# GRAIN MARKETS, ELEVATOR MARGINS, AND THE CONSERVATION RESERVE PROGRAM

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Bachelor of Science

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Stillwater, Oklahoma

1992

Submitted to the Faculty of the
Graduate College of
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
December, 1993

OKLAHOMA STATE UNIVERSITY

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THE CONSERVATION RESERVE PROGRAM

Thesis Approved:

Thesis Adviser

Dean of the Graduate College

## ACKNOWLEDGEMENTS

I would like to express my appreciation to the people who made my dream of a graduate degree become a reality. To begin, I would like to thank Dr. Brian Adam, my major advisor, for his patient guidance and contributions to this thesis. Also, to my committee memebers Dr. Mike Dicks, Dr. Wade Brorsen, and Dr. Kim Anderson for the effort each devoted to this endeavor.

I would also like to thank the Department of Agricultural Economics for the financial, technical, and personal support which made my graduate studies possible. It is hard to imagine a finer assembly of administration, faculty, and staff. Thanks to my fellow graduate students for making this time enjoyable. A special thanks goes to Betsy Little for her meticulous work in preparing the thesis for submission.

I owe a great debt to my parents, Leonard and Mary Kay Garrison, for instilling the two values in me which I hold most dear: hope and determination. The examples they set when I was young and continue to set today are the reason I am this person. I hope that they are as proud of their son as he is of his parents.

Finally, my sincere appreciation to my wife, Heather, for her patience and support as I worked to complete this degree. Those times when it must have seemed that this thesis came first in my life were the times that she unselfishly supported me the most. My prayer is that one day I may give to her all the things that she has given me.

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# CHAPTER I

# OVERVIEW

## Problem Statement

In the past, the primary objective of long term land retirement programs has been to reduce soil erosion on marginal cropland. However, these programs also have a major impact on supply. Land retirement programs were used in the early 1900s to control excess capacity (Dicks and Osborn). While erosion control is still the primary objective, supply control is a stated secondary objective of recent land use legislation. A prominent example of this kind of program is the Conservation Reserve Program (CRP), mandated in the Food Security Act of 1985. The stated objectives of the CRP are to: (1) reduce wind and water erosion on marginal, or highly erodible, cropland by diverting this land to less intensive uses, (2) reduce surplus production of commodities, (3) improve water quality, (4) foster wildlife habitat (Osborn, Llacuna, and Linsenbigler). Nearly 34 million acres of highly erodible cropland in the United States was enrolled with 333,392 Conservation Reserve Program contracts during the first nine signup periods from 1986 to 1990.

Among the acres enrolled in the CRP are 10 million acres which have historical wheat base and 3.8 million acres of corn base. These acres could produce nearly 288 million bushels of wheat and 342 million bushels of corn each crop year (Osborn, Llacuna, and Linsenbigler). Removing these acres from production may have had large impacts on the grain marketing system. Particularly in areas of high CRP participation, grain handlers as well as input suppliers, may have been subjected to severe competitive pressures as a result of decreased sales.

A major unknown for analysts, policy makers, and agribusiness decision makers over the next few years is the extent to which CRP acres will return to crop production. Since most CRP contracts are for ten years, land enrolled in the CRP in 1986 will be eligible for crop production when contracts begin to expire in 1996. As contracts expire annually, incremental increases in cropland due to CRP land enrolled in the first nine signups returning to crop production will occur each year through 2000 as contracts expire yearly. In light of the potential impacts of 34 million acres of land becoming eligible for production, the question this research proposes to answer is: What effect will CRP contract expiration have on the supply and quantity demanded of wheat in the United States and on marketing margins at country elevators?

## Objectives

The general objective of this research is to determine the effect of Conservation Reserve Program contract expiration on merchandising margins at country wheat elevators. This objective will be met by accomplishing three specific objectives:

(1) Determine the percent of CRP land which producers intend to return to crop production as contracts expire.

(2) Forecast changes in the quantity of wheat produced and the subsequent price impacts in each year from 1996-2000 as CRP land returns to production.

(3) Determine the effect of the Conservation Reserve Program on country elevator marketing margins, returns to storage, and returns to merchandising activities.

The first objective is accomplished using a two-limit Tobit model to correct survey data on producer intentions for nonresponse bias. A weighted mean of actual and imputed survey responses concerning land use intentions of CRP contract holders is calculated.

The second objective is completed using a comprehensive market simulation model designed to determine price and quantity under alternative policies. A baseline is set assuming no CRP land returns to production. Yearly predictions of production and price are estimated. Two scenarios are considered: (1) the rate of recropping predicted in the first objective is applied to base acres and (2) 100 percent of the base acres idled under the CRP returns to production.

The third objective is conducted under a theoretical framework derived to include policy variables such as the CRP in the specification of elevator merchandising margins. A case study of elevator margins in Oklahoma is conducted to demonstrate how this theory could be empiricized and to gain some insight on the influence of the CRP on elevator margins. The overall objective is met by combining the results of the three specific objectives to determine the direction of change in elevator margins.

To understand the potential influence of land use policies on commodity markets it is essential to realize the prominence of such policies in agriculture's history. The following section provides background into the most important land use policies of the

1900s. A detailed description of the Conservation Reserve Program is included in the subsequent section.

## Government Involvement in Soil Conservation

Over the past sixty years government policies have been used to maintain an agricultural infrastructure capable of supplying potential demand and to prevent current surplus production of agricultural commodities by diverting marginal cropland to conserving uses. The prominence of soil conservation in American agriculture is evident by the major land use provisions of past and present agricultural legislation.

### Soil Conservation and Domestic Allotment Act of 1936

The Soil Conservation and Domestic Allotment Act of 1936 legislated the Agricultural Conservation Program (ACP) which is still used today to promote soil conservation. The objectives of the ACP are to improve soil fertility, minimize wind and water erosion, and conserve agricultural resources and wildlife. Under the ACP farmers are provided cost sharing for land use improvements and development of conservation practices which would not otherwise be carried out (Hallberg). The ACP provides incentives for farmers to invest in long term conservation practices.

### Bankhead-Jones Farm Tenancy Act of 1937

The Bankhead-Jones Farm Tenancy Act of 1937 provided for the retirement of submarginal land which could not be economically farmed. Land retired under this act later became the National Grasslands of the Great Plains (Dicks and Osborn).

Agricultural Act of 1956

The Agricultural Act of 1956 introduced two programs to provide for short- and long-term diversion of marginal cropland to conserving uses. These programs were the forerunners of current land use policies.

The Acreage Reserve Program (ARP) was implemented from 1956 through 1958 to curb production and protect marginal land from soil erosion. Under the ARP farmers signed one year contracts with the federal government to set aside a portion of program base acreage and receive payments to compensate for lost income (Aines). Today the ARP is mandatory for commodity program participation.

The Agricultural Act of 1956 also legislated the Soil Bank Reserve (SBR), commonly referred to as the Conservation Reserve Program (CRP), to provide for long term land diversion. From 1956 through 1960 more than 300,000 contracts were signed by land owners and the Secretary of Agriculture to enroll more than 28 million acres in the SBR. Under the terms of the contracts producers agreed not to harvest crops or to pasture land and to reduce the acreage of crops grown by the number of acres enrolled in the SBR. Producers received annual rental payments and cost sharing as compensation for converting cropland to conserving uses (Aines). Contracts under the Soil Bank lasted from three to ten years. The current Conservation Reserve Program, legislated by the Food Security Act of 1985, was modeled after the Soil Bank Reserve.

## Great Plains Conservation Program of 1956

The Great Plains Conservation Program (GPCP) is much like the Agricultural Conservation Program in that the objective was and is to provide incentives to producers in the ten Great Plains states for a permanent diversion of marginal cropland to a grass cover (Dicks and Osborn). More than 60,000 contracts have been signed under the GPCP to divert more than 110 million acres of erodible land from crop production.

## Food and Agricultural Act of 1965

The Food and Agricultural Act of 1965 provided for the Cropland Adjustment Program (CAP) in an attempt to cut current stocks. The CAP offered five to ten year contracts to producers willing to develop conservation practices on cropland (Hallberg).

## Food Security Act of 1985

The Food Security Act of 1985 (FSA 1985) is one of the most comprehensive attempts at influencing agricultural land use. Existing programs such as the ARP were extended and several new programs and policies were mandated.

The Paid Land Diversion (PLD) is a voluntary land retirement program which compensates producers for foregone production on land eligible for commodity program participation (crop acreage base). The concept of underplanting is one in which farmers who plant 50 to 92 percent of their crop acreage base (CAB) of cotton and rice and devote the remaining CAB to conserving uses are eligible for up to 92 percent of the deficiency payment provided by commodity program participation on the diverted acres. This program is commonly referred to as 50/92. This provision was later extended to wheat and feed grains as 0/92 under the Omnibus Budget Reconciliation Act of 1987 (Hallberg).

Conservation compliance requires farmers to begin implementation of an approved conservation plan on highly erodible cropland by 1990 and complete the plan by 1995. Eligibility for deficiency payments under commodity program participation are denied to producers who do not adhere to the requirements of conservation compliance (Dicks, Ray, and Sanders). Similarly, the sodbuster and swampbuster provisions of FSA 1985 would deny commodity program benefits to producers who convert grassland or wetlands to cropland use.

The largest conservation program mandated by FSA 1985 is the Conservation Reserve Program (CRP). Under the CRP farmers voluntarily divert marginal cropland from production to conserving uses. Because this research is concentrated on the impacts during and after the CRP a more detailed description of the program follows in the next section.

## Conservation Reserve Program

The Conservation Reserve Program (CRP) was mandated under Title XII of the Food Security Act of 1985 (FSA 1985) and later extended by Title XIV of the Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA 1990) as the Environmental Conservation Acreage Reserve Program (ECARP). The primary purpose of the CRP is to reduce wind and water erosion on marginal, or highly erodible, cropland by diverting this land to less intensive uses. Secondary objectives include supply control, improving water quality, and fostering wildlife habitat.

Agricultural producers who choose to enter into a CRP contract with the federal government are given an annual rental payment for the duration of the contract, usually ten years, and a one-time 50 percent cost share allowance for land conversion costs to establish conservation practices such as vegetative cover or terraces on highly erodible cropland.

Annual rental payments are determined on an individual basis through competitive bids associated with specifically identified fields submitted during a designated signup period by agricultural producers who wish to participate in the CRP. The Secretary of Agriculture determines a maximum acceptable rental rate (MARR) for each multicounty area, referred to as land pools, after all producer bids have been submitted. Land pools encompass counties with similar soil erosion rates, production levels, and other land characteristics.

County Agricultural Stabilization and Conservation Service (ASCS) committees review each submission. Bids which exceed the applicable MARR are not accepted for enrollment in the CRP. However, if the committee determines that the bid exceeds the local cash rental rate for comparable land, even a bid lower than the MARR may not be accepted (Osborn, Llacuna, and Linsenbigler). This process of competitive bidding potentially provides equitable compensation to producers by establishing a competitive market which determines price (rent) based on the erosion and productive potential of the field while minimizing government costs of the CRP. Payments to individual contract holders for participation in the CRP may not exceed

$50,000 annually. This payment limitation is independent of limits set for commodity program participation. However, land enrolled in the CRP with established crop acreage base (CAB) which normally is eligible for commodity program participation and federal deficiency payments through the Commodity Credit Corporation (CCC) is not eligible for payments associated with those programs during the period of the contract. The producer will retain established CAB and commodity program eligibility upon expiration of the CRP contract.

The original mandate for the Conservation Reserve Program began in fiscal year 1986 and extended through fiscal year 1990. During this time nine signup periods were held. As the Conservation Reserve Program was implemented, eligibility for enrollment differed by signup to ensure that the most marginal cropland would be diverted from production during the first signup periods. In later signup periods, eligibility requirements were relaxed to expand the amount of cropland eligible for CRP participation and to increase the number of acres planted to trees as a conservation practice. In addition, the fourth signup period offered incentives commonly referred to as "corn bonus" to entice producers from the Corn Belt to enroll corn base acres in the CRP.

Prior to establishment of vegetative cover or other conservation practices, erosion of soil on land enrolled in the CRP was extensive. Over three million acres currently enrolled in the CRP had annual erosion rates of over forty tons of soil per acre per year. Nearly 30 million acres were eroding at a rate of over ten tons per acre per year before the establishment of conservation practices. However, under the CRP erosion has been reduced on average by 19 tons per acre per year. For contracts over 500 acres erosion has been reduced on average by 20 tons per acre per year (Osborn, Llacuna, and Linsenbigler). Clearly, the CRP has been successful in controlling soil erosion on marginal cropland. A summary of average reduction in soil erosion weighted by the number of acres enrolled is shown in Figure 1.

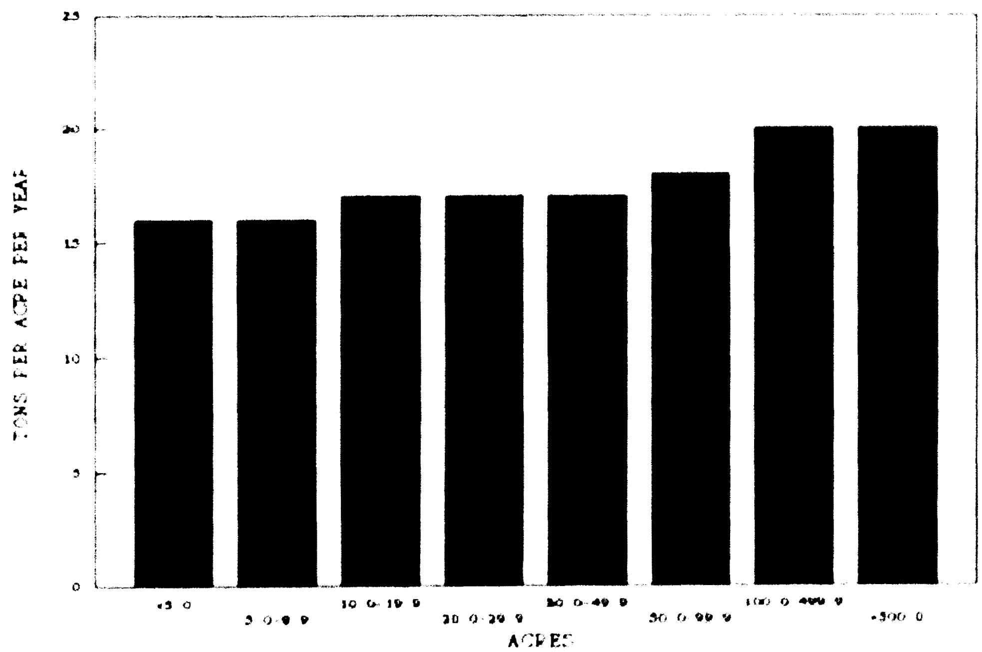

Figure 1. Summary of Average Reduction in Soil Erosion due to the Conservation Reserve Program by Number of Acres Enrolled.

## Summary

The preceding pages described how the supply control objective of the Conservation Reserve Program may have impacted components of the marketing system, defined the objectives of this research, and provided background into the past land retirement legislation and the Conservation Reserve Program. Although the specific objectives of this research are motivated by the same general problem and combine to accomplish an overall objective, each specific objective lends its own contribution to the current body of knowledge and will be accomplished using a separate procedure. The following three chapters report research conducted to accomplish each specific objective. These chapters include more concise definitions of each of the problems addressed, contribution to knowledge, relevant theory, results, and implications of research conducted. The final chapter consists of a summary and suggestions for further research.

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# CHAPTER II

# RECROPPING RATES OF CONSERVATION RESERVE PROGRAM ACREAGE

## Background

The Conservation Reserve Program (CRP) was mandated by the Food Security Act of 1985 to protect marginal cropland from soil erosion. Under the CRP, the contract holder receives an annual payment from the government in exchange for establishing and maintaining a conservation practice on highly erodible land for ten years. Through the first nine signup periods the CRP has reduced available cropland by nearly 34 million acres, including 18 million acres which will retain crop acreage base (CAB) when the contract expires. The first CRP contracts expire in 1996 and subsequent contracts expire through 2000. A major unknown for analysts, policy makers, and agribusiness decision makers over the next few years is producer land use intentions as Conservation Reserve Program contracts expire. The rate of land returning to crop production, or the recropping rate, is of particular interest because of the potential impact on government program costs and commodity supplies.

The Soil and Water Conservation Society (SWCS) conducted a national survey of 2,739 contract holders through signup nine in 1990, in part to determine the post-CRP land use intentions of contract holders. The 2,016 responses (74 percent) represent 366,818 acres of CRP land. Based on these responses Nowak, Schnepf, and Barnes found that 41.9 percent of the respondents had plans to return a portion of their CRP acreage to crop production. However, this estimate was not weighted by the number of acres controlled by individual producers and therefore does not directly predict the proportion of CRP acres returning to crop production. Osborn (1992a) weighted the responses by acres to find that the rate of expected recropping was 52.7 percent of the acres enrolled in the program.

This paper shows that the SWCS survey suffered from nonresponse bias and then determines expected rate of recropping using the SWCS survey adjusted for nonresponse bias. The methods used go beyond Osborn by correcting for nonresponse bias. A two-limit Tobit model is used to impute the rate of recropping for nonrespondents to correct the SWCS survey data for nonresponse bias. This allows calculation of the weighted mean of recropping corrected for nonresponse bias.

### Land Use Alternatives

Characteristics of land enrolled in the Conservation Reserve Program and the conservation practices developed under the program coupled with various land use policy provisions make the determination of post-CRP land use somewhat difficult. Many alternatives are available to contract holders when the CRP expires. Among these are leaving the conservation practice in place or using the land for crop or livestock production. Land may be left in vegetative cover for several reasons.

To be eligible for enrollment in the CRP, land had to meet specific signup criteria. Although later signups were more liberal in these requirements, all land enrolled in the CRP qualifies as marginal or highly erodible. Marginal acres may be less productive, or more difficult or less profitable to farm. However, it has been implied and understood that more than 22 million acres enrolled in the first nine signups will retain crop acreage base and commodity program eligibility as CRP contracts expire. This provides some economic incentive for producers to return these acres to crop production. Additionally, native or introduced grass cover has been the main conservation practice under the CRP. This grass cover could be easily tilled and converted to cropland. Less than 6 percent of the 34 million acres enrolled from 1986 to 1990 were planted to trees which would make cultivation more costly.

In addition, other land use policies must be considered. Government programs and policy provisions will likely influence the use of CRP land as contracts expire. Conservation compliance, legislated by the Food Security Act of 1985, provides economic disincentives for crop production. Producers must develop and implement an approved conservation plan on erodible cropland in order to remain eligible for Commodity Credit Corporation (CCC) loans and deficiency payments. The economic costs of conservation compliance and the potential loss of government payments may discourage producers from returning erodible land enrolled in the CRP to crop production. In addition, CRP land may remain idled under the acreage reduction program (ARP) which requires a portion of crop acreage base be set aside from crop production to maintain program eligibility. Also, flexibility provisions (normal flex acres) and participation in underplanting programs (i.e. 0-50/92) would allow producers to leave CRP land idle while participating in government programs.

Because it is not known whether producers consider these provisions as alternatives, the determination of post-CRP land use is somewhat uncertain.

From 1956 to 1960 more than 28 million acres of cropland were enrolled in the Soil Bank Reserve (SBR), commonly referred to as the conservation reserve. The SBR was used as a model to develop the provisions of the current CRP. Land from the SBR was eligible for crop production beginning in 1960 and extending through 1970. One attempt at estimating land use intentions as SBR contracts expired determined that 55 percent of the land enrolled would be returned to crop production (Aines). However, nearly 97 percent of the 28 million acres in the SBR were returned to crop production shortly after the contracts expired (Cacek). It must be realized, though, that land enrolled in the SBR was more productive than land in the current CRP since no land erosion criteria were specified for enrollment eligibility. Also, the other land use programs mentioned above had not been legislated at the time of SBR expiration. Therefore, the Soil Bank provides only limited insight into the land use intentions of current CRP contract holders. The post-CRP era should be analyzed using the land use intentions of contract holders while remembering the lessons of the Soil Bank.

Correcting for Nonresponse Bias

In most sample surveys some level of incompleteness occurs. The most prevalent sources of incompleteness result from survey nonresponse. Survey nonresponse creates problems since data that are intended to be observed are missing leading to less efficient estimates. Bias may exist if respondents are systematically different than nonrespondents (Rubin).

Two types of nonresponse can lead to bias: unit nonresponse and item nonresponse. Unit nonresponse occurs when some members of the survey sample fail to respond to the survey instrument (response rate is less than 100 percent). Unit nonresponse is almost impossible to alleviate entirely. In most cases, a response rate of 20 percent is considered adequate if the resulting sample comprises 1 percent of the population. However, if the respondents are statistically different in some aspects than nonrespondents, unit nonresponse bias exists and inefficient estimates may result.

The survey conducted by the Soil and Water Conservation Society (SWCS) in 1990 generated a response rate of nearly 74 percent representing approximately 1 percent of the acres in the CRP. Although this response rate falls into the conventional guidelines, it is important to determine if unit nonresponse bias exists.

Item nonresponse occurs when members of the survey sample respond to some, but not all, questions on the questionnaire. Many times item nonresponse is associated with a request for information that is not easily available to sample members or a poorly planned or worded question. In the SWCS survey, item nonresponse was created by a flaw in the survey instrument where sample members were instructed to skip the question relating to post-CRP land use intentions if no decision had been made. Item nonresponse bias occurred automatically since those who answered the question (had plans for CRP land) were systematically different from those who failed to answer the question (did not have plans for CRP land). It is important, however, to determine other characteristics which distinguish respondents to item nonrespondents in order to correct for item nonresponse bias.

Rubin states that "complete-data methods cannot be immediately used" for estimation when nonresponse bias exists. Therefore, it must be determined if nonresponse bias exists in the SWCS survey data and whether some method of correction must be used to complete the data so that the most likely predictions of the rate of land returning to crop production can be made.

Data imputation is a procedure used to adjust for survey nonresponse bias by replacing each missing value due to nonresponse with an acceptable prediction of response (Rubin). Imputation is similar to weighting responses more heavily to adjust for nonrespondents with similar characteristics. In the case of the SWCS survey data, a model of respondents can be estimated which can then be applied to nonrespondents to predict the missing value. However, because the cause of nonresponse is unknown, correcting for bias is often difficult (Rubin).

Through modelling, data imputation incorporates the analyst's knowledge related to the factors which may influence the likely response. In order to predict a response for post-CRP land use, a model of the CRP contract can be used to estimate the influence of such factors as conservation practice and rental payment on the land use decision. In using data imputation it must be assumed that nonresponse bias does not extend beyond that explained by the background variables which can be observed, tested, and used in correcting for nonresponse bias (Rubin).

## Procedures and Data

### Testing Survey Data

Data regarding each CRP contract holder in the United States are available on a data base maintained by the Agricultural Stabilization and Conservation Service (ASCS). Since data on the population are available, this survey presents an unusual opportunity to test and correct for nonresponse bias.

The SWCS survey sample of 2,739 contract holders is drawn from the ASCS national data tapes of 333,392 contracts nationwide through the ninth signup. The survey requested information about the operator such as age, income, and education. In addition, information on conservation practices, satisfaction with the decision to enroll in the CRP, and characteristics of the farm enterprise was requested.

The data used in testing the validity of the SWCS survey data came from the national CRP tapes for signup periods one through nine. The survey respondents are identified by contract number and matched to the corresponding observation on the CRP tapes to ensure consistent data between the population and the sample. Although 2,016 responses were gathered, only 1,930 of these matched an observation on the CRP data tapes. The data for the respondents contained the 1,930 observations that returned the survey and matched an observation in the population of CRP contracts. The nonrespondents contained 809 observations which were not returned or were not matched to the population.[1] In their own testing, the Economic Research Service was

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[1]The 86 observations from the sample which could not be matched to the population were tested using a t-test to determine if they may significantly affect the direction of any bias. It was determined that omitting these observations does not affect the results of the bias testing.

also unable to match some of the contract numbers. Sample size for variables which may not appear in each observation (e.g. wheat yield) corresponds to the number of respondents with the attribute in question. For example, only 1,081 contract holders with wheat yield responded to the survey, therefore, sample size is 1,081. In the case of base acreage, missing values are set to zero.

The data on the CRP tapes is ordered by CRP contract. Since a farm may have multiple contracts, the contract data are aggregated for each farm for both the sample and the population. The aggregation is done by summing over all contracts from each farm for those variables pertaining to acreage (e.g. acres enrolled). For variables such as yield and rent, an average weighted by the number of acres per contract is calculated over contracts to obtain a single number for each farm. For the variable describing land capability class, the acres accepted per contract were added by capability class over the contracts to determine the total acreage in each class for both each farm. Similarly, acres were summed over conservation practice to obtain the total acreage in each conservation practice. These aggregations provide for consistent farm level data between the population and the sample.

A chi-square test for goodness-of-fit was used to determine how well the SWCS survey data fit the distribution of the population. Since the chi-square tests the entire distribution instead of just first moments it is a more powerful test than a test of two means. A t-test of means is also used to substantiate the chi-square and determine the direction of any bias.

The chi-square test statistic is calculated as the squared difference between the number of sample observations observed in the $i^{th}$ category and the number of observations expected in the $i^{th}$ category based on the population, divided by the expected number in the $i^{th}$ category, summed over all categories for each variable.

(1) $$\Sigma^{k}_{i=1} (X_i-m_i)^2/m_i$$

where:

$X_i$ = the number observed from the $i^{th}$ category of the sample, and

$m_i$ = the number expected from the $i^{th}$ category of the sample based on the population; or sample size multiplied by the percent of the population in the $i^{th}$ category (Shannon).[2]

The category divisions for the chi-square test are inherent to discrete variables, such as land capability class, since each class represents one category. The case of continuous variables (i.e. CRP acres) presents a problem in that the categories must be created based on the units to be measured (100 acres to 500 acres is one category, etc.). Here, categories are created by adding or subtracting multiples of the standard deviation to or from the mean for each variable from the population and creating ten categories. For example, between the average and .25 standard deviations above the average is one category. Although information may be lost in the process of

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[2]Some question has arisen over the correct method for calculating a chi-square statistic during the course of this testing. Osborn, conducting chi-square tests on land capability class, calculated the squared difference in the percentage in each category between the population and the sample and divided by the percentage from the population summed over the classes to arrive at the test statistic (Osborn, 1992b). This method is incorrect in that it fails to account for the size of the sample in any way. To clarify, Snedecor states, "results are often reported not in numbers originally counted but as percentages of individuals having the attribute; that is, as so many per hundred enumerated. It is clear that such percentages cannot be used directly in the calculation of chi-square except in the case where the sample size is an even hundred. In all other samples, before chi-square is computed the percentage must be converted to the actual number of individuals found with the attribute." Therefore, the percent of total in each category for the population must be converted to the expected frequency from the sample by multiplying by sample size (to get m in the formula).

transforming quantitative data into qualitative data, the process is based on the first and second moments of the probability distribution. The data transformation is necessary to conduct the chi-square goodness-of-fit test and does not weaken the test.

Once the categories are created, each observation from the population and the sample fits into one of the ten categories measuring the number and percent of total in each category for each data set. The test statistic is calculated by measuring the difference between observed and expected frequencies, as in equation (1) above.

The null hypothesis of the chi-square test is that the population and the sample have the same distribution, or:

$$H_N: \quad P_p = P_s$$
$$H_A: \quad P_p \neq P_s$$

where:

$P_p$ is the probability distribution of the population and

$P_s$ is the probability distribution of the sample.

Only an approximation of the population mean from the sample is known. Therefore, the t-test is calculated as:

(2) $$t = \frac{\bar{X} - \mu}{s / \sqrt{n}}$$

where:

$\bar{X}$ is the sample mean

$\mu$ is the population mean

s is the standard deviation of the sample, and

n is the number of observations in the sample.

The null hypothesis is rejected if the calculated t-statistic is larger than the critical value of a t-distribution with the corresponding degrees of freedom. The degrees of freedom is the number of observations in the sample.

The sample of respondents is compared to the sample of nonrespondents using the chi-square method described previously to determine if the subsamples have similar distributions. The means for the respondents and nonrespondents are then calculated and compared using a t-test between samples to determine the direction of any bias.

To test whether item nonresponse bias occurred, the data for those contract holders who had plans for CRP land after the contract expires are compared to data for those without plans. The data for item respondents represents the 886 contract holders who responded to the post-CRP land use question. The sample of 1,130 item nonrespondents includes those contract holders who indicated no decision had been made concerning land use.

The tests for unit and item nonresponse bias are identical except for the observations in the respective samples. The samples are compared using the chi-square test as well as a t-test. The null hypothesis of the t-test is that the difference between the sample means is zero:

$$H_N: \quad (\mu_1 - \mu_2) = 0$$
$$H_A: \quad (\mu_1 - \mu_2) \neq 0$$

The test uses a pooled variance estimate which is calculated as:

(3) $$\sigma_{(\bar{x}_1 - \bar{x}_2)} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

In order to use this pooled variance estimate, the difference between the sample variance estimates is zero.[3] The test statistic is:

(4) $$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sigma_{(\bar{x}_1 - \bar{x}_2)}}$$

This test differs from the t-test illustrated in (2) because (2) is a test between a true population and a sample while (4) is a test between two samples. The tests conducted under (1) and (2) indicate only whether a bias exists in the SWCS survey data. The tests for unit or item nonresponse bias conducted with equations (1) and (4) more precisely define the source and direction of the bias. If the results of these tests show that bias exists, or more specifically that unit or item nonresponse bias exists, in the SWCS survey, the data must be adjusted to obtain more consistent estimates.

Data Imputation

The SWCS survey data is adjusted for response bias by estimating the recropping rate of all nonrespondents to obtain a recropping value for every contract holder who was surveyed (2,739). The two-limit Tobit model is used since the dependent variable (recropping rate) is censored at both an upper and lower value (100 and 0 percent, respectively). The Tobit returns a set of estimators which

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[3]The difference between the variance estimates has not been tested explicitly. We assumed that this condition holds in this case from the Central Limit Theorem.

maximizes a specified log likelihood function. This set of estimators maximizes the probability of predicting a value of the recropping rate is the actual value. The log likelihood function of the two-limit Tobit model is:

$$\begin{gathered} logl=(1-ll)*(1-ul)*((-(r-xb)^2/(2*s))- \\ .5*\ln(2*\pi*s))+(ll*\ln(cdfn(ll*rl-xb)/\sqrt{s})))+ \\ (ul*\ln(1-ul*cdfn((ru-xb)/\sqrt{s}))) \end{gathered} \tag{5}$$

where:

logl is the log likelihood function,

ll is the lower limit of the dependent variable (recropping=0),

ul is the upper limit of the dependent variable (recropping=100),

r is the rate of recropping for survey respondents,

xb is the X matrix of independent variables multiplied by the vector of estimators,

s is the variance estimate,

ln is the natural log operator,

cdfn is the cumulative distribution function,

rl is 0 if the dependent variable is at the lower limit, and

ru is 100 if the dependent variable is at the upper limit.

The log likelihood function and the maximum likelihood procedure for the two-limit Tobit model was performed in GAUSS econometrics software. The iteration procedure used to obtain convergence of the log likelihood function to a maximum is a quasi-Newton secant method which updates the Hessian after each iteration (REFERENCE). The resulting parameter estimates are used to predict the recropping rate of unit and item nonrespondents.

In the SWCS survey producers were asked whether they had plans for their land when their contract expired. The respondents who answered "yes" to this question were asked what those plans were. One of the options was to estimate the percent of land that would be returned to crop production under a conservation compliance plan. Another was to estimate the percent of land that would be recropped without a conservation compliance plan. The sum of these options reported by the respondent was used as the dependent variable in the models. Of the 886 respondents who indicated that plans had been made for their CRP acres, 434 did not plan to resume crop production (recrop=0), and 250 planned to crop 100 percent of the land enrolled in the program. The remaining 202 planned to crop some proportion of their CRP land less than 100 percent. Since data on the independent variables for those who failed to return the survey are limited to those existing on the ASCS national data base while the data available for those without land use plans also include responses to other survey questions, two models are specified, one for each source of bias. Each model is estimated using the available data for respondents. The parameter estimates are then used with the data available for nonrespondents to predict missing values of recropping rates. To predict recropping of unit nonresponders the following model is specified:

$$\begin{aligned} RECROP = \beta_0 + \beta_1 SIZEPCT + \beta_2 CRPACRE + \beta_3 RENT + \\ \beta_4 EROSIONB + \beta_5 SLT + \beta_6 NATVPCT + \beta_7 TREEPCT \end{aligned} \tag{6}$$

where:

RECROP is percent of CRP acres expected to be returned to crop production,

SIZEPCT is the percent of all farm land acres in CRP, CRPACRE is the number of acres enrolled in the CRP program,

RENT is the annual rental payment under the CRP contract,

EROSIONB is the erosion rate on the CRP acres prior to cover establishment,

SLT is soil loss tolerance of the land enrolled in the CRP,

NATVPCT is the percent of CRP acres in native grass, and

TREEPCT is the percent of CRP acres in trees.

This model is estimated using data available on the ASCS national data tapes for sample members who indicated their post-CRP intentions. Each regressor characterizes the CRP contract or the farm operation. The hypothesis that these regressors influence post-CRP land use intentions is tested in this estimation. The expected influence of each independent variable on RECROP, the proportion of land the contract holder expects to return to crop production, is described separately.

Two of the independent variables are included to represent the number of acres enrolled in the CRP and the relationship of this land to the overall farming operation. These include SIZEPCT and CRP.

SIZEPCT is the proportion of the contract holders farm which is enrolled in the CRP. Some analysts believe that many older producers enrolled a large proportion of their farms in the CRP in order to begin retirement on the annual rental payments. If this has been the case, the larger the proportion of the overall farm enrolled in the CRP, the less likely the land will be returned to crop production as contracts expire.

CRPACRE is the number of acres enrolled in the CRP. The total opportunity cost of keeping cropland idled increases as the number of acres are increased.

Therefore, the more acres enrolled in the CRP by the contract holder the more likely that land will be returned to crop production.

The productive capacity of land enrolled in the CRP will likely influence the decision to return the land to crop production. The model to adjust for unit nonresponse bias is specified to include three regressors which represent the value of the land.

The independent variable RENT represents the annual rental payment received by the CRP contract holder. Since rental bids are made by producers in a competitive process, the value and productivity of land enrolled in the CRP would be reflected in the annual rental payment. If the land enrolled in one contract is comparably more productive than other CRP land, the annual rental payment would be greater since the opportunity cost of enrollment would be greater. For this reason, a higher rental payment is hypothesized to lead to a higher proportion of CRP land returning to crop production.

The erosion rate of CRP land prior to enrollment (EROSIONB) should be an indication of the erodibility of the same land if it is recropped. The costs of returning highly erodible land to production would be higher due to conservation compliance provisions.

If the soil loss tolerance (SLT), as measured by the universal soil loss equation, is high, the erodibility of the land is relatively low. So, from similar logic used to derive expectations about the influence of EROSIONB, it is expected that the parameter estimate associated with SLT will be positive.

The type of vegetative cover established on the acres enrolled in the CRP will also likely influence the decision to return land to crop production. CRP acres planted to native grass are more likely to be converted to crop production than those acres planted to trees. The percent of CRP acres in native grass (NATVPCT) is hypothesized to be positively related to the rate of recropping. Conversely, the percent of CRP acres covered with trees (TREEPCT) is hypothesized to be inversely related to the rate of recropping.

The model used to correct for item nonresponse bias includes the variables mentioned above, plus some variables corresponding to responses to SWCS survey questions. The model which will be used to predict the post-CRP land use for those who indicated that no decision had been reached is:

$$\begin{aligned} RECROP = \beta_0 + \beta_1 SIZEPCT + \beta_2 CRPACRE + \beta_3 RENT + \beta_4 EROSIONB + \\ \beta_5 SLT + \beta_6 NATVPCT + \beta_7 TREEPCT + \beta_8 LANDBUY + \\ \beta_9 HAY + \beta_{10} LANDVAL + \beta_{11} OWNOP + \beta_{12} OLDER + \\ \beta_{13} LIVEINC + \beta_{14} CROPFARM + \beta_{15} OFFFARM \end{aligned} \tag{7}$$

where:

RECROP is percent of CRP acres which will be returned to crop production,

SIZEPCT is the number of CRP acres relative to all farm land,

CRPACRE is the number of acres enrolled in the CRP program,

RENT is the annual payment under the CRP contract,

EROSIONB is the erosion rate on the CRP acres prior to cover establishment,

SLT is soil loss tolerance of the land enrolled in the CRP,

NATVPCT is the percent of CRP acres in native grass,

TREEPCT is the percent of CRP acres in trees, LANDBUY is 1 if CRP payments used to purchase land; 0 otherwise,

HAY is 1 if contract would be extended if haying allowed; 0 otherwise,

LANDVAL is the current market value of land enrolled in CRP,

OWNOP is 1 if the contract holder is the owner; 0 otherwise,

OLDER is 1 if contract holder is over the age of 55; 0 otherwise,

LIVEINC is the percent of total farm income attributable to livestock,

CROPFARM is 1 if 50% of total farm income attributable to crop production, and

OFFFARM is the percent of total income from nonfarm sources.

These regressors characterize the CRP contract, the operator, and the farming operation. The data required to estimate this model are available from the ASCS national data base and responses to the SWCS survey. The independent variable, RECROP, is the same for both model specifications. The hypotheses previously stated for the unit nonresponse model are consistent between the specifications. However, hypotheses are required for additional independent variables in the item nonresponse model.

LANDBUY is a dummy variable which is one if the CRP rental payment was used to buy arable farmland during the ten year contract and zero otherwise. If land was financed with the CRP payment being a primary source of repayment, other means of cash inflow may be required in order to continue repayment. It is expected that if land was purchased with the CRP rental payment (LANDBUY is one) a higher proportion of land will be returned to crop production.

If the survey respondent indicated that the CRP contract would be extended if limited haying were allowed on the land enrolled, then HAY is one, otherwise, HAY is zero. The propensity to extend the contract and the desire to hay the grass on current CRP land, most likely for existing livestock, suggests the contract holder/respondent will be less likely to return the land to crop production.

LANDVAL is the current market rental value of the land under CRP contract. Since higher rents could be demanded for more productive land, it is expected that LANDVAL would be positively related to the rate of recropping. That is, the higher the rental value of the land, the more likely it will be returned to crop production.

Owners of marginal cropland may be more protective stewards of the soil in order to sustain productivity into the future. OWNOP is one if the contract holder is the owner of the land and zero if he or she is not.

OLDER is an independent variable to determine what influence the contract holder's age will have on the decision to return land to crop production. OLDER has a value of one if the contract holder is over the age of 55 and is zero otherwise. Presuming that many older agricultural producers enrolled land in the CRP to begin retirement, it is expected that OLDER will have an inverse relationship with the rate of recropping.

Agricultural producers with a large percentage of farm income attributable to livestock enterprises may consider leaving vegetative cover on CRP land after the contract expires to use as forage. Conversion costs would be lower than if the land were prepared for crops. For this reason, LIVEINC, the percent of farm income from livestock activities, is hypothesized to negatively influence recropping rate.

If the majority of farm income is attributable to row crop production, it is likely that land in the CRP would be converted to this use. CROPFARM is one if at least 50 percent of total farm income results from crop production. When CROPFARM is one, the rate of recropping is hypothesized to be higher.

The percent of total income that is earned from nonfarm sources (OFFFARM) is expected to have a negative influence on the proportion of land returned to crops since income from that land is less vital.

The models used for data imputation are estimated using the data available for respondents who had plans for CRP land. The maximum likelihood estimators are used with data of nonrespondents to predict the missing responses. These predictions are then adjusted so that the resulting predicted value of recropping imputed for nonrespondents is within the relevant range (0 to 100). The adjusted predictions are calculated as:

$$\begin{aligned}(8)\qquad & adjpre = 100 * (1 - cdfn((100 - pred)/s)) + \\ & (cdfn((100 - pred)/s - cdfn(-pred/s)) * \\ & pred + s * (pdfn(-pred/s) - \\ & pdfn((100 - pred)/s))\end{aligned}$$

where:

adjpre is the adjusted prediction value of the rate or recropping,

cdfn is the cumulative distribution function,

pred is the predicted value of the rate of recropping from the two-limit Tobit,

s is the variance estimate, and

pdfn is the probability distribution function.

This adjustment is essential since the estimators are calculated within the same relevant range by the two-limit Tobit model specification and predicted values must be censored at upper and lower limits.

The mean of recropping weighted by CRP acres and adjusted for nonresponse bias is:

$$(9) \qquad \bar{X}_{recrop} = \frac{\sum RECROP_i \; W_i}{W_i} \qquad where \qquad (i = 1,2,...,n)$$

where:

$RECROP_i$ is the actual or predicted percent of CRP acres which the $i^{th}$ contract holder intends to return to crop production, and

$W_i$ is the number if CRP acres enrolled by the $i^{th}$ contract holder.

This weighted mean, adjusted for unit and item nonresponse, indicates the proportion of CRP acres which will be returned to crop production if CRP contracts are not extended. This estimate of the rate of recropping represents the best estimate of post-CRP land use intentions of contract holders from the first nine signup periods.

## Results

### Results of Survey Testing

Results of the chi-square testing showed that the sample was significantly different than the population (at 10%, df=9) for 10 of the 20 variables tested. Included in these are some of the most important variables such as land capability class, acres enrolled, farm size, rent, and conservation practices. For each variable that was significantly different under the chi-square criterion, the means were also found to be different using a t-test. Results of the chi-square and the means tests between the population and the sample can be seen in Table I.

# TABLE I

## CHI-SQUARE AND MEANS TESTS OF SWCS SAMPLE VS. NATIONAL POPULATION OF CRP CONTRACTS

| Variable | Calculated Chi-square | Population Mean | Sample Mean | Sample Size | Calculated t-statistic |
|---|---|---|---|---|---|
| Farm size | 19.46 | 362.47 | 320.28 | 1930 | -3.07 |
| CRP Acres | 60.05 | 101.75 | 92.88 | 1930 | -2.64 |
| Pct. Farm | 70.07 | 0.56 | 0.50 | 1930 | -7.58 |
| Bid Amount | 17.56 | 55.26 | 56.81 | 1930 | 3.42 |
| LCC[1] | 482.07 | 3.44 | 3.41 | N/A | N/A |
| Wheat Base | 14.94 | 30.88 | 25.89 | 1930 | -2.90 |
| Corn Base | 12.50 | 11.34 | 11.61 | 1930 | 0.04 |
| Barley Base | 9.58 | 8.20 | 7.08 | 1930 | -1.24 |
| Rice Base | 1.35 | 0.04 | 0.01 | 1930 | -0.33 |
| Sorghum Base | 6.37 | 7.08 | 6.92 | 1930 | -0.20 |
| Upland Base | 4.32 | 3.91 | 3.87 | 1930 | -0.06 |
| ELS Base[3] | | 0.01 | 0.00 | 1930 | |
| Oats Base | 10.28 | 3.87 | 3.67 | 1930 | -0.65 |
| Wheat Yield[2] | 35.80 | 27.40 | 27.34 | 1081 | -0.13 |
| Corn Yield[2] | 24.88 | 84.83 | 86.49 | 836 | 1.98 |
| Barley Yield[2] | 7.07 | 39.34 | 39.45 | 236 | 0.15 |
| Rice Yield[2] | 5.50 | 3879.35 | 4166.00 | 1 | |
| Sorghum Yield[2] | 7.75 | 47.23 | 46.69 | 352 | -0.63 |
| Upland Yield[2] | 9.20 | 372.07 | 356.25 | 98 | -1.07 |
| ELS Yield[2] | | 381.46 | 0.00 | 0 | |
| Oats Yield[2] | 24.50 | 50.44 | 50.75 | 503 | 0.66 |

[1]Means weighted by CRP acres
[2]Means weighted by crop base acres
[3]No non-zero responses
[4]Means not calculated on total conservation practices
Note: For Chi-square: df = 9: $\alpha$ = .10, $X^2$ = 14.6837; $\alpha$ = .05, $X^2$ = 16.919

These results indicate that the SWCS sample does not adequately represent the distribution of CRP acres for the nation. Therefore, the data will produce biased estimates of the rate of recropping.

Further investigation indicates that the survey suffers from two independent sources of bias. First, the results of the chi-square and means tests for unit nonresponse showed that many of the same variables were also significantly different between survey respondents and nonrespondents. This indicates that unit nonresponse bias occurred in the survey data since respondents are systematically different from the nonrespondents. In this case, larger farms with more acres enrolled in the CRP tended to not return the survey, thereby biasing the means of the sample. Results of the chi-square and means tests to determine whether unit nonresponse bias occurred and the direction of the bias are shown in Table II.

The second source of bias which was tested was item nonreponse bias. Item nonresponse occurred in the SWCS because a distinction was made between contract holders with plans for their CRP acres and those without plans. Results of the t-tests between these subsamples indicate that many factors are significantly different. Those producers without plans had fewer acres in the program but received a higher annual rental payment. The direction of the item nonresponse bias may lead to overestimation of the rate of land returning to crop production. Results of the tests for item nonresponse bias are shown in Table III.

TABLE II

CHI-SQUARE AND MEANS TESTS OF UNIT NONRESPONSE
BIAS BETWEEN SURVEY RESPONDENTS
AND NONRESPONDENTS

| Variable | Calculated Chi-square | Respondents Mean | Nonrespondents Mean | Calculated t-statistic |
|---|---|---|---|---|
| Farm size | 66.55 | 318.81 | 391.47 | 3.69 |
| CRP Acres | 60.70 | 92.19 | 120.99 | 4.66 |
| Bid Amount | 68.76 | 56.89 | 52.75 | -7.63 |
| LCC[1] | 1665.79 | 3.40 | 3.33 | -0.17 |
| Conservation | 3013.44 | ** | ** | |
| Wheat Base | 452.49 | 25.66 | 38.72 | 4.19 |
| Corn Base | 361.51 | 11.60 | 12.22 | 0.54 |
| Barley Base | 1273.33 | 6.78 | 11.47 | 2.34 |
| Rice Base | 1919.00 | 0.01 | 0.03 | 0.64 |
| Sorghum Base | 579.15 | 6.96 | 7.75 | 0.81 |
| Upland Base | 801.91 | 3.90 | 4.29 | 0.36 |
| Oats Base | 558.33 | 3.62 | 4.88 | 2.44 |
| Wheat Yield | 256.34 | 32.21 | 30.48 | -4.54 |
| Corn Yield | 348.15 | 86.65 | 78.29 | -5.55 |
| Barley Yield | 855.35 | 39.46 | 38.18 | -1.97 |
| Rice Yield | 1919.00 | 4166.00 | 3580.00 | N/A |
| Sorghum Yield | 677.92 | 46.65 | 44.81 | -1.48 |
| Upland Yield | 649.64 | 356.25 | 352.10 | -0.18 |
| Oats Yield | 426.79 | 50.79 | 47.30 | -5.19 |

[1]Means weighted by CRP acres
**Means not calculated on total conservation practices
Note: For Chi-square: df = 9: $\alpha$ = .10, $X^2$ = 14.6837; $\alpha$ = .05, $X^2$ = 16.919

## Results of Two-limit Tobit Models for Data Imputation

During the estimation process some problems arose. First, the variance of the cumulative distribution function was very small. This is good in the sense that the log-likelihood function will return a set of unbiased estimators which have a very low

TABLE III

MEANS TESTS OF ITEM NONRESPONSE BIAS BETWEEN RESPONDENTS WITH PLANS FOR CRP ACRES VS. RESPONDENTS WITHOUT PLANS FOR CRP ACRES

| Variable | Plans Mean | No Plans Mean | Variance[1] | Calculated t-statistic |
|---|---|---|---|---|
| Farm size | 369.90 | 285.53 | 27.36 | 3.08 |
| CRP acres | 103.56 | 85.02 | 6.70 | 2.77 |
| Rent | 55.55 | 57.53 | 0.74 | -2.67 |
| Wheat Base | 28.87 | 23.58 | 3.33 | 1.59 |
| Corn Base | 13.23 | 10.33 | 1.42 | 2.04 |
| Barley Base | 9.03 | 5.89 | 1.81 | 1.74 |
| Sorghum Base | 8.05 | 5.94 | 1.58 | 1.33 |
| Upland Base | 4.69 | 3.12 | 1.37 | 1.15 |
| Oats Base | 4.06 | 3.56 | 0.64 | 0.78 |
| Native Grass[2] | 54.38 | 46.62 | 5.02 | 1.54 |
| Introduced Grass[2] | 32.22 | 19.51 | 4.48 | 2.84 |
| Trees[2] | 6.54 | 6.02 | 1.27 | 0.41 |

[1]Pooled variance estimate
[2]Conservation practices

variance. But, the small variance of the cumulative distribution function repeatedly caused the log-likelihood function to be zero. Since some observations were outside of three standard deviations from the mean these were assigned a probability of zero. Therefore, the data, including the variance estimate was rescaled to avoid iterations within a singular Hessian. Even with these adjustments, the computer program in GAUSS seemed to search for the maximum of the likelihood function outside the relevant range. This was overcome by changing the algorithm used in the iteration process to finally converge to a set of estimators which maximized the log-likelihood function.

Complete results of the estimated model used for data imputation of unit nonrespondents are shown in Table IV. The results show that six of the seven independent variables are significantly different from zero. Only the percent of the total farm in CRP was insignificant. The independent variables CRP, RENT, and TREEPCT show exceptional explanatory power (p-value of .0000). The remaining variables, including EROSIONB, SLT, and NATVPCT, are significant at the .05 level. The signs of the parameter estimates are consistent with expectations.

If a greater proportion of the total farm was enrolled in the CRP (SIZEPCT) the contract holder typically plans to resume production on a lower percent of the CRP acreage. This is consistent with the theory that many older producers used the CRP with the annual rental payment to begin retirement. The signs on variables which relate to the value of the land enrolled in the CRP indicate that productive capacity will influence the decision to return land to crop production as hypothesized. Also, as expected TREEPCT is negative indicating the higher the proportion of CRP land planted in trees the lower the rate of recropping will be. The sign on NATVPCT, the number of acres planted to native grass, is positive indicating that CRP acres in native grass are more likely to be returned to crop production. This has implications for both livestock and grain markets, since it is assumed this land would be used to graze livestock.

TABLE IV

TWO-LIMIT TOBIT MODEL OF RECROPPING RATE
USING ONLY NONSAMPLE INFORMATION
AS REGRESSORS

| Variable | Parameter Estimate | Standard Error | t-ratio | Probability > \|t\| |
|---|---|---|---|---|
| CONSTANT | -103.51 | 32.58 | -3.18 | 0.00 |
| SIZEPCT | -7.94 | 14.74 | -0.54 | 0.29 |
| CRP | 0.16 | 0.04 | 4.50 | 0.00 |
| RENT | 1.95 | 0.35 | 5.51 | 0.00 |
| EROSIONB | -1.00 | 0.39 | -2.53 | 0.01 |
| SLT | 9.05 | 5.52 | 1.64 | 0.05 |
| NATVPCT | 33.28 | 12.69 | 2.62 | 0.00 |
| TREEPCT | -100.01 | 21.05 | -4.75 | 0.00 |
| VARIANCE | 1.23 | 0.07 | 16.59 | 0.00 |

724 observations used in estimation
Mean of log-likelihood -2.29

The results of the model used to impute data for item nonrespondents are shown in Table V. These results show seven of the fifteen independent variables are significant at the .05 level. Compared to the model for unit nonrespondents, RENT, SLT, and NATVPCT show reduced explanatory power. The variable SIZEPCT has increased power, but is still not significant at .05. Several variables obtained from the survey data are useful in explaining the rate of recropping. These include the use of CRP payments to buy land (LANDBUY), current market value of CRP land (LANDVAL), the age of the producer (OLDER), and the percent of total income

TABLE V

TWO-LIMIT TOBIT MODEL OF RECROPPING RATE
CONDITIONAL ON SAMPLE AND
NONSAMPLE INFORMATION

| Variable | Parameter Estimate | Standard Error | t-ratio | Probability > \|t\| |
|---|---|---|---|---|
| CONSTANT | -5.97 | 34.15 | -0.18 | 0.43 |
| SIZEPCT | -14.43 | 15.57 | -0.93 | 0.18 |
| CRP | 0.10 | 0.03 | 2.98 | 0.00 |
| RENT | 0.51 | 0.37 | 1.38 | 0.08 |
| EROSIONB | -0.55 | 0.43 | -1.30 | 0.09 |
| SLT | 7.39 | 5.63 | 1.31 | 0.09 |
| NATVPCT | 15.25 | 12.82 | 1.19 | 0.12 |
| TREEPCT | -118.37 | 22.46 | -5.27 | 0.00 |
| LANDBUY | 9.93 | 3.85 | 2.58 | 0.01 |
| HAY | 2.50 | 2.35 | 1.07 | 0.14 |
| LANDVAL | 0.07 | 0.02 | 4.57 | 0.00 |
| OWNOP | 1.77 | 6.18 | 0.29 | 0.39 |
| OLDER | -25.12 | 11.02 | -2.28 | 0.01 |
| LIVEINC | -0.78 | 0.20 | -3.90 | 0.00 |
| CROPFARM | 19.57 | 12.61 | 1.55 | 0.06 |
| OFFFARM | -0.50 | 0.16 | -3.10 | 0.00 |
| VARIANCE | 1.04 | 0.07 | 15.85 | 0.00 |

560 observations used in estimation
Mean of log-likelihood = -2.37

earned from non-farm sources (OFFFARM). Several others are significant at the .10 level. The signs of the parameter estimates are consistent with the expectations used to specify the model. The signs of parameters also used in the previous estimation were unchanged indicating the model is fairly robust. The influence of several variables from the survey data, tested implicitly by this model, suggest some interesting implications.

LANDBUY shows a positive relationship to the rate of recropping. This may indicate that some producers used the CRP to expand their operation with the intention of producing more grain rather than permanently retiring marginal land.

The primary function of the farming operation will influence the post-CRP land use decision. This is indicated by the negative relationship between LIVEINC, the percent of income earned from livestock enterprises, and the rate of recropping. In addition, the positive coefficient on CROPFARM indicates that if the primary source of income is from grain production a higher proportion of CRP land will be returned to crop production. The theory that the CRP was used by some older producers is strengthened by the negative relationship between OLDER and the rate of recropping. Willingness to extend the CRP contract if haying or grazing is allowed (HAY) is positively related to the percent of CRP land returning to crop production. Although the relationship is not extremely significant this shows the influence CRP contract expiration may have on both livestock and grain markets.

The results of the weighted mean of recropping rate adjusted for unit and item nonresponse bias is 48.2 percent. Osborn used a weighted mean without adjusting for nonresponse bias to predict 52.7 percent of the land enrolled in the Conservation

Reserve would be returned to crop production. Although these results at first do not appear large, the difference is nearly one million acres returning to crop production if all contracts expire. The small difference between this prediction and Osborn's prediction is a result of the two sources of bias acting to cancel each other out.

## Summary and Implications

The purpose of this research was to predict the proportion of CRP land which producers intend to return to crop production when contracts expire. Based on the results of means tests, previous attempts to predict recropping were flawed in assuming valid survey data from the 1990 survey conducted by the Soil and Water Conservation Society. This research corrects the survey data for two sources of nonresponse bias. Data imputation, using a two-limit Tobit model, is used to predict the rate of recropping for both unit nonrespondents and item nonrespondents separately. After adjusting for nonresponse bias the weighted mean of recropping is calculated. The results of this research indicate that producers intend to return 48.2 percent of the land enrolled in the Conservation Reserve Program in the United States to crop production when contracts expire.

It seems reasonable, based on the results, that much of the marginal land in the CRP may remain idle in grass to meet conservation compliance requirements or annual set-aside provisions for government program participation. This land may also be kept in vegetative cover under the normal flexed acres or 0-50/92 programs.

Although the government has alternatives other than letting all CRP contracts expire, the proportion of CRP acres which will be returned to crop production if CRP contracts are not extended will have important implications on the predicted impacts on grain and livestock prices, the environment, and government costs.

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# CHAPTER III

# GRAIN MARKETS AFTER THE CONSERVATION RESERVE PROGRAM

## Introduction

The overriding objective of long term land retirement programs has been to reduce soil erosion on marginal cropland. Many researchers, producers, and agribusiness managers maintain that all land retirement programs have an implicit objective of supply control. The most recent long term land retirement program, the Conservation Reserve Program (CRP), gives producers an annual rental payment and cost-sharing in exchange for establishing a vegetative cover on marginal land. The CRP has reduced available cropland in the United States by nearly 34 million acres under the first nine signup periods (1986-1990). Among these are 22 million acres with historical crop acreage base (CAB) which will most likely be retained upon contract expiration. Ten million acres have wheat base and another 3.8 million acres have corn base. These acres could potentially produce 288 million bushels of wheat and 340 million bushels of corn (Osborn, Llacuna, and Linsenbigler). The purpose of this research is to determine the impacts the expiration of Conservation Reserve Program contracts will have on production and prices of wheat and corn in the United States.

Most research conducted on the price impacts of the Conservation Reserve Program has concentrated on the impacts during the CRP. In comparison, no current work has attempted to analyze the impacts of CRP land returning to crop production. However, these earlier studies may be helpful in determining the changes brought about by contract expiration.

Many estimates of commodity price impacts were made during the implementation of the CRP. These estimates ranged from a 1.5 percent increase in the price of wheat to a 19 percent increase in all grain prices (Taylor; Hertel and Preckel).

In 1990 Dicks, Ray, and Sanders used POLYSIM, an econometric policy simulation model, to determine the past impacts government programs, including the CRP, had on farm prices. The current research also uses POLYSIM to predict a baseline set of prices without the effects of CRP contract expiration. However, this analysis goes beyond Dicks, Ray, and Sanders by using RASS, a linear programming model, to predict changes in harvested acres, variable costs, and government participation due to changing government programs in the year following CRP contract expiration. These changes are used by POLYSIM to predict changes in production and price due to the incremental impacts of CRP contract expiration.

Despite these predictions, price levels for most agricultural commodities have not increased significantly during the CRP. This may be attributed to lower annual set-aside requirements on crop acreage base over the last several years. For example, the ARP for wheat in 1985 was 27.5 percent of base. Currently, the ARP on wheat is zero. In effect, the government has used a short-term policy instrument to balance some of the effects of a long-term policy.

Market outlook for grains depends on expected production. The assumptions and facts used in previous studies of price impacts due to land entering the CRP no longer apply. Clearly, with the first CRP contracts set to expire in 1996, commodity outlook must include the land use intentions of CRP contract holders to estimate the commodity price impacts of CRP contract expiration.

A major unknown for analysts and agribusiness decision makers over the next few years is the extent to which CRP acreage will return to crop production. The fate of land enrolled in the CRP as contracts expire has been the topic of several recent studies. In 1990, the Soil and Water Conservation Society (SWCS) conducted a national survey of CRP contract holders, in part to determine the rate of land returning to crop production. Forty two percent of respondents indicated they would return some CRP acreage to crop production (Nowak et al.). Osborn weighted responses to this survey by the number of acres controlled by each respondent to find crop production would resume on 52.7 percent of CRP acres. However, these estimates were made based on the survey data without testing the data for bias.

Recent work by Garrison et al. has shown the SWCS survey data suffered from two sources of nonresponse bias. A two-limit Tobit model was used for response imputation to adjust the data. After correcting for nonresponse bias the mean of recropping weighted by CRP acres was calculated. Results indicate 48.2 percent of the CRP land enrolled in the first nine signups will be returned to crop production. These recropping predictions are incorporated into market outlook in order to predict most likely changes in production and prices of wheat and corn in the post-CRP era.

## Procedure

Producer intentions represented by the SWCS survey are for land enrolled in the Conservation Reserve from 1986 to 1990. For this reason, the analysis will focus on the expiration of contracts entered in this period although subsequent signups have been offered. Enrollment eligibility is based on land characteristics including land capability class and soil loss tolerance. The most highly erodible land was enrolled in the first signups, so it will be the first eligible to return to production. As contracts expire, less fragile land will be eligible. The fourth signup offered incentives commonly referred to as "corn bonus" to entice producers from the corn belt to enroll in the CRP. For these reasons the market outlook for wheat and corn will be forecast by year from 1996 through 2000.

Although the government has alternatives other than allowing all CRP contracts to expire, the analysis is conducted assuming the Conservation Reserve will be terminated in the 1995 farm legislation. However, the analysis considers two alternative proportions of land returning to crop production.

First, a baseline market forecast will be made assuming all CRP contracts are extended. From this, changes in the wheat and corn markets are predicted assuming first that 100 percent of base and then, under the most likely scenario, 48.2 percent of base acres for all crops enrolled in CRP will return to production. Past land use should indicate the most profitable land use, and therefore, the analysis assumes only land which has established crop acreage base will return to production. It should be noted that this analysis does not consider the 12 million acres which do not have crop acreage base. Therefore, impacts due to land returning to soybean production are not explicitly estimated. Although the characteristics of the land enrolled in each signup differ, there is little difference in the average productivity of land between signups (Osborn, Llacuna, and Linsenbigler). Therefore, all land returning to crop production is assumed to be of average productivity for the production area where it returns. Under these assumptions and scenarios the impacts of CRP contract expiration on the production and prices of wheat and corn are predicted for each year of contract expiration.

The analysis is accomplished using a comprehensive simulation model, POLYSYS, developed at Oklahoma State University and the University of Tennessee. POLYSYS combines linear programming, econometric simulation, and Input-Output models to determine the impacts of policy changes (Dicks, Ray, and Ugarte). To determine production and price impacts of CRP contract expiration only the econometric component is used fully. The linear programming capabilities of POLYSYS are bypassed even though the LP component is partially employed. Each component and the methods used to conduct this analysis are described.

POLYSIM (Policy Simulator) is the econometric component used to estimate annual supply and demand, as well as prices for major U.S. commodities. POLYSIM uses a baseline set of data over the analysis period in order to predict prices and production (Dicks, Ray, and Ugarte). For this analysis, the Food and Agriculture Policy Research Institute (FAPRI) baseline assumptions (November 1992) are used to construct the supply and demand components of POLYSIM used to predict production and price. However, this baseline includes an estimate of CRP land returning to crop production. For the purpose of this analysis the FAPRI baseline has been adjusted to represent complete extension of all CRP contracts. The FAPRI baseline originally assumed 60 percent of the crop base acres would return to crop production. These acres are removed from the baseline scenario. POLYSIM uses percentage changes from baseline values and supply and demand price elasticities, capturing cross-price relationships, to estimate the effects of changes in farm policy (Dicks, Ray, and Ugarte). The initial simulation using the modified FAPRI baseline provides a measure of the production and price changes that could be expected if the CRP is extended, with none of the land returning to production. The estimates of price for each year of analysis are incorporated into RASS (Resource Allocation Summary Sheet), the second component of POLYSYS, to predict changes in harvested acreage as CRP land returns to crop production.

RASS is an interregional linear programming model which estimates the expected distribution of crop production activities across 105 production areas of the contiguous United States. RASS combines variable cost, yield, price, and acreage for each crop in each of the production areas. Variables for each crop are summarized in a separate spreadsheet and the spreadsheets are linked through an objective function to maximize net returns. An input sheet is used to provide changes in each of the variables to represent pre-planting expectations (Dicks, Ray, and Ugarte). For this analysis, changes in the acreage available for crop production due to yearly CRP contract expiration in each production area were made in RASS to predict the change in harvested acreage. This prediction is then used in POLYSIM to support predictions of supply, demand, and market prices in each year.

RASS and POLYSIM are linked in a recursive framework which uses the forecasting abilities of POLYSIM to provide expected prices, costs, and yields. Based on these expectations, RASS determines cropping activities for all regions and aggregates them to a national level. The output from RASS is then supplied to POLYSIM to estimate the price response associated with the estimated levels of harvested acreage.

For this analysis the expected price, variable costs, and national program acreage for 1996 obtained from the adjusted FAPRI baseline in POLYSIM are supplied to RASS. The changes in available crop acreage in each production area due to contract expiration under each scenario for 1996 are made in RASS. RASS is then used to predict changes in harvested acreage under the alternative scenarios. RASS also predicts changes in national yields, cost of production, and commodity program participation that will occur as a result of changes in land use. These percentage changes for each crop are then provided to POLYSIM to estimate the impacts of CRP expiration on production and prices of wheat and corn for 1996. Using these predictions, the 1997 price under the alternative scenarios of recropping for each crop is forecast by POLYSIM. The procedure is repeated under each land-use scenario to obtain the impacts of contract expiration in 1997 along with a forecast for 1998. This recursive procedure is repeated for each year from 1996 through 2000 to determine the yearly impacts of CRP contract expiration of the first nine signups.

## Results

As CRP land returns to production, price and production diverge from the baseline estimates generated by POLYSIM. Because predictions are based on deviations from a set of baseline assumptions affecting supply and demand in each year, price does not consistently decline or production increase in absolute terms over time. Rather, price diverges from the baseline prediction as land returns to crop production over time. The impacts of Conservation Reserve Program contract expiration on the market outlook for corn and wheat are discussed separately.

Predicted corn production under the alternative scenarios is shown in Table VI. The percentage changes in corn production grow steadily farther from the baseline predicted in POLYSIM in each year of contract expiration. By 2000, production is expected to be 2% higher than the baseline under the 48.2 percent scenario, and 5% higher under the 100 percent scenario.

As CRP contracts expire, the price of corn steadily diverges from the baseline price predicted by POLYSIM. The impacts on corn price for each year of contract expiration are shown in Table VII. The price impact of contract expiration in 1996 is minimal. The biggest year-to-year impact on corn prices is in 1997, the year contracts for land enrolled under the corn bonus expire. The 1997 baseline price is $2.39/bu. The price under the 48.2 percent CRP recropping scenario is $2.35/bu., a 1.7% decline from the predicted baseline, and the price under the 100 percent recropping scenario is $2.45/bu., a 5% decline. The results for predicted corn price and production deviations from the baseline are illustrated in Figure 2.

TABLE VI

PREDICTED CORN PRODUCTION DEVIATIONS
FROM BASELINE, 1996-2000

| Year | Baseline (Million bushels) | 48.2 Percent (%) | 100 Percent (%) |
|---|---|---|---|
| 1996 | 8822.2 | 0.10 | 0.19 |
| 1997 | 8887.7 | 1.36 | 2.83 |
| 1998 | 8919.0 | 1.67 | 3.46 |
| 1999 | 9013.5 | 1.98 | 4.14 |
| 2000 | 9140.3 | 2.23 | 4.64 |

TABLE VII

PREDICTED CORN PRICE DEVIATIONS
FROM BASELINE, 1996-2000

| Year | Baseline ($/bu) | 48.2 Percent (%) | 100 Percent (%) |
|---|---|---|---|
| 1996 | 2.48 | 0 | -0.40 |
| 1997 | 2.39 | -1.67 | -2.93 |
| 1998 | 2.38 | -1.68 | -3.78 |
| 1999 | 2.45 | -2.04 | -4.48 |
| 2000 | 2.58 | -2.32 | -5.04 |

Table VIII indicates that in 2000 wheat production will be 6% above the baseline under the 48.2 percent scenario, and 12.5% above the baseline under the 100

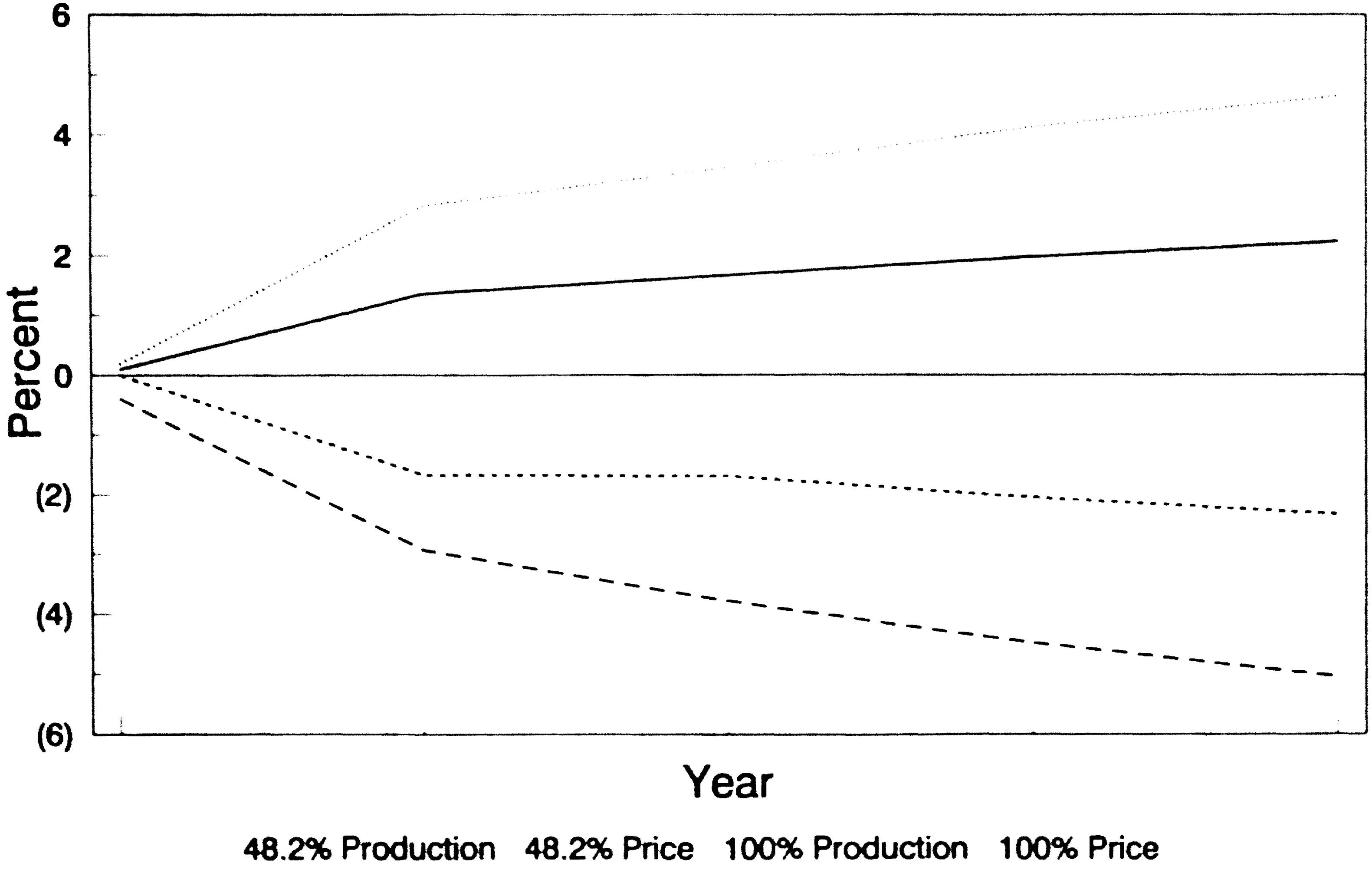


Figure 2. Predicted Corn Price and Production, Deviations from the Baseline Under 48.2% and 100% Recropping Scenarios, 1996-2000

TABLE VIII

PREDICTED WHEAT PRODUCTION DEVIATIONS FROM BASELINE, 1996-2000

| Year | Baseline (Million bushels) | 48.2 Percent (%) | 100 Percent (%) |
|---|---|---|---|
| 1996 | 2535.4 | 0.31 | 0.65 |
| 1997 | 2499.2 | 2.36 | 4.95 |
| 1998 | 2495.0 | 4.09 | 8.54 |
| 1999 | 2461.1 | 5.11 | 10.68 |
| 2000 | 2464.9 | 5.98 | 12.50 |

percent scenario. While corn price does not show real decline from the baseline until 1997, Table IX shows the price of wheat is expected to drop 0.5% from the POLYSIM baseline in 1996 under the 48.2 percent scenario, and 1% under the 100 percent scenario. Wheat price consistently diverges from the baseline until in 2000 it is 7% below the baseline under the 48.2 percent scenario, and 13% below under the 100 percent scenario. The results for predicted wheat price and production deviations from the baseline are illustrated in Figure 3.

The price impacts estimated in this analysis due to increased wheat and corn production suggest a near-unitary demand elasticity, since percentage increases in production are nearly matched by percentage decreases in price. This would be an inappropriate representation of agricultural markets in general. However, the elasticity is a long-run estimate of both the wheat and corn markets covering a period

TABLE IX

PREDICTED WHEAT PRICE DEVIATIONS FROM BASELINE, 1996-2000

| Year | Baseline ($/bu) | 48.2 Percent (%) | 100 Percent (%) |
|---|---|---|---|
| 1996 | 3.67 | -0.54 | -1.09 |
| 1997 | 3.75 | -3.20 | -6.93 |
| 1998 | 3.65 | -5.48 | -9.58 |
| 1999 | 3.81 | -6.30 | -11.29 |
| 2000 | 4.04 | -7.18 | -12.87 |

of five years. It takes into account the cumulative impacts of CRP contract expiration including increasing grain stocks and changing cross-price effects. Thus, the results imply elasticities within the range of those historically estimated for agricultural commodities.

## Summary and Implications

The results clearly suggest that CRP contract expiration will influence the price of wheat and corn. Under the most likely scenario, based on past production practices and producer intentions, 48.2 percent of the base acres enrolled in the CRP will return to production. Under this scenario, price of corn declines by more than 2% from baseline by 2000, and the price of wheat declines by more than 7%.

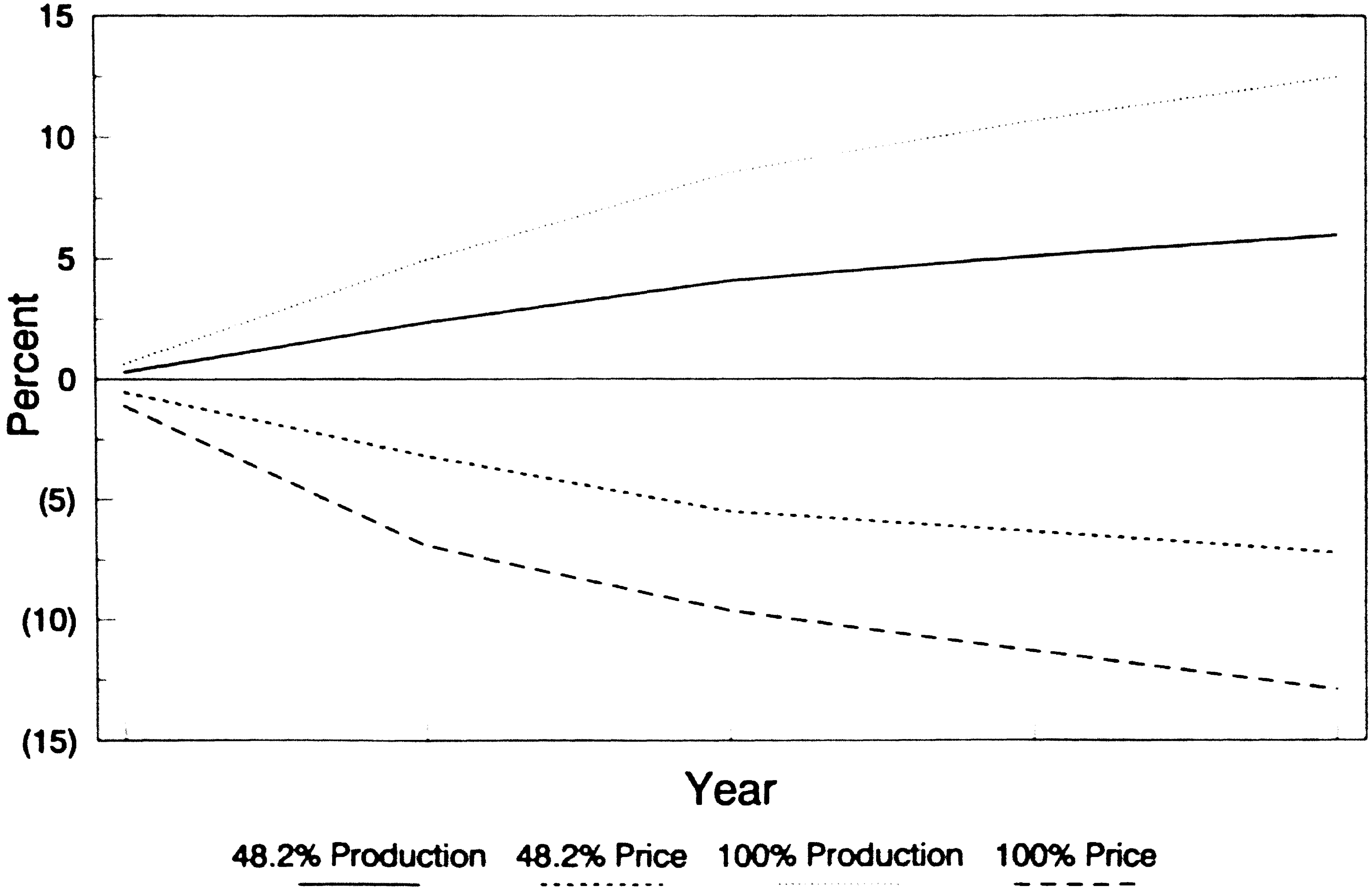


Figure 3. Predicted Wheat Price and Production, Deviations from the Baseline Under 48.2% and 100% Recropping Scenarios, 1996-2000

Declining farm prices for wheat and corn may cause declining net farm returns. Also, government program costs for these and other crops may increase unless the Secretary of Agriculture uses discretionary controls to keep the loan rate higher in 2000. These implications, along with many others, must be considered in the 1995 farm bill debate when the future of the Conservation Reserve will be decided.

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# CHAPTER IV

# THE EFFECTS OF THE CONSERVATION RESERVE PROGRAM ON MERCHANDISING MARGINS OF ELEVATORS

## Background

Economic conditions and farm programs in the 1980s and 1990s have changed the economic environment in which grain elevators conduct business. Land retirement programs in the mid-1980s reduced grain production and increased competition among elevators for available supplies. The largest land retirement program in recent years is the Conservation Reserve Program (CRP), with approximately 37 million acres of cropland enrolled to date.

Many elevator managers, particularly those in areas with high CRP participation, believe that the CRP program has contributed substantially to their financial stress. In Oklahoma, for example, CRP enrollment for several counties exceeds 25 percent of the total cropland in the county. In a recent survey of Oklahoma and Texas cooperative elevator managers, sixty percent of those surveyed indicated the CRP had a negative impact on the elevator (Sanders, Kenkel, and Smith). By diverting cropland away from production, the implicit supply control objective of the CRP may have caused lower profits and tighter marketing margins for country wheat elevators.

Although many factors have contributed to the problems facing grain elevators, such as reduced grain exports, heavy borrowing and expansion in the late 1970s and early 1980s, and the overall weak farm economy, an evaluation of the effects of the CRP will provide useful information as the 1995 farm legislation is debated. Although much research has attempted to evaluate the environmental and budgetary impacts of CRP, little research has examined the impacts on agribusiness firms.

Despite the changing structure of the industry, grain elevators still maintain an important role in marketing basic commodities. Country grain elevators remain a vital transfer and pricing mechanism in the marketing system.

This paper focuses on the effect of CRP on elevator profits by assessing the impacts of CRP on elevator merchandising margins. A theoretical model is developed for grain elevators performing grain merchandising services. An empirical model is formulated for assessing the impacts of CRP on a grain elevator in a major wheat-producing county in Oklahoma.

## Theoretical Framework

Less grain in the marketing system could shift market centers away from small country elevators. In periods of tight supply, convenience yield, associated with immediate delivery, increases. With less grain to be stored, country elevators would likely find it unprofitable to store their own grain under a storage hedge. More significantly, the lower volume of grain would mean decreased storage revenues received from producers and government storage programs. One way the elevator could improve its storage volume and revenues is to reduce its storage charges. Lower storage charges may make it profitable for producers to contract with the elevator for storage services, but they will reduce the margin received by the elevator for its storage activity.

The merchandising margin is defined as the difference between the price received from next-in-line (NIL) buyers and the price paid to farmers (Tomek and Robinson). Reduced production due to CRP may have forced country elevators to increase the bid price offered to farmers in order to maintain the volume of grain merchandised to cover a portion of fixed costs. Higher bid prices are offered to entice local producers to reduce on-farm storage and to refrain from selling to competing elevators. By definition, as the bid price is increased the merchandising margin would be reduced unless a proportional increase was offered by NIL buyers.

Profitability is a measure of the efficiency of the business organization in agricultural elevators (Christy and Zapata). Since price margins constitute a management objective and affect the profitability of the elevator, it should prove useful to observe the association between margins and land retirement programs.

Virtually no research has addressed the impacts of the Conservation Reserve Program on marketing margins of grain elevators. The hypothesis that the supply control objective of the CRP has forced elevators to reduce storage and merchandising margins to maintain volume has the potential to determine the impacts on profitability of elevators both during and after the CRP. The theoretical framework of several sources will provide a useful guide in analyzing these impacts.

Most research of marketing margins has focused on the farm-retail price spread. Describing the effects of price uncertainty on margins of U. S. flour mills, Brorsen et al. solved a utility maximization problem. The marketing margin was expressed as a function of wealth, input prices, price uncertainty, and output. Although price uncertainty is beyond the scope of the present research, this research provides a basis for the analysis of the marketing margin received by an intermediate firm within the marketing system.

Gardner, in his groundlaying work on margins, defines an equilibrium price margin as the difference between retail and farm price, $P_x$ - $P_a$.[4] For a grain elevator, price margins (M) are defined as the difference between price received from next-in-line (NIL) buyers[5] ($P_R$) and price paid to producers ($P_f$).

(10) $$P_R - P_f = M$$

Analyzing the elasticity of the farm-retail price ratio, Gardner shows how an exogenous force which decreases the supply of agricultural input (i. e. wheat) decreases the marketing margin. In addition, Gardner concludes an increase in the supply of marketing services would cause tighter margins. Under the CRP, the supply of marketing services has increased relative to demand due to an increased convenience yield associated with immediate delivery of wheat.

The marketing margin may be determined by the difference between the equilibrium prices occurring at the intersection of primary supply and derived demand

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[4]Gardner defines several measures of the price spread between retail and farm price. In this definition, $P_x$ is the retail price of food and $P_a$ is the farm price of agricultural output.

[5]For example, processors, millers and terminal or port elevators.

and the intersection of derived supply and primary demand (Tomek and Robinson). As the price of wheat increases in deficit processing areas primary suppliers (farmers) may bypass grain elevators so that derived supply (elevator volume) decreases resulting in a higher equilibrium price between derived supply and primary demand.

Tomek and Robinson also define the marketing margin as the collective price of marketing services which is determined in the market for those services. As previously discussed, the CRP has caused a lower demand for marketing services resulting in a relative surplus supply.

Wohlgenant and Mullen, as well as Gardner, define the supply of marketing services as a function of input prices and output prices. The quantity of marketing services is defined as:

$$Q_m = f(P,r) \tag{11}$$

where:

$Q_m$ is the supply of marketing services,

P is the price paid to the elevator by NIL buyers, and

r is a vector of input prices including the farm price of wheat.

Assuming this function is positively sloped, the price of marketing services would decrease as demand is decreased, resulting in tighter margins (Tomek and Robinson).

By inverting this supply function and solving for P - $r_1$, where $r_1$ is the farm price of wheat, we obtain a representation of the marketing margin:

$$P - r_1 = M = g(Q_m, r_2, \ldots, r_n) \tag{12}$$

where:

M is the marketing margin and

$r_2,\ldots,r_n$ are other marketing input prices.

The empirical aggregation of the supply of marketing services would be difficult or impossible. However, if it is assumed that the quantity of wheat produced ($Q_p$) is a suitable proxy for the quantity of marketing services ($Q_m$), such that $Q_m=Q_p$, $Q_p$ may be substituted.

The quantity of wheat produced is a function of the price received by farmers ($P_f$), farm input costs (C), price of competing enterprises ($P_c$), and federal policies which influence land use and the intensity of production (G)

(13) $$Q_p=h(P_f,P_c,C,G)$$

Substituting (13) into (12) yields margin as a function of production, input prices, and output prices

(14) $$M=g(h(P_f,P_c,C,G),r_2,\ldots,r_n)$$

or simplifying,

(15) $$M=l(P_f,P_c,C,G,r_2,\ldots,r_n)$$

This provides a theoretical foundation for including policy variables in the specification to explain the variation in marketing margins. Although derived using a proxy the theoretical relationship between the quantity of wheat produced, elevator volume, and marketing margins is easily comprehended.

Gardner concluded that changes in both supply and demand affect the marketing margin. Therefore, the impacts of the CRP on margins could only be fully analyzed using simultaneous market equations. However, the purpose of this research is to determine the structural specification of the marketing margin. Due to data limitations a quasi-reduced form model of marketing margins is used to gauge the impacts of the CRP. In the next section the impacts of a government program (i.e., CRP) which reduces production intensity on elevator merchandising margins is investigated.

In a competitive market it has been shown that the behavior of cooperatives and commercial elevators are identical (Sexton, Wilson, and Wann). Consider a competitive elevator providing one service, merchandising. It is assumed that grain purchased from farmers is sold directly to NIL buyers. That is, all grain must be taken out of storage at the end of the period, so beginning and ending inventory is zero. Risk and liquidity constraints limit elevators from storing the grain for long periods of time. Thus, the total quantity of grain marketed by the elevator ($Q_m$) equals the quantity purchased from farmers and sold to NIL buyers in the current period ($Q_f$). The model described above is applied to a cooperative wheat elevator in Oklahoma.

## Empirical Model

The merchandising margin received by the local elevator is determined by local supply and demand conditions. Since wheat is an export-based commodity, conditions in the world market directly affect the demand for wheat at the elevator. These effects are assumed to be captured in the Gulf - Kansas City basis (Tilley and Campbell). Likewise, the biological nature of production, producer decisions, and government programs impact the supply of wheat available to the elevator. The purpose of the empirical model is to assess the impact of CRP on elevator marketing margins after allowing for other factors.

The merchandising margin is assumed to be a function of the price received by the elevator, the nearby Gulf - Kansas City basis, acres enrolled in the CRP, mandatory government program set-aside requirements, and price of feeder cattle. Therefore, the model is specified as:

$$M=\beta_0+\beta_1 P_f+\beta_2 BASIS+\beta_3 FEEDER+\beta_4 ARP+\beta_5 CRP+e \quad (16)$$

where M = merchandising margin

$P_f$ = price received by farmers

BASIS = July basis

FEEDER = price of feeder cattle

ARP = percentage set-aside requirement

CRP = acres in CRP

Data used are harvest-time (June 20) data on price received and merchandising margins for a cooperative elevator in Oklahoma for the period 1975 through 1990. Futures prices are June 20 prices for Kansas City Hard Red Winter wheat contracts. Gulf prices are June 20 cash bids for Hard Red Winter wheat at the Gulf of Mexico. The dependent variable, merchandising margin, represents the actual merchandising margin received by the elevator on June 20 of each year. The margin is calculated as the difference between the Gulf bid and the local bid on this date, less transportation costs from the elevator to the Gulf port.

The price received ($P_R$) is the Gulf bid less transportation cost. Unless the elevator's merchandising margin is a constant absolute markup over time, the margin should be positively related to price received.

Nearby basis is assumed to reflect storage costs, the level of export commitments relative to free stocks, and futures market liquidity (Tilley and Campbell). The nearby basis is the difference between the Gulf bid and the price of the nearby futures contract. The July contract is used to calculate the nearby basis. Since the analysis focuses on the margin on June 20, the most important contract month is July.

A high price for feeder cattle (FEEDER) may entice some central Oklahoma producers to leave stocker calves on wheat pasture beyond the jointing stage of production. This allows for better weight gains for the calves, but destroys any harvest potential for the wheat. Producers may also graze out winter wheat pasture as a result of participation in the 0/92 or 50/92 program. In either case the intensity of wheat production is reduced in the elevator's trade area. The value of feeder cattle is based on the average price in March for 700-800 pound steers at the Oklahoma City Stockyards for each year of analysis. Stocker cattle would normally be taken off wheat pasture during March (before the jointing stage) while still weighing close to 700 pounds. A prolonged grazing period would put cattle in the 700-800 pound range. It is expected that as the March price of 700-800 pound steers increases, producers have more incentive to pasture the wheat rather than harvest it, and the local elevator will bid a higher price to improve the relative profitability to the farmer for producing wheat. The higher bid would cause the margin to decrease.

The supply control objective of government farm policy affects the intensity of wheat production and the supply of grain available in the elevator's trade area. The number of acres enrolled in the CRP has reduced the wheat base acres available for production by nearly 10,000 acres in the elevator's trade area since implemented in 1986. Acres participating in CRP in each year in the county where the elevator is located are taken from the Agricultural Stabilization and Conservation Service (ASCS) national data tapes. The variable represents the summation of incremental reductions in wheat base due to enrollment in CRP. From 1975 through 1985 there was no Conservation Reserve Program, therefore, no reduction in wheat base occurred and the variable CRP is zero for this period. The mandatory set-aside percent for program participation is represented by ARP. Oklahoma had a participation rate in government programs of well over 90 percent over this period.

The empirical model of elevator marketing margins is estimated with ordinary least squares. Preliminary results indicated that a significant time trend existed in the period. To correct for this, a trend variable was included in the set of independent variables used in estimation. Data for the variables MARGIN, PRICE, and BASIS were obtained from a cooperative elevator in central Oklahoma. The data for CRP represents the number of acres enrolled in the program in the county where the elevator is located. The data for CRP came from the Agricultural Stabilization and Conservation Service national data base of CRP contracts. All other data were obtained from the Oklahoma Agricultural Statistical Service.

## Results

The results of the regression analysis show that the variables in the model explain 85 percent of the variation in the elevator margin ($R^2$ = 0.85, adj. $R^2$ = 0.74) Three of the variables in the model show a significant relationship with the elevator margin at a .15 or higher significance level. The direction of the relationship between the margin and the independent variables was as expected with the exception of feeder cattle price, which was insignificant. A summary of the empirical results can be found in Table X.

TABLE X

OLS REGRESSION ESTIMATES OF FACTORS EXPLAINING ELEVATOR MERCHANDISING MARGINS

| VARIABLE | PARAMETER ESTIMATE | STANDARD ERROR | P-VALUE |
|---|---|---|---|
| INTERCEPT | 0.041587 | 0.113747 | 0.72 |
| PRICE | 0.129493 | 0.040429 | 0.01 |
| NEARBY | 0.032585 | 0.161988 | 0.85 |
| CRP | -0.000010 | 0.000008 | 0.07 |
| ARP | -0.152743 | 0.223031 | 0.25 |
| FEEDER | 0.001330 | 0.001849 | 0.25 |
| TIME | 0.027994 | 0.01562 | 0.03 |

$R^2$ = 0.85
adj. $R^2$ = 0.74

The significant positive coefficient on price suggests that the elevator merchandising margin is not a constant absolute markup, but is higher (larger margin) for higher wheat prices. The nearby basis was not a significant factor in explaining elevator margin.

The value of feeder cattle seemingly shares a positive relationship with the elevator margin. This result is not expected since Oklahoma producers have the opportunity to graze out the wheat pasture rather than produce grain depending on the relative profitability of each enterprise. However, this coefficient is not significantly different from zero.

The results of the model suggest that government programs which reduce the intensity of production also reduce the margin of the local elevator. While an inverse relationship exists between the ARP and the margin the parameter estimate is near zero. However, the results of a one-tailed t-test of the significance of the parameter CRP suggest that the Conservation Reserve Program has significantly (at the 0.07 level) affected elevator merchandising margins. Apparently, the intensity of wheat production has decreased sufficiently that the elevator has been forced to accept a smaller margin in order to maintain the volume necessary to cover fixed costs and profit.

## Summary and Implications

The results of the regression analysis and the hypothesis test on the impact of the CRP on elevator margins suggest that the supply control objective of this land retirement program has burdened country elevators. These results add a new dimension to the debate over the fate of the Conservation Reserve Program in the 1995 farm legislation. The model used here to estimate the relationship between variables related to supply and demand and the elevator margin may be useful in predicting the margins and profitability of country elevators as CRP contracts begin to expire and some of this land returns to wheat production.

The effect of CRP seems to be significant, but evaluation of the magnitude of those effects should wait for more precise estimates. Further research should expand on this model by including dynamics and considering other elevator activities, such as storage. Finally, these results have focused on a single elevator. More robust estimates will require consideration of a larger population of elevators.

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# CHAPTER V

## SUMMARY AND IMPLICATIONS

Land use policies have been a prominent force in the development of agriculture. Early policies in the 1800s were focused on the expansion of agriculture, the country's primary economic industry. Environmental concerns, excess production, and maintaining the country's long run production capacity have become the driving force of land use policies in the 1900s. While erosion control continues to be the primary objective of land use policies, recent legislation carries supply control as a secondary objective. The most prominent example of this kind of program is the Conservation Reserve Program (CRP), mandated in the Food Security Act of 1985. Nearly 34 million acres of highly erodible cropland in the United States has been idled in the CRP during the first nine signup periods from 1986 to 1990.

As a producer enrolled land in the CRP, a proportional base acreage reduction occurred. Among the acres enrolled in the CRP are 10 million acres which have historical wheat base and 3.8 million acres of corn base. These acres could produce nearly 288 million bushels of wheat and 342 million bushels of corn each crop year (Osborn, Llacuna, and Linsenbigler). Removing these acres from production may have had large impacts on the grain marketing system by subjecting grain handlers and input suppliers to severe competitive pressures.

A major unknown for analysts, policy makers, and agribusiness decision makers over the next few years is the extent to which CRP acres will return to crop production. The purpose of this research is to determine the effect CRP contract expiration will have on the supply and demand for wheat in the United States and on marketing margins at country elevators.

This objective is met by accomplishing three specific objectives. The specific objectives of this research are: (1) determine the percent of CRP land which producers intend to return to crop production as contracts expire; (2) forecast the quantity of wheat produced and the subsequent price of wheat for each year from 1996 through 2000 as CRP land returns to production; (3) determine the effect the Conservation Reserve Program has had on country elevator marketing margins and returns to storage and merchandising activities. The overall objective is met by combining the results of the three specific objectives to determine the direction of change in elevator margins.

A summary of the research, implications, and suggestions for future research associated with each specific objective are discussed separately in the following sections. Some general implications and suggestions for further research are included in the closing section.

## Recropping Rates of CRP Acreage

The first land enrolled in the Conservation Reserve will be eligible for production activities beginning in 1996. The land use intentions of contract holders are the primary factor in determining the how much CRP land will return to crop production.

The Soil and Water Conservation Society (SWCS) conducted a national survey of 2,739 contract holders through the ninth signup in 1990, in part to determine the post-CRP land use intentions of contract holders. Previous research which has utilized this data was flawed in assuming the survey data adequately represents the population of CRP contract holders.

Chi-square and means tests show that the SWCS survey suffered from both unit and item nonresponse bias. Separate two-limit Tobit model specifications are used to impute the rate of recropping for nonrespondents to correct the survey data for each source of nonresponse bias. The mean of recropping rate weighted by acres enrolled is calculated from actual and imputed survey responses.

The results of the two-limit Tobit models suggest some interesting implications from the factors which seem to influence land use intentions. A positive relationship exists between the percent of acres planted to native grass and the rate of recropping. Both livestock and grain producers have tended in the past to assume these acres would be used to graze livestock. However, the results show that this is not necessarily the case. Also, the results indicate that producers who enrolled a large percentage of their farm in the CRP do not plan to return as much of the land to crop production. Therefore, these acres may not be recropped immediately, but future tenants or land owners may decide otherwise.

The CRP may have also aided in the expansion of some crop producing farms by providing capital to producers who purchased more cropland. This expansion has likely already been absorbed by the markets since no restrictions on using this land apply. However, contract holders who expanded operations under the CRP will return more acres to crop production. Also, the primary enterprise of the farming operation will influence the land use decision. Livestock producers will be returning less land to crops as crop producers return more.

The results of the weighted mean of recropping show that 48.2 percent, or 17 million acres, of the land in the CRP will return to crop production if contracts are not extended. However, the 1995 farm legislation will play a major role in determining the actual rate of recropping. Some producers expressed an interest in extending contracts for a reduced annual payment if haying or grazing is allowed. The nature of the survey data and the myriad of possible options to the government for extending the CRP make the results of this analysis somewhat uncertain.

This analysis could be improved if a second survey, underway by the SWCS, employs a stratified sample so that the sample better represents the population and unit nonresponse bias is less likely. Also, if the question relating to post-CRP land use intentions is asked more appropriately item nonresponse bias may not occur.

The results of the models used in data imputation suggest that some adjustment should be made for acres planted to trees. In addition, future research should account for land use alternatives such as flex acres, annual set aside, and underplanting provisions of recent farm legislation. Also, the impacts of conservation compliance should be estimated. The actual rate of recropping will depend on what action is taken by the government in the next farm legislation scheduled for 1995. It is likely that the annual set-aside requirements (ARP) will be increased to counter falling prices expected when CRP contracts expire.

## Grain Markets After the CRP

The land use intentions of CRP contract holders is of critical concern to the agricultural industry. The rate of land returning to crop production will have ramifications on farm prices, net returns, and government program costs. The second objective of this research investigates the potential influence of CRP contract expiration on production and prices of wheat and corn in the United States.

The analysis is conducted using POLYSYS, a comprehensive policy simulation model designed to analyze the impacts of agricultural policy changes. Two alternative proportions of base acres returning to crop production are compared to a baseline scenario. First, it is assumed that all base acres in the CRP will return to crop production. Second, it is assumed that the percent of base acres returning to crop production is the rate of recropping estimated under the first objective. The analysis does not consider the remaining 12 million acres without crop acreage base.

POLYSIM (Policy Simulator) is the econometric component of POLYSYS used to estimate annual supply and demand, as well as prices, for major U. S. commodities. For this analysis, the Food and Agriculture Policy Research Institute (FAPRI) baseline assumptions are adjusted to represent complete extension of all CRP contracts. The FAPRI baseline originally assumed 60 percent of the crop base acres would return to crop production. These acres were removed and a new baseline was created using POLYSIM.

The expected price, variable costs, and national program acreage for 1996 from the baseline are supplied to RASS, a linear programming component of POLYSYS. The changes in available crop acreage in each production area of the U.S. due to CRP contract expiration are made in RASS. RASS is then used to predict changes in harvested acreage, national yields, variable costs, and government program participation under the alternative scenarios. The percentage changes for each crop are then provided to POLYSIM to estimate the impacts of CRP expiration on production and prices of wheat and corn for 1996. Using these predictions, the 1997 price under the alternative scenarios of recropping for each crop is forecast by POLYSIM. The procedure is repeated in a recursive framework for each year from 1996 through 2000 to determine the yearly impacts of CRP expiration of the first nine signup periods.

The results of the analysis show that production and price for both wheat and corn diverge steadily from the baseline forecasts. Under the 100 percent recropping scenario corn price declines by a total of 5 percent in 2000. Under the most likely scenario, corn price drops 1.7 percent. Proportional increases in production account for these price declines. If 100 percent of the wheat base acreage in the CRP were to return to production, wheat price would decline nearly 13 percent by 2000. If only 48.2 percent returns the price of wheat would drop more than 7 percent. Wheat production shows corresponding increases as contracts expire.

Lower farm prices for wheat and corn may cause a decrease in net farm returns. Also, government costs for commodity programs may rise substantially by

2000 unless the administration uses discretionary power to maintain the loan rate at higher levels or the calculation of the loan rate is changed.

However, as more grain is produced the volume handled by the grain marketing system will increase. This may allow some reprieve to grain elevators who have raised bid prices to maintain grain volume under the supply control objective of the CRP. Also, convenience yield associated with immediate delivery of grain may diminish so that substantially higher returns to storage may occur.

The future of the CRP will not be certain until the 1995 farm legislation. Although this research provides estimates of price and production impacts under reasonable scenarios, consideration of other policy and producer alternatives as more information becomes available would provide more detail for policy makers and agribusiness decision makers.

## The CRP and Elevator Margins

Many elevator managers, particularly in areas of high CRP participation, believe that the CRP has contributed to their recent financial stress. By diverting cropland away from production, the CRP may have caused lower profits and tighter marketing margins for country wheat elevators. The third objective of this thesis is to determine the affect the CRP has had on marketing margins of wheat elevators.

The marketing margin is the price for a collection of marketing services which is determined by the supply and demand for those services. The CRP has decreased the demand for marketing services by suppressing grain production. A theoretical model is derived based on the supply of marketing services. Wheat production is used as a proxy for the quantity of marketing services so that the marketing margin is ultimately a function of farm prices, input prices, price paid by next-in-line buyers, and policy variables which influence agricultural land use.

An empirical model of elevator margins is specified in accordance with the theory derived to explain the variation in marketing margins. Data from a cooperative elevator in central Oklahoma is used to demonstrate how the theory could be empiricized.

The results of the model showed that for the case analyzed the most important factor in determining the marketing margin was the farm price. In addition, the results suggested that the CRP may have marginally impacted the margin received by this elevator. This provides the basis for future research which may utilize a larger sample. The small sample used in this analysis is not sufficient to draw any reasonably sound inferences on elevator margins after the CRP. However, the sign on the parameter estimate for the CRP suggests a need for further investigation. More robust estimates will require consideration of a larger population of elevators. Further research should consider other elevator activities such as storage and provide for a more dynamic analysis.

Based on the results of the three specific objectives accomplished in this thesis it could be concluded that the expiration of Conservation Reserve Program contracts set to begin in 1996 will relieve some of the pressure placed on wheat elevators by the supply control objective of the CRP. It should be stressed that this analysis is conducted based on estimates of land use intentions at the time of the SWCS survey. These intentions may change by the time the first contracts are set to expire. In addition, this analysis has been conducted assuming that the CRP will not be extended in the 1995 farm legislation.

As the 1995 farm legislation is debated the results and implications of this analysis must be considered. The Conservation Reserve Program creates a dilemma for the future of farm policy. The objectives stated by the Clinton administration have been both to protect the environment and to reduce the federal budget deficit. Continuation of the CRP would require substantial spending to protect marginal land from soil erosion. However, if the CRP is eliminated, commodity program spending under the current legislation will increase as farm prices decline in the post-CRP era unless the Secretary uses authorized discretion to maintain the loan rate. Government program costs and the costs to the environment must be weighed in deciding the future of the CRP. The relative importance of the administration's objectives will have a profound impact on the future of the CRP.

# REFERENCES


Osborn, Tim, Felix Llacuna, and Michael Linsenbigler. The Conservation Reserve Program: Enrollment Statistics for Signup Periods 1-9 and Fiscal Year 1989. United States Department of Agriculture, Economic Research Service. Statistical Bulletin Number 811, July 1990.

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