronger for spouses than is the case for farm operators in that the education coefficients are substantially larger.[8] The unemployment rate in the county has a negative effect on the degree of participation in off-farm labor markets by spouses, though it narrowly misses being statistically significant. In contrast, farm operators' off-farm work efforts are not significantly affected by the county-level unemployment rate. This suggests that spouses' labor supply may be more volatile in response to the diminished work opportunities implied by higher rates of unemployment. Spouses from larger households are less likely to work off the farm, a result that likely reflects the child care obligations that typically are more substantial in larger farm households. Household size does not appear to have a significant impact on farm

[8]Note that an adequate approximation for marginal effects at the mean values of the data in a Tobit model can be derived by scaling the parameter estimates by the proportion of noncensored values in the data—0.54 for operators and 0.60 for spouses. The similarity of these proportions suggests that direct comparisons of the coefficients across the equations will not be misleading.

operators' participation in off-farm labor markets. More farming experience, a factor that would be expected to be correlated with returns to farming, is associated with less work off the farm.

The results reveal several interesting findings in relation to the effects of agricultural market conditions on labor supply. A higher rate of return to farming appears to significantly diminish farm operators' participation in off-farm labor markets—a finding consistent with the fact that such a condition raises the relative returns to on-farm work. In contrast, spouses' off-farm work decisions do not appear to be significantly affected by the average rates of return to agricultural activities. Perhaps of greatest interest are the effects of farm program payments on the labor allocation decisions of farm households. In the case of farm operators, off-farm labor is only affected by the "all other payments" category. In that case, more payments are correlated with less off-farm work. In the case of spouses, more coupled payments tend to lead to more off-farm work while more direct, decoupled payments tend to be associated with less off-farm employment. The wealth transfers implied by direct payments may lead to a diminished work effort and the consumption of more leisure. At first glance, the positive relationship between coupled payments and the off-farm labor supply of spouses is harder to explain. However, it is important to recognize that we are conditioning off-farm labor supplies on our farm structure variables which represent size and scope. We expect that increased coupled payments will increase farm size (discussed below) and thus potentially decrease off-farm labor supplies (as more labor is directed to the farm). This additional effect on off-farm labor supplies may represent increased specialization within the household, as spouses allocate more effort off the farm.

The results also reveal interesting results for the effects of farm structure on off-farm labor efforts. In the case of the farm operator, larger farms tend to lower the extent of participation in off-farm labor markets. This is not surprising in that the labor demands associated with farms of increased size and scope should result in an allocation of the farm operator's labor away from off-farm work. In the case of spouses' off-farm work, farm size does not have a significant influence on the work decision. In contrast, increased diversification tends to be associated with more work off the farm by spouses. This may reflect the fact that off-farm work by spouses is an additional diversification measure that may be undertaken, along with diversification of the farm enterprise, to better manage farm risk. Thus, it is not surprising to find such diversification through participation in off-farm labor markets occurring on farms that are also highly diversified in terms of farm output.

Table 4 presents bootstrapped parameter estimates and summary statistics for our two farm structure measures—size (acres operated) and scope (diversification). In the case of farm size, we find reinforcement for the relationship between labor allocation and scale in the off-farm labor supply equations. More acreage tends to be operated for farms having operators that do not work off the farm but spouses that do participate in non-farm labor markets. Farm program payments also tend to have important impacts on farm structure. Direct payments tend to be associated with less acreage being operated. This may reflect the presence of important wealth effects, implying that less effort is directed to farm labor (and thus farm scale) as more leisure is consumed. As expected, coupled payments are correlated with larger farms. Payments tied directly to production raise farm returns and thus would be expected to lead to larger farms. Other types of farm program payments, largely representing disaster relief, are correlated with larger farms. More highly diversified farms tend to be larger, possibly reflecting greater land demands associated with diversified production. Table 4 also contains parameter estimates for the farm diversification equation. In this application, farm diversification only appears to be responsive to variables representing the composition of the county in terms of crops produced and changes over time.

In short, the results demonstrate that there are important interrelationships among farm structure, farm program participation, farm households' time allocation decisions, and farm payments. Direct farm payments tend to be associated with less off-farm work and less acreage in production. This may suggest that, in contrast to arguments in favor of substantial production effects, decoupled farm program payments tend to be associated with a smaller work effort both on the farm and in off-farm markets. This may reflect a wealth effect that corresponds to an increased consumption of leisure in response to policy-driven wealth transfers. Coupled payments directly influence the returns to farming and thus are expected to be positively correlated with the size of farms and negatively correlated with off-farm labor supplies—at least for farm operators. Our results are consistent with these expectations and also suggest that payments tied to production are correlated with larger, more specialized farms. We do not find important linkages between off-farm work and participation in the CRP program—the evaluation of which was a major objective of this research. The topic certainly merits additional consideration and evaluation.

## Concluding Remarks

Our analysis has considered relationships among CRP enrollment, time allocation for farm operators and their spouses and endogenous farm structure. We considered two aspects of farm structure—farm scale and farm scope. In the case of scale, we consider two alternative measures. The first considers total acreage under operation for all farm types while the second focuses on harvested acreage for crop farms. Several important conclusions emerge from our analysis.

Our results do not suggest a statistically significant link between land set-asides occurring as a result of participation in the CRP program and time allocation decisions. We do find that other aspects of farm structure and household time allocations are significantly related to one another. In general, operators on larger and more diversified farms tend to work less off the farm. Size may be endogenous to off-farm work decisions in that farms tend to also be smaller when farmers pursue off-farm work opportunities. The converse is true for the operators' spouses. Farms with spouses that spend considerable effort working off the farm tend to actually be of a larger scale.

Perhaps of greatest significance are our results linking policy expectations (measured through long-run averages of payments at the county level) with farm structure and time allocation. Direct (decoupled) payments tend to be associated with less off-farm work by spouses, a smaller scale of production, and more diversification. This result has relevance to the ongoing debate over the production neutrality of decoupled payments. Coupled payments tend to be associated with more off-farm work by spouses and larger farms, thus suggesting a positive effect on farm labor (at least to the extent that larger farms demand more labor from an operator).

Table 1. Variable Definitions and Summary Statistics[a]

| Variable | Definition | Mean | Standard Deviation |
|---|---|---|---|
| Household Size | Number of household members | 3.0810 | 1.4353 |
| Acres Operated (thousands) | Total number of farm acres operated | 1.2635 | 1.8695 |
| Operator Farming Experience | Years of farming experience of operator | 26.4680 | 13.6311 |
| Spouse Farming Experience | Years of farming experience of spouse | 6.5360 | 12.6661 |
| Operator Age | Age of operator | 53.1796 | 11.9050 |
| Farm Scope | 1 - Herfindahl index of farm diversificaiton, defined by values of output | 0.3373 | 0.2569 |
| Operator $\text{Education}_2$ | High school education or equivalent | 0.3704 | 0.4830 |
| Operator $\text{Education}_3$ | Some college | 0.2822 | 0.4502 |
| Operator $\text{Education}_4$ | College degree | 0.2221 | 0.4157 |
| Operator $\text{Education}_5$ | Graduate degree | 0.0515 | 0.2210 |
| Spouse $\text{Education}_2$ | High school education or equivalent | 0.3528 | 0.4779 |
| Spouse $\text{Education}_3$ | Some college | 0.2801 | 0.4491 |
| Spouse $\text{Education}_4$ | College degree | 0.2509 | 0.4336 |
| Spouse $\text{Education}_5$ | Graduate degree | 0.0724 | 0.2591 |
| Hours Operator | Annual total of hours of off-farm work (hundreds) | 5.1882 | 9.2021 |
| Hours Spouse | Annual total of hours of off-farm work (hundreds) | 10.2514 | 9.9260 |
| Mean Market Returns | Average agricultural rate of return 1990-2002, given by ln(revenues/costs) | 0.0033 | 0.1249 |
| Std. Deviation Market Returns | Standard deviation of agricultural rate of return, 1970-2002 | 0.1704 | 0.0639 |
| Total County Output Value 2002 | Total value of agricultural output in the county, 2002 ($million) | 0.1183 | 0.1877 |
| County Average Output per Farm | Average value of output per farm acre, 2002 | 13.1569 | 15.3878 |
| County Share of Grains | County-level share of market value of agricultural sales: grains and oilseeds | 0.3163 | 0.2739 |
| County Share of Tobacco | County-level share of market value of agricultural sales: tobacco | 0.0242 | 0.0913 |
| County Share of Cotton | County-level share of market value of agricultural sales: cotton and cottonseed | 0.0448 | 0.1261 |

[a]Number of observations is 12,935. Summary statistics weighted by population sampling weights.

Table 1. (continued)[a]

| Variable | Definition | Mean | Standard Deviation |
|---|---|---|---|
| County Share of Vegetables | County-level share of market value of agricultural sales: vegetables | 0.0462 | 0.1058 |
| County Share of Fruit | County-level share of market value of agricultural sales: fruits | 0.0340 | 0.1088 |
| County Share of Nursery Products | County-level share of market value of agricultural sales: nursery products | 0.0603 | 0.1304 |
| County Share of Poultry | County-level share of market value of agricultural sales: poultry and eggs | 0.0595 | 0.1549 |
| County Share of Cattle | County-level share of market value of agricultural sales: cattle | 0.1417 | 0.1815 |
| County Share of Dairy | County-level share of market value of agricultural sales: dairy products | 0.0807 | 0.1420 |
| County Share of Hogs | County-level share of market value of agricultural sales: hogs | 0.0544 | 0.0990 |
| County Share of Livestock | County-level share of market value of agricultural sales: all livestock | 0.4010 | 0.2550 |
| County Diversification | 1 - County-level Herfindahl index of diversification of agricultural sales | 0.5785 | 0.1705 |
| Change in Total County Output | Change in total agricultural county output, 1997-2002 | −0.2040 | 0.2347 |
| Change in Output per Farm | Change in agricultural output per farm | −0.1492 | 0.2339 |
| Unemployment Rate | County-level unemployment rate | 6.0666 | 2.0395 |
| County Average Output per Acre | County-level value of output per acre in 2002 | 0.3650 | 0.3373 |
| Coupled Payments | County average per farm acre for payments tied to production | 127.6718 | 118.2290 |
| Direct Payments | County average per farm acre for payments not tied to production | 125.6719 | 96.7473 |
| All Other Payments | County average per farm acre for all other government payments | 61.2673 | 39.7920 |
| CRP Payments | County average payments / CRP acre | 92.5413 | 81.9600 |
| County CRP Acres Enrolled | County total CRP Enrollment (ten-thousand acres) | 1.8090 | 3.5293 |
| CRP Acres Enrolled | Enrollment of CRP on-farm | 27.5187 | 189.3296 |

[a]Number of observations is 12,935. Summary statistics weighted by population sampling weights.

Table 2. CRP Program Participation Tobit Equation Estimates

| Variable | Parameter Estimate | Standard Error | t Ratio[a] |
|---|---|---|---|
| Intercept | −732.5754 | 154.5745 | −4.74* |
| Acres Operated | 247.9670 | 85.1239 | 2.91* |
| Operator Hours | −4.7532 | 3.5622 | −1.33 |
| Spouse Hours | −0.3338 | 4.6324 | −0.07 |
| County Share of Livestock | 108.8967 | 59.2133 | 1.84* |
| County CRP Acres Enrolled | 0.2531 | 0.1362 | 1.86* |
| CRP Payments | 13.9009 | 6.9458 | 2.00* |
| County Average Output per Acre | −14.9292 | 51.1449 | −0.29 |
| $\sigma$ | 415.7484 | 80.6776 | 5.15* |

[a]An "*" indicates statistical significance at the $\alpha = .10$ or smaller level.

Table 3. Off-Farm Labor Supply Tobit Equation Estimates

| Variable | Parameter Estimate | Standard Error | t Ratio[a] |
|---|---|---|---|
| Farm Operator | | | |
| Intercept | 3.3156 | 8.8678 | 0.37 |
| Spouse Hours | 0.4930 | 0.1187 | 4.15* |
| Age | 0.6497 | 0.3291 | 1.97* |
| $Age^2$ | −0.0086 | 0.0034 | −2.55* |
| $Education_2$ | 0.8465 | 1.6883 | 0.50 |
| $Education_3$ | −3.0712 | 1.9238 | −1.60 |
| $Education_4$ | 0.8738 | 1.8524 | 0.47 |
| $Education_5$ | 2.0481 | 2.0553 | 1.00 |
| Acres Operated | −4.0991 | 2.0238 | −2.03* |
| Farming Experience | −0.2247 | 0.0673 | −3.34* |
| Farm Scope | 5.6274 | 4.1657 | 1.35 |
| Unemployment Rate | 0.0075 | 0.2960 | 0.03 |
| Mean Market Returns | −8.2463 | 3.5665 | −2.31* |
| Std. Deviation Market Returns | −10.5979 | 8.7160 | −1.22 |
| Direct Payments | −0.0114 | 0.0238 | −0.48 |
| Coupled Payments | −0.0093 | 0.0208 | −0.45 |
| All Other Payments | −0.0250 | 0.0119 | −2.10* |
| Household Size | 0.3976 | 0.3374 | 1.18 |
| CRP Acres Enrolled | 0.0023 | 0.0028 | 0.84 |
| $\sigma$ | 16.1961 | 0.3233 | 50.10* |
| Spouse | | | |
| Intercept | −11.8836 | 8.0207 | −1.48 |
| Operator Hours | 0.3290 | 0.0764 | 4.31* |
| Age | 0.8531 | 0.2370 | 3.60* |
| $Age^2$ | −0.0101 | 0.0024 | −4.20* |
| $Education_2$ | 2.7684 | 1.7083 | 1.62 |
| $Education_3$ | 7.4952 | 1.7522 | 4.28* |
| $Education_4$ | 8.4386 | 1.8351 | 4.60* |
| $Education_5$ | 9.2298 | 1.8598 | 4.96* |
| Acres Operated | 1.4451 | 1.2516 | 1.15 |
| Farming Experience | −0.0293 | 0.0246 | −1.19 |
| Farm Scope | 4.5118 | 2.3079 | 1.95* |
| Unemployment Rate | −0.3115 | 0.2085 | −1.49 |
| Mean Market Returns | −1.4638 | 2.5409 | −0.58 |
| Std. Deviation Market Returns | 5.3684 | 5.7841 | 0.93 |
| Direct Payments | −0.0375 | 0.0193 | −1.94* |
| Coupled Payments | 0.0266 | 0.0159 | 1.68* |
| All Other Payments | 0.0038 | 0.0100 | 0.38 |
| Household Size | −0.5833 | 0.2929 | −1.99* |
| CRP Acres Enrolled | −0.0003 | 0.0022 | −0.15 |
| $\sigma$ | 12.9812 | 0.2317 | 56.02* |

[a] An "*" indicates statistical significance at the $\alpha = .10$ or smaller level.

Table 4. Farm Structure Equation Estimates

| Variable | Parameter Estimate | Standard Error | t Ratio[a] |
|---|---|---|---|
| ........ Farm Size ........ | | | |
| Intercept | 0.0037 | 0.1623 | 0.02 |
| Mean Market Returns | 0.5158 | 0.3269 | 1.58 |
| Std. Deviation Market Returns | 1.9914 | 0.7689 | 2.59* |
| Farm Scope | 0.3422 | 0.1088 | 3.14* |
| Direct Payments | −0.0025 | 0.0010 | −2.65* |
| Coupled Payments | 0.0014 | 0.0007 | 1.92* |
| All Other Payments | 0.0016 | 0.0005 | 2.91* |
| Operator Hours | −0.0139 | 0.0059 | −2.37* |
| Spouse Hours | 0.0213 | 0.0070 | 3.07* |
| County Average Output per Farm | 0.0272 | 0.0077 | 3.55* |
| Change in Output per Farm | 0.0812 | 0.1401 | 0.58 |
| Total County Output Value 2002 | −0.4098 | 0.3402 | −1.20 |
| County Average Output per Acre | −0.5188 | 0.1008 | −5.15* |
| County Share of Livestock | −0.0845 | 0.1284 | −0.66 |
| ........ Farm Scope (Index of Diversification) ........ | | | |
| Intercept | −0.1042 | 0.0740 | −1.41 |
| Acres Operated | 0.1247 | 0.0801 | 1.56 |
| Coupled Payments | 0.0003 | 0.0004 | 0.74 |
| Direct Payments | 0.0005 | 0.0005 | 1.03 |
| All Other Payments | −0.0004 | 0.0003 | −1.34 |
| Operator Hours | −0.0029 | 0.0034 | −0.85 |
| Spouse Hours | 0.0083 | 0.0046 | 1.80* |
| County Diversification | 0.0024 | 0.0851 | 0.03 |
| Change in Total County Output | −0.1284 | 0.0532 | −2.41* |
| County Share of Grains | 0.1773 | 0.0721 | 2.46* |
| County Share of Tobacco | 0.1858 | 0.1041 | 1.78* |
| County Share of Cotton | −0.8426 | 0.1771 | −4.76* |
| County Share of Vegetables | −0.0965 | 0.1502 | −0.64 |
| County Share of Fruit | −0.7350 | 0.1987 | −3.70* |
| County Share of Nursery Products | −0.2543 | 0.1210 | −2.10* |
| County Share of Poultry | 0.0373 | 0.0833 | 0.45 |
| County Share of Cattle | −0.1575 | 0.0672 | −2.34* |
| County Share of Dairy | 0.1737 | 0.0822 | 2.11* |
| County Share of Hogs | 0.4468 | 0.1110 | 4.02* |
| $\sigma$ | 0.3925 | 0.0067 | 58.55* |

[a] An "*" indicates statistical significance at the $\alpha = .10$ or smaller level.

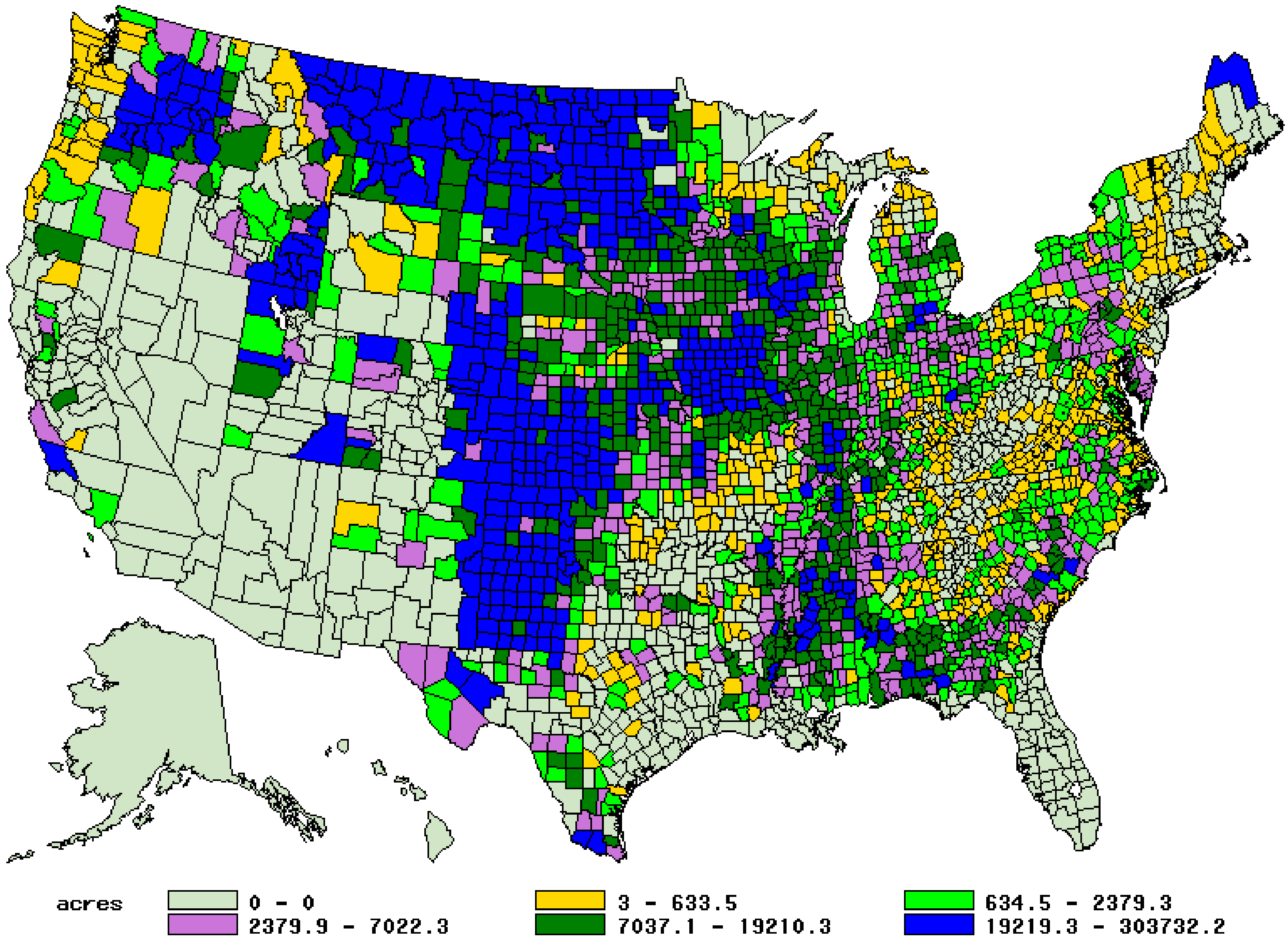


Figure 1: Enrollment in the CRP Program (2004)

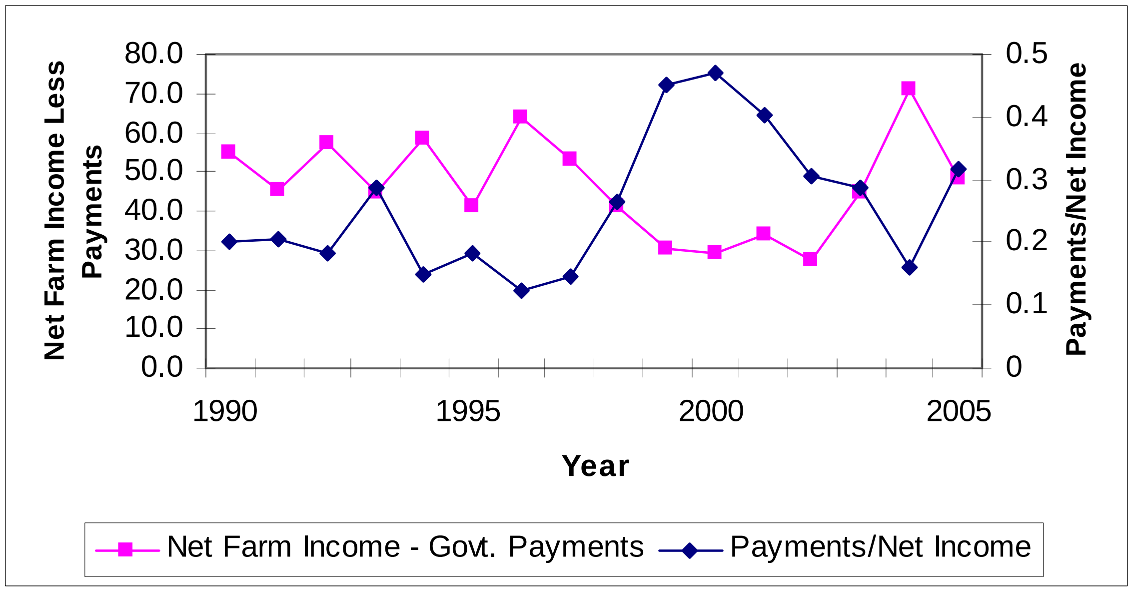


Figure 2: Net Farm Income Less Government Payments and Ratio of Payments to Non-Payment Net Farm Income

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