The Federal Crop Insurance Program : An Empirical Analysis of Regional Differences In Acreage Response and Participation *

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Abstract

The extent to which crop insurance programs have resulted in additional land being brought into production has been a topic of considerable debate. We extend a multi-equation structural model of crop acreage response, insurance participation, CRP enrollment, and input usage developed in Goodwin and Vandeveer (2000) to wheat and barley production in the "Northern Great Plains" region. We also update earlier results for corn and soybean production in the "Heartland" region. Our results confirm earlier findings that increased participation in insurance programs provoke a statistically significant acreage response. This response is, however, relatively modest. We find that across-the-board decreases of 50% in insurance premiums significantly increase participation but result in acreage increases of about 0.47% for barley and 3.66% for wheat. In the modern period (1997-1998), expanded insurance participation brought about by premium rate reductions has almost no effect on acreage. Our results for the recent period show an increase in insurance participation due to the provision of revenue insurance.

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1 Introduction

Crop insurance programs have been a part of U.S. agricultural policy since the 1930s and their prominence has increased in recent years as the program has expanded. Over most of its history, the U.S. crop insurance program has been intended to protect agricultural producers from yield risk by paying indemnity payments whenever realized yields fell beneath some guaranteed level. Though the program has undergone many changes over its history, the basic components and operation of the crop insurance program were largely unchanged until recent years. With the reductions in federal price supports mandated by the Federal Agricultural Improvement and Reform (FAIR) Act Of 1996, the federal crop insurance programs have been given a central role in providing for farm income stability.[1]

Over the last several years, U.S. crop insurance programs have undergone significant change. In 1994, the Crop Insurance Reform Act (CIRA) brought about a brief period of mandatory participation in the program and instituted a "catastrophic" (CAT) level of protection that was intended to replace disaster relief payments at a very low cost to producers.[2] The 1994 Act also mandated development of insurance programs that would provide "cost of production" coverage to agricultural producers. These programs along with innovations driven by private insurers led to the development of several different revenue insurance programs that provided protection against lost revenue occurring from any combination of low prices and/or yields. There are currently three primary revenue insurance products— Crop Revenue Coverage (CRC), Revenue Assurance (RA), and Income Protection (IP). Participation has grown substantially in response to these new programs and other policy changes that have made crop insurance more attractive to producers.[3]

Critics of the U.S. crop insurance program have noted the program's relatively poor actuarial performance. Between 1981 and 1999, the average loss ratio was 1.89, which implies that for each dollar paid in by a farmer, an average of $1.89 was received back in indemnity payments.[4] While

[1] The FAIR Act of 1996 eliminated (1) set aside and base acreage controls that provided supply control and (2) deficiency payments that provided the farmer with protection against unfavorable price movements.

[2] CAT coverage is nearly free, requiring only a small administrative fee.

[3] For example, in 1995, total liability for corn insurance was $6.7 billion. In 2000, total liability for corn had grown to over $9.8 billion, with $5.7 billion being accounted for by the CRC program (USDA-RMA, 2000).

[4] Loss ratios were calculated using unpublished data from the RMA. Note that this loss ratio does not include the amount of premium paid by the government through premium subsidies. Of course, if such subsidies are included in premiums, loss ratios are lower. In this light, what we consider to be poor actuarial performance may reflect large

the loss ratios were of a large magnitude in general, they also differed substantially across crops and geographic location. During the period between 1980 and 1998, loss ratios ranged from 1.01 in Iowa to 2.97 in Arkansas and from 1.33 for corn to 2.55 for cotton. Thus, insurance programs convey rather large and non-uniform net transfers from the government to agricultural producers.

While these programs provide positive net benefits to participating producers, their provision will enable an economic agent to better withstand risk, and thus provide incentives for agents to assume greater risk. Likewise, if participation in any program conveys positive net economic benefits to producers, the program may alter incentives and thus distort production patterns. To the extent that the benefits of risk management programs are not homogeneous across crops and across regions, production patterns may be distorted.

In addition, considerable concern that risk management programs provide inducements for production of riskier crops in riskier regions has recently been raised. Environmental concerns lie at the heart of this debate. The issue has typically been framed in terms of the "extensive margin" of production. There are two fundamental margins at issue. The first involves land within a region (e.g., a county) that, in the absence of risk management programs, may not be planted because of its relatively high risk. The second margin involves land in other growing regions that may be brought into production if programs are provided to assist producers with the higher degree of production risk associated with growing that crop in a region with less favorable growing conditions. The conventional wisdom is that riskier regions and riskier land within a region tend to be more environmentally fragile. Thus, programs which permit producers to assume more production risk may actually damage the environment by encouraging production on environmentally-fragile, marginal land. Goodwin, Smith, and Hammond (2000) considered a reduced-form model of the effects of risk management and conservation reserve programs on measured patterns of soil erosion. Their results revealed a modest positive effect of increases in participation in crop insurance programs on soil erosion. A larger positive effect was exerted by direct government payments and a very significant negative effect was found for the Conservation Reserve Program (CRP).

A closely related though distinct issue involves the extent to which new land was brought into production by the expansion of risk management programs in the 1980s.[5] Increases in erosion could reflect production shifts to more erosive land or, alternatively, simply expansion that brought more land into production. Recent research by Keeton, Skees, and Long (2000) found that expansions in risk management programs led to the introduction of about 50 million new acres of U.S. crop land

subsidies that are applied to premiums, which may in fact be actuarially sound.

[5]Since total crop acreage declined in the 1980's, we could view the impact of risk management programs in terms of mitigating against further acreage reductions due to falling crop prices instead of leading to actual crop acreage increases.

into use (where use includes planted acres, idled acres, and land in conservation reserves). A large proportion of this increase, approximately 35 million acres, was accounted for by land put into the Conservation Reserve Program. An alternative analysis by Young and Vandeveer (2000) suggested very modest aggregate U.S. acreage responses to the provision of risk management programs.

Distortions created by crop insurance could be important for several reasons. First, if the acreage response to insurance is large, there will be higher production and negative effects on price. The premium subsidy benefits would be partially offset by lower crop prices. These distortions could carry over into input markets, affecting demand for fertilizer, seed, chemicals, fuel, land prices, and so on. Some regions of the country would be at a disadvantage relative to others regarding production of particular crops. Higher production, if large enough to affect prices, would also affect trade patterns. Negative environmental consequences, such as greater soil erosion and water quality problems could result if marginal land was brought into production or if land switched into production of crops with greater chemical use and more potential for erosion. If crop insurance is encouraging acreage expansion, particularly onto marginal lands, then it may be at odds with other government programs such as the Conservation Reserve Program, which is paying farmers to switch land out of crop production into conservation uses.

The existing research has provided important insights into the effects of the expansion of risk management programs on production patterns. However, a wide gap exists in the implications of existing studies, with some results (Keeton, Skees, and Long (2000)) pointing to large effects and others (Goodwin, Smith, and Hammond (2000) and Young and Vandeveer (2000)) showing modest effects. While most of the existing research is focused on *national* acreage and production response, production conditions and the parameters of risk management programs are very heterogeneous across regions and crops. For example, net indemnities for cotton, which tends to be largely regional in production, are much higher than what is commonly observed for other crops. Likewise, loss-ratios are much higher in some regions than for others, even for the same crop. This heterogeneity suggests that a focus on aggregate effects, though valuable, may conceal crop- and region-specific effects.

Using data from the Heartland region representing the U.S. corn belt, Goodwin and Vandeveer (2000) estimated a system of equations representing farmer decision variables, i.e. insurance participation, crop acreage response, and input use. This approach contrasted with previous research that failed to take into account the simultaneous nature of the decision process and, therefore, did not account for the endogenous nature of some of the independent variables.[6] In addition, their

[6]Smith and Goodwin (1996) and Wu (1999) used Wu-Hausman tests to demonstrate that insurance, crop mix, and chemical use decisions are not exogenous and can best be estimated using a simultaneous equations approach.

study used empirical measurements of acreage shifts which contrasted with studies (Young and Vandeveer (2000)) that relied on simulated data to measure acreage shifts.

Goodwin and Vandeveer (2000) found a statistically significant acreage response for corn and soybean production to changes in insurance participation.[7] The response was small in magnitude with elasticities of acreage response to increases in insurance participation of 0.029 to 0.043 for soybeans and corn, respectively. While their exploration of crop and region-specific effects was a valuable contribution, this focus on the corn belt did not address regions and crops suspected to be most likely to experience acreage increases. Due to larger and more variable indemnity payments and lower participation rates in other areas , findings based on data from the Heartland region may not apply to other crops and areas of the country. At the same time, Goodwin and Vandeveer (2000) concentrated on data from the period between 1983 and 1993. Many of the significant changes in the provision of crop insurance have occurred since 1994, particularly the availability of revenue insurance instruments.

In this light, the focus of our analysis is on an extension of their work to include other crops and geographic regions. Specifically, we will look at wheat and barley production in the Northern Great Plains region during the period between 1985 and 1993.[8] We will also provide updated estimates of corn and soybean production in the Heartland region to cover the period where revenue insurance instruments were available, specifically the 1997-1998 period. Following Goodwin and Vandeveer (2000), we utilize estimates of structural models of variables reflecting the endogenous decisions of agricultural producers to simulate the possible effects of large premium changes. Our results reveal that increased participation in the federal crop insurance program is indeed correlated with more acreage for a given crop. However, the magnitude of the effect, though statistically significant, is modest. Our conclusions are in agreement with earlier studies (Young and Vandeveer (2000)) that have concluded that the increases in acreage in production brought about by risk management programs is small.

The plan of our paper is as follows. The next section discusses a conceptual framework for considering the effects of risk management programs on acreage allocation decisions. The third section discusses the data and empirical framework used to empirically assess acreage response. The fourth section presents estimates of structural econometric models of acreage response, insurance demand, CRP participation, and input usage. Revenue insurance demand equations are included in the Heartland update. Simulations of the effects of premium changes are considered using the

[7] The Heartland region is one of nine regions enumerated in "Farm Resource Regions" (2000). This includes Iowa, Illinois, Indiana, and parts of Minnesota, South Dakota, Nebraska, Missouri, Ohio, and Kentucky.

[8] The Northern Great Plains region is one of nine regions enumerated in "Farm Resource Regions" (2000). This includes North Dakota and parts of Minnesota, South Dakota, Nebraska, Montana, Wyoming, and Colorado.

model estimates. The final section contains a review of the analysis and offers some concluding remarks.

2 Conceptual Issues

Theoretical considerations of the demand for insurance generally consider the actions of a risk averse agent facing a single source of risk for which a risk-neutral insurer offers some level of protection. Stylized models that attempt to capture the essential elements of crop insurance plans are typically rather simplified and thus often fail to capture actual characteristics of the operation of the crop insurance program. For example, most crop farms are multiproduct operations. Multiple crops face an array of risks from various sources. In addition, risks are often correlated across crops, such that yield outcomes (and thus loss events) for individual crops are correlated.

In addition, the insurance choice (i.e., the participation decision) is made jointly with other production decisions that must be made by producers. In our analysis, we focus on three decisions (choice variables) that are relevant to the insurance participation decision. At the time of planting, a producer must decide what to produce, how to produce it, and whether to participate in a myriad of government programs that may be available. We focus on two specific policies that were relevant to production decisions in the 1980s and 1990s—the federal crop insurance program and the Conservation Reserve Program (CRP). Thus, for a producer facing the option of growing multiple crops, the decision involves the choice of a level of production (acreage for each crop), the level of insurance to purchase for each crop (which potentially could be zero), and whether or not to enroll land in the CRP program.

The focus of our analysis is empirical and thus we make no pretense as to the development of a detailed theoretical framework for jointly evaluating acreage response, insurance participation, and conservation program participation for multiple crops.[9] However, some consideration of the conceptual framework underlying such choices is useful.

Consider an agent that produces two crops, with per acre yields denoted by Y_1 and Y_2. Of a fixed amount of available land T, the agent must choose the level of acreage to devote to crop 1 A_1 and crop 2 A_2 and the level of acreage C to enroll in any set-aside program such as the CRP, for which a payment of r per acre is received . Crops are produced using a single variable input denoted as z. Usage of this input reflects agents' self-protection against yield losses. Per-acre yields for crop i are denoted by $Y_i(e_i, z)$. The e_i term represents a mean zero random shock to the yield of crop i. Insurance is available that directly addresses the randomness associated with crop yields

[9] The motivated reader is referred to Innes and Ardila (1994) for a detailed evaluation of insurance participation and soil depletion in a single crop model.

by offsetting the variability associated with e_i.[10] If we define the variance of e_i to be σ_i^2, insurance has the effect of reducing σ_i^2 say to $\lambda_i \sigma_i^2$. Thus, λ_i (where $0 \leq \lambda_i \leq 1$) represents the level of pure insurance purchased. Insurance premiums for crop i, π_i, will reflect the level of insurance purchased and the variability associated with yields for crop i. Use of inputs z are costly, such that total variable costs are given by $c(z)$.

Under these conditions, agents will choose A_1, A_2, λ_1, λ_2, and z to maximize the expected value of a utility of profits function:

$$EV\{\Pi\} = EV\{P_1 A_1 Y_1(e_1(\sigma_1^2, \lambda_1), z) + P_2 A_2 Y_2(\sigma_2^2, \lambda_2), z) + (T - A_1 - A_2)r - c(z) - A_1 \pi_1 - A_2 \pi_2\}, \quad (1)$$

First order conditions are of the general form:

$$V_k = E\{V'(\Pi)\Pi_k\} = 0, \quad (2)$$

where Π_k denotes the derivative of profits with respect to choice variable k. As Innes and Ardila (1994) note, signing the effects of risk in such a multiproduct maximization problem is complex. Interactions among individual terms may also complicate comparative statics results. However, the solution to first-order conditions of the form given by (2) will yield estimable insurance demand equations of the form:

$$\lambda_i = f(\pi_i, A_i, C, \phi_i) \quad (3)$$

where ϕ denotes operator and farm characteristics relevant to the utility function (in particular, risk preferences) and production conditions. We expect $\partial \lambda_i / \partial \pi_i < 0$. To the extent that production of each product is joint and land is an allocatable input, acreage in one crop will be a function of the acreage devoted to the other (see Shumway, Pope, and Nash (1984); Lau (1972); and Lynne (1988)). Thus, acreage response equations will be of the form:

$$A_i = g(P_i, C, \lambda_i, A_j, \phi_i). \quad (4)$$

Equation (4) is a major focus of our analysis—in particular, we are interested in the sign and magnitude of $\partial A_i / \partial \lambda_i$. As we have noted above, a range of results as to this effect exist in the literature. Though our simplified empirical framework does not provide a prediction as to the expected sign and magnitude of this effect, we expect that the provision of economic benefits through insurance will result in expanded acreage and thus a positive relationship between acreage and participation.

[10] In the sense of Rothschild and Stiglitz's (1970) definition of risk, such a plan represents "pure insurance" in that it directly offsets risk. An alternative form of insurance that more closely resembles what is actually available in most insurance markets, including the U.S. crop insurance program, is "truncating" insurance, which compensates for negative shocks.

Previous research (Smith and Goodwin (1996)) demonstrated that fertilizer and chemical usage for Kansas wheat producers tended to be negatively correlated with insurance purchases. That is, growers that purchased insurance tended to use less inputs than those growers that did not buy insurance. In more recent work, Wu (1999) found that changes in the crop mix may make the overall relationship between insurance participation and fertilizer and chemical usage less clear. If insurance encourages shifting toward crops with more demanding input requirements, insurance participation may actually increase fertilizer usage. Thus, the expected relationship between insurance participation and input usage is unclear.

3 Empirical Framework and Discussion of Data

As with Goodwin and Vandeveer (2000), our empirical analysis makes use of pooled cross-sectional, time-series data collected at the county level. Our data cover the years from 1985-1993 for wheat and barley production in the Northern Great Plains extension of the earlier study. We use data from 1997-1998 for corn and soybean production in our update of the Heartland region results. [11] The results from our study will be compared to the earlier findings to see if the earlier results are applicable when extended to other geographic areas and time periods.

The conceptual framework implies that the demand for insurance (i.e, insurance program participation) should be influenced by the expected return to insurance. Returns to insurance will be influenced by premium rates as well as the expected indemnity payments. Goodwin (1993) found that adverse selection implied the potential for a differential response to premiums with respect to expected indemnities. Following the approach applied there, we include premium rates, the average loss ratio (for the preceding six years of experience in the county) and an interaction of the loss ratio and the premium rate. We also include the coefficient of variation of county average yields. The average loss ratios should reflect expected indemnities or the adequacy of premium rates, while the yield coefficient of variation should reflect the yield risk faced by the producer. We also include a measure of farm diversification (the ratio of livestock sales to total sales) and a measure of the overall land quality for a given county (the proportion of land in capability classes one and two).[12]

To account for the availability of revenue insurance in the 1997-1998 study period, we included a variable representing the proportion of total liability accounted for by revenue insurance. [13]

[11] A discussion of the variability in longitudinal data and its implications for our work can be found in Goodwin and Vandeveer(2000).

[12] Land is categorized in eight classes with the quality or productivity of land decreasing as the the class number increases. Therefore, classes one and two indicate the highest quality land.

[13] We should note that we do not believe our dependence on cross-sectional variability limits our modeling of revenue insurance since such insurance was gradually introduced and adopted in limited geographic areas.

Of course, this variable is jointly determined with other choice variables in the system and thus is modeled endogenously as a function of the premium rate for revenue insurance and lagged insurance participation.

Our empirical models of acreage allocations essentially consider factors that are relevant to the expected return from producing the crop in question. Goodwin and Vandeveer (2000) attempted to capture the effects of farm policy variables by including a measure of adjusted base acreage as an explanatory variable. This was designed to capture the deficiency payments that were available for corn during the period of study. This approach failed to account for other policy changes that occurred during the study period. To avoid the shortcomings of trying to model all of the policy changes that occurred during this period, we will include annual dummy variables for the years contained in the sample. These dummy variables will pick up changes that occurred over time and that are independent of the cross-sectional unit, i.e. the county. In addition to policy changes, the dummy variables will also capture changes in output and input prices, as well as other factors that vary by year but not across counties. While avoiding the problems associated with not capturing all of the details of the applicable policies, this approach will make it difficult to sort out the impact of the various factors captured in the dummy variables. The dummy variables were also included in the insurance participation equations, CRP participation equation, and input usage equations.

In addition, we included the acres diverted from wheat and barley production under the acreage reduction program (ARP) in the acreage response equations for both wheat and barley. A scaling factor of total county acres was used to replace the measure of total acres used by Goodwin and Vandeveer (2000). [14]The total land acres in the county was also included as an explanatory variable in the insurance participation and CRP equations. In the earlier study, this scale variable suffered from problems of potential endogeneity, since if insurance programs cause net increases in total land in production, this variable will be endogenous to insurance participation and thus to land in an individual crop.

In addition to the previously described land capability class variable, we also included variables to account for differences in the quality of the land in each county. A variable (the K-factor) was included to measure the susceptibility of the land for soil erosion. [15] Another variable (the T-factor) was included to account for differences in land sustainability in the presence of soil erosion. [16]

[14]Total acres in that study were defined as the sum of harvested acres across thirteen major crop categories for the earlier study. Clearly, such a variable may be endogenous to acreage decisions for a single crop.

[15]The K-factor is a relative index of the susceptibility of cultivated soil to particle detachment and transport due to rainfall or overland flow. Larger values of the index indicate land that is more susceptible to erosion by water.

[16]The T-factor measures the maximum rate of annual soil erosion that will permit crop productivity to be sustained economically and indefinitely. The values range from 1 to 5 tons per year, with 1 ton indicating fragile land and 5 tons indicating deep soil that is least subject to damage by soil erosion.

Our empirical analysis is complicated to a degree by the fact that the CRP program was introduced in 1986. CRP program participation is important to our analysis as it represents an important use of crop acreage. The CRP program essentially provided producers with a rental payment for removing land from production for conservation purposes. In 1985, participation in the CRP program was exogenously fixed at zero. In 1986 and subsequent years, CRP program participation was endogenously determined by farms in a joint evaluation with other production decisions, including acreage allocation and insurance program participation. To address this switching environment, we utilize the following specification for CRP:

$$CRP_{it} = \delta(X_{it}\beta) + e_{it} \tag{5}$$

where CRP_{it} is an indicator of CRP enrollment and δ is 1 if the year is 1986 or greater and is zero otherwise. This is equivalent to endogenously modeling participation for 1986 and later and setting participation exogenously at zero in 1985.[17]

We hypothesize that input usage, which is jointly determined with acreage and insurance participation decisions, will be influenced by the crops planted, by insurance participation, and by land quality characteristics. We include measures of land capability as well as a measure of the proportion of agricultural land in each county that was allocated to grass and pasture in 1982. These latter variables are intended to reflect soil and other land characteristics that may be relevant to productivity and thus input usage patterns.

In short, for our analysis of wheat and barley acreage response and insurance participation in the Northern Great Plains region, the preceding discussion implies a system of six equations— wheat and barley acreage allocation equations, wheat and barley insurance participation equations, an equation representing input usage, and an equation representing CRP enrollment. A similar system of seven equations (adding equations for revenue insurance participation for corn and soybeans and removing the CRP equation) was used for corn and soybeans in the Heartland region for the updated period.

Data were collected from a wide variety of sources. Insurance program data were taken from the RMA's unpublished county level "summary of business" database. An important caveat associated with the use of such data should be noted at this point. Experience data are available only for those farms that actually purchased insurance. Thus, to the extent that nonbuyers faced higher rates than buyers, our premium rates may understate the actual rates faced by the entire

[17]The only difference in our approach versus a two step method where CRP participation is modeled separately for 1986 and later years arises from our use of three-stage least squares in estimation. Parameter estimates are identical in the first step of each case, though corrections made for cross-equation correlation may result in differences in final estimates. This arises in light of the fact that our application of three-stage least squares results in residuals that are zero for the pre-1986 period where CRP participation is exogenously set to zero. The implications of our analysis and the simulations that follow are entirely transparent to the manner of modeling CRP participation.

insurance pool. This criticism is relevant to most other empirical studies of insurance demand and participation. Unpublished NASS county level yield and acreage statistics were collected. Input usage and farm sales statistics were taken from the U.S. Department of Commerce's Regional Economic Information System (REIS) database. CRP statistics were taken from unpublished data obtained from the Economic Research Service. Soil characteristics and land use patterns (grass and pasture) in 1982 were taken from the NRCS National Resource Inventory (NRI) database. Nominal economic variables were deflated using the producer price index.

The demand for insurance was measured as the ratio of actual liability to total possible liability. Actual liability was measured by the real liability purchased by the farmer. Following Goodwin and Vandeveer (2000), we constructed a rough measure of total possible liability by taking the product of the futures market price, planted acres, and 65 percent of the average yield for the preceding ten years. Alternative measures of participation that are commonly used include the ratio of net insured acres to total planted acres. We argue that such a measure is likely to be inferior in that it does not recognize the fact that the level of participation can be changed without cancelling coverage merely by changing the price or yield coverage election. Variable definitions and summary statistics for the variables included in the analysis of wheat and barley in the Northern Great Plains region are presented in Table 1. Summary statistics for the variables included in the analysis of corn and soybeans in the Heartland region are presented in Table 2. The analysis of wheat and barley over the 1985-93 period utilized 1,090 observations. The analysis of corn and soybeans in the 1997-98 period utilized 1,130 observations.

4 Empirical Results

4.1 Model Estimates

Table 3 and Table 4 contain three-stage least squares parameter estimates and summary statistics for the analysis of Northern Great Plains wheat and barley production for the 1985-1993 period and Heartland corn and soybean production for the 1997-1998 period, respectively. The insurance demand equations reflect a statistically significant negative relationship between premium rates and the level of participation for wheat and soybeans, while the corn equation show a negative but statistically insignificant relationship. The premium rate coefficient in the barley equation is positive, but statistically insignificant. At the data means, the results imply an elasticity of demand of -0.01 for corn, 0.05 for soybeans, -0.18 for wheat, and -0.06 for barley. This compares to an elasticity of -0.34 for corn and -0.35 for soybeans in the earlier study of the Heartland region. Several factors make insurance demand less elastic in the later period, including the wide array of revenue insurance products available, higher premium subsidies, and higher degree of overall participation. The relatively inelastic nature of these demand functions will play a critical role in simulations of the effects of premium subsidy changes on insurance participation presented below.

As previously mentioned, the 1997-1998 corn and soybean insurance participation equations were conditioned on the existence of crop revenue insurance. The coefficients on the revenue liability variable were positive and highly significant. The equation for corn revenue insurance exhibited a negative and statistically significant relationship between insurance demand and premium rates, while the soybean equation exhibited a negative but insignificant relationship. The elasticities of demand for the revenue insurance with respect to premium rates were -0.21 and -0.05 for corn and soybeans, respectively. While it is difficult to determine the extent to which shifting occurred from APH to revenue insurance, we can conclude that the availability of revenue insurance significantly increased the overall level of insurance participation in the Heartland region.

In the case of the corn, wheat, and soybean equations, a higher average loss ratio appears to significantly decrease the responsiveness of agents to premium changes. In the case of barley, however, the interaction terms are actually negative, though not statistically significant.[18] These findings are relatively consistent with those in the earlier Heartland study.

Fertilizer and chemical expenditures exhibit the expected negative effect for all of the crops in the study. These results are inconsistent with the earlier Heartland study where fertilizer and chemical expenditures had a positive impact on corn insurance participation. While it was previously argued that it may be difficult to separate the effects of increased production of a crop and insurance purchases on input usage since the input usage variable applies to all crops and not just to the individual crop under consideration, these results indicate a clear negative relationship.[19]

The ratio of livestock sales to total farm sales is significantly positive in the corn and soybean cases, suggesting that farms (counties) with greater relative sales from livestock commodities are more likely to purchase insurance. This is consistent with the findings in the earlier Heartland study. This relationship is negative and statistically significant in the cases of wheat and barley. Counties with more productive land, as represented by the land capability class variable, appear to purchase less insurance in every case except barley, though the relationship is statistically insignificant in the case of wheat. In the earlier Heartland study, we found a positive relationship between land productivity and insurance participation.

[18] Identification of this adverse selection effect may be confounded by the inclusion of loss-ratios as a regressor. This arises because of the manner in which insurance premiums are determined. In particular, the adjusted twenty year loss experience in each county is used to define rates. Details regarding methods for premium rate determination can be found in Goodwin (1994).

[19] The earlier study did not include an input price variable, while the present study represents this effect with the annual dummy variables.

Higher average loss ratios, which correspond to higher expected relative indemnities, are positively correlated with greater demand for insurance for wheat and barley, but exhibit a negative (though statistically insignificant) relationship for corn and soybeans. The earlier Heartland study findings contained a significantly positive relationship between average loss ratios and insurance demand. The coefficients on the CV yields are positive in all cases, though it is statistically insignificant in the wheat equation. The cases (wheat and barley) where both higher loss ratios and higher yield CVs are positively correlated with insurance demand may suggest that there are benefits to producers both from the income subsidy effects of insurance as well as from the risk reduction brought about by crop insurance. Separately identifying the effects may be difficult. Increases in acreage for each crop is correlated with more insurance purchases for that crop. This finding is in agreement with the results of other research (see, for example, Goodwin (1993) and Black and Dorfman (2000)) implying that insurance purchases are likely to be greater for larger farms or larger areas in that incentives for selling on the part of agents working on commission are likely to be greater in such cases.

The heart of our analysis lies in the acreage response equations. In the earlier Heartland study, corn and soybeans exhibited a statistically significant acreage response to increases in insurance participation rates. The elasticity of corn acreage response to increases in participation was 0.04, while the elasticity for soybeans was 0.03. Thus, small positive increases in acreage appear to occur as increased participation in the insurance program takes place, though the magnitudes of these increases are small. In the wheat equation, insurance participation had a significant positive impact on acreage response, while the barley equation contained a statistically insignificant and small positive impact. The elasticities of acreage response to insurance participation were 0.02 for barley and 0.06 for wheat, respectively. In the 1997-1998 Heartland equations, corn and soybeans again exhibited a positive and statistically significant relationship with insurance participation. The elasticities of acreage response to insurance participation were 0.02 for both corn and soybeans. This indicated a small reduction from the elasticities found in the earlier period, but both results indicate that the acreage response is of a small magnitude. In total, our results indicate that increases in insurance participation will yield small increases in crop acreage.

The dummy variables that were added to capture price and policy changes were of mixed signs and degrees of significance. While these dummy variables capture the impact of crop prices and policy changes, it is difficult to separate these from other changes that occurred over time that had a common impact on all counties. We included total acres in the county as an indicator of the scale of a county's total size. This variable had an insignificant impact on acreage response in all cases. As mentioned earlier, the use of total county acres as the scale variable avoids the potential endogeneity problem associated with the earlier Goodwin and Vandeveer (2000) study.

In the earlier Heartland study, a strong negative effect from CRP enrollment was implied by the estimates for corn and soybeans. An insignificant positive effect was found in the estimates from the wheat equation. In the barley equation, a significant negative relationship was found between CRP enrollment and acreage response. As could be expected, an increase in CRP enrollment leads to a reduction in crop acreage for three of the four crops. We also find some evidence of shifting among the alternative crops. Increases in wheat acreage are correlated with less barley acreage and vice versa. In the 1997-1998 corn and soybean estimations, increases in the acreage of one crop leads to a positive increase in the acreage of the other crop. While this is in contrast to the earlier Heartland study where a negative relationship was observed, the magnitude of the coefficient was relatively small.

More corn and soybean acreage increased input usage, as did increased purchases of corn and soybean insurance.[20] In the Northern Great Plains estimation, more barley acreage and insurance participation increased input usage, while the wheat insurance variable exhibited a significant and negative relationship with input usage. Increases in acres planted in wheat increased input usage, but the impact was statistically insignificant. The results from the 1997-1998 Heartland estimations were consistent with the hypothesis of a negative relationship, though the acres planted in corn exhibited a positive relationship. These effects could be expected since corn has much greater fertilizer requirements than soybeans. Counties with land more suitable to pasture tend to exhibit more input usage. Counties with more land suitable to grass tended to exhibit an insignificant impact on fertilizer and chemical expenditures. Higher quality land tends to exhibit less input usage per planted acre. This is consistent with findings in the earlier Heartland study. Again, it is relevant to point out that our input usage applies to all crops and thus it is difficult to identify the effects associated with individual crops.

4.2 Policy Simulations

In order to evaluate the implications of our analysis for the effects of insurance participation on acreage response, we considered a number of policy simulations. In particular, we consider the effects of large premium subsidy increases (i.e., premium decreases) on insurance participation and land use patterns. Premium changes are "across-the-board" meaning that all counties' premiums are decreased by a proportionally equivalent amount. The rate change simulations essentially involve exogenously changing premium rates (from their mean values) while holding all other variables at their mean values. We then use the six equation system (or seven equation system with rev-

[20] Again, it may be difficult to separate these effects.

enue insurance included) to evaluate how predictions regarding insurance participation or acreage allocations change. We utilize estimates obtained treating total acreage as being exogenous and allowing the loss ratios to be treated as endogenous variables.

The results from the 1997-1998 estimations for corn and soybeans are contained in Table 5. A 50% reduction in both corn and soybean insurance premiums lead to a 5.83% increase in corn insurance purchases and a 6.08% increase in soybean insurance purchases. Revenue insurance purchases increase by 10.08% for corn and 2.57% for soybeans. . The impact on corn and soybean acreage response was very small, ranging from 0.11% for corn to 0.13% for soybeans. These results are consistent with the earlier Heartland study which indicated a relatively small impact on acreage allocation. Reductions of 50% in the premium rate of one crop while holding the premium rate of the other crop constant yielded similar results. Insurance participation increases by approximately 5% for the premium-reduced crop, while remaining relatively constant for the other crop. Again, the impact on acreage response is minimal, ranging from 0.02% to 0.12%.

Table 6 contains the results of the same premium reduction simulations on wheat and barley insurance purchases and acreage allocations in the Northern Great Plains region. A 50% reduction in the insurance premiums for both wheat and barley results in a 48.7% increase in wheat insurance purchases and a 40.5% increase in barley insurance purchases. Wheat acreage increases of 3.7% and barley acreage increases of 0.5% are implied by the 50% reduction in both premium rates. Reductions of 50% in the premium rate of one crop while holding the premium rate of the other crop constant yielded similar results. Insurance participation increases by approximately 35.9% (barley) and 53.7% (wheat) when the premium rate for that crop is reduced by 50%, holding the other premium rate constant. The acreage response is minimal from the 50% reduction in the barley premium, ranging from an increase of 1.0% for barley to a reduction of 0.5% for wheat. A reduction in the premium rate for wheat leads to acreage increases of 4.2% for wheat and a reduction of 0.6% for barley, respectively.

The overall implications of our results are quite clear. Even in the most extreme case, large premium decreases trigger significant increases in participation but do not bring about large increases in planted acreage for barley and wheat. In the most extreme case, a 50% decrease in premiums which is accompanied by an analogous doubling of expected loss-ratios brings about an additional 0.5% increase in planted acreage for barley and a 3.7% increase in planted acreage for wheat. A similar 50% reduction in premium rates for corn and soybeans yielded increases in acreage of 0.11% for corn and 0.13% for soybeans, respectively. It should be noted that these results indicate that differences exist between crops and regions as to the impact of premium rate decreases, i.e. crop insurance subsidies. Given the existence of crop and region differences, our results would still seem to imply that expansions in the federal crop insurance program have not resulted in significant increases in planted acreage. Though the increases have indeed occurred and parameters underlying these effects are statistically significant, the responses are quite modest.

5 Concluding Remarks

Significant expansions of the U.S. federal crop insurance program have led many to question the extent to which the risk protection and subsidies inherent in the programs triggered an expansion in production. Goodwin and Vandeveer (2000) considered a sample of reasonably homogeneous counties in the U.S. corn belt region to address this issue. We have extended their methodology to look at other crops in other regions to evaluate the general applicability of their results. We have also extended their original Heartland data set to include years where revenue insurance instruments were available.

Our empirical estimates suggest that the demand for insurance is quite price inelastic, with elasticities ranging from 0.01 to 0.18. Our results also confirm that increased participation in crop insurance programs is indeed correlated with additional acreage in corn and soybeans. However, simulations of the effects of large premium decreases (50%) reveal that the effects on acreage of such policy changes are very modest. In particular, in the most extreme case we consider, an across-the-board premium decrease of 50% for both crops implied increases in planted acreage of 0.5% for barley and 3.7% for wheat. Similar premium reductions for corn and soybeans induced even smaller acreage responses, ranging from 0.11% to 0.13%. The lack of acreage response to large premium rate reductions seem to result from a combination of the relative inelastic nature of insurance demand with respect to premium rates and the inelastic nature of crop acreage responses to changes in insurance participation rates.

Thus, our results would seem to support findings from the earlier study that suggests that increases in insurance participation bring about relatively small acreage responses. Our results are still preliminary, however, and much work remains to be done before definite conclusions on this point can be reached. The differences in insurance participation and acreage response with respect to differences in selected crop and geographic location indicate that additional crops and regions should also be considered. For example, high loss ratios associated with cotton produced in Texas would make it a logical area to explore in any extension of this work.

Table 1. Variable Definitions and Summary Statistics for Northern Great Plains Wheat and Barley (1985-1993)

Variable	Definition	Mean	Std. Dev.
Insurance Participation (wheat)	liability / maximum possible liability	0.4504	0.2444
Input Usage	fertilizer and chemical expenditures (real $thousand) / planted acre	0.0242	0.0166
Land Capability	proportion of land in capability classes 1 and 2	0.2592	0.1294
Livestock Sales	livestock revenues / total farm sales	0.5093	0.2542
CV Yield (wheat)	CV of historical wheat yields	27.3581	10.2465
LR (wheat)	historical mean loss ratio (wheat)	2.0337	1.2564
Acres Planted (wheat)	acres planted of wheat (ten thousand)	14.7960	10.7548
Insurance Participation (barley)	liability / maximum possible liability	0.3299	0.2767
CV Yield (barley)	CV of historical barley yields	29.4300	12.2127
LR (barley)	historical mean loss ratio (barley)	2.1462	1.4127
Acres Planted (barley)	acres planted of barley (ten thousand)	4.0228	4.3302
CRP Enrollment	proportion of land enrolled in CRP program	0.0550	0.1173
Total Harvested Acres	total planted acres (all crops) (ten thousand)	19.9140	14.7457
K-Factor	universal K-factor	0.2885	0.0410
T-Factor	t-factor representing tolerance to soil loss	4.3493	0.5598
Rental Rate	real CRP rental rate / acre	27.0499	17.1063
Cost Share	real cost share payments for CRP / acre	121.1617	21.0245
$Pasture_{82}$	proportion of county acres in pasture in 1982	0.0477	0.0370
Premium (wheat)	insurance premium rate (wheat)	0.0684	0.0213
Premium (barley)	insurance premium rate (barley)	0.0892	0.0308
D86	dummy variable for 1986	0.1107	0.3139
D87	dummy variable for 1987	0.1122	0.3158
D88	dummy variable for 1988	0.1146	0.3186
D89	dummy variable for 1989	0.1153	0.3195
D90	dummy variable for 1990	0.1138	0.3177
D91	dummy variable for 1991	0.1099	0.3129
D92	dummy variable for 1992	0.1060	0.3080
D93	dummy variable for 1993	0.1068	0.3090
County Acres	total acres in the county	10.0245	5.9807
Acres Diverted (wheat)	ARP acres diverted from production	10.1246	8.0253
Acres Diverted (barley)	ARP acres diverted from production	3.2537	3.6306

Table 2. Variable Definitions and Summary Statistics for Heartland Corn and Soybeans (1997-1998)

Variable	Definition	Mean	Std. Dev.
Insurance Participation (corn)	liability / maximum possible liability	0.3224	0.1375
Input Usage	fertilizer and chemical expenditures (real $thousand) / planted acre	0.0631	0.0142
Land Capability	proportion of land in capability classes 1 and 2	0.3065	0.1427
Livestock Sales	livestock revenues / total farm sales	0.3789	0.1822
CV Yield (corn)	CV of historical corn yields	20.3097	7.7919
LR (corn)	historical mean loss ratio (corn)	1.7133	1.0634
Acres Planted (corn)	acres planted of corn (ten thousand)	8.6031	5.8739
Insurance Participation (soybeans)	liability / maximum possible liability	0.2896	0.1367
CV Yield (soybeans)	CV of historical soybean yields	14.3260	6.6400
LR (soybeans)	historical mean loss ratio (soybeans)	1.1487	0.7613
Acres Planted (soybeans)	acres planted of soybeans (ten thousand)	8.3612	4.9136
K-Factor	universal K-factor	0.3291	0.0479
T-Factor	t-factor representing tolerance to soil loss	4.3962	0.4865
Grass_{82}	proportion of county acres in grassland in 1982	0.0511	0.0407
Pasture_{82}	proportion of county acres in pasture in 1982	0.1405	0.1056
Premium (corn)	insurance premium rate (corn)	0.0657	0.0530
Premium (soybeans)	insurance premium rate (soybeans)	0.0371	0.0349
D97	dummy variable for 1997	0.4569	0.4984
County Acres	total acres in the county	3.3316	1.1367
Revenue Liability (corn)	revenue insurance liability / total liability	0.2612	0.1749
Revenue Liability (soybeans)	revenue insurance liability / total liability	0.2556	0.1733
Revenue Premium (corn)	(revenue premium - subsidy) / revenue liability	0.0600	0.0219
Revenue Premium (soybeans)	(revenue premium - subsidy) / revenue liability	0.0538	0.0232

Table 3. 3SLS Estimates of Wheat/Barley Model

Variable	Estimate	Standard Error	t-Ratio
.... Wheat Insurance Participation			
Intercept	0.7126	0.0449	15.87*
Premium	−1.6335	0.3690	−4.43*
Premium*LR	0.2217	0.1552	1.43
Fertilizer	−12.9675	0.6265	−20.70*
Land Capability	−0.0163	0.0410	−0.40
Livestock Sales	−0.2080	0.0259	−8.04*
CV Yield	0.0001	0.0006	0.18
LR	0.0481	0.0104	4.63*
Wheat Acres	0.0029	0.0007	4.37*
County Acres	0.0056	0.0008	7.06*
D86	0.0193	0.0208	0.93
D87	−0.0307	0.0213	−1.44
D88	0.0644	0.0209	3.07*
D89	−0.0304	0.0216	−1.40
D90	0.1207	0.0219	5.52*
D91	0.1585	0.0221	7.18*
D92	−0.0236	0.0218	−1.08
D93	0.0447	0.0221	2.02*
.... Barley Insurance Participation			
Intercept	0.0796	0.0576	1.38
Premium	0.1040	0.3730	0.28
Premium*LR	−0.1472	0.1493	−0.99
Fertilizer	−1.7947	1.1423	−1.57
Land Capability	0.1523	0.0481	3.17*
Livestock Sales	−0.3052	0.0376	−8.12*
CV Yield	0.0049	0.0007	6.82*
LR	0.0730	0.0139	5.25*
Barley Acres	0.0081	0.0019	4.20*
County Acres	0.0049	0.0010	4.68*
D86	0.0097	0.0234	0.41
D87	−0.0342	0.0243	−1.41
D88	−0.0324	0.0237	−1.36
D89	−0.0019	0.0241	−0.08
D90	0.0664	0.0250	2.66*
D91	0.1810	0.0258	7.02*
D92	0.0309	0.0258	1.20
D93	−0.0393	0.0272	−1.44

Asterisks indicate statistical significance at the $\alpha = .10$ or smaller level.

Table 3. (continued)

Variable	Estimate	Standard Error	t-Ratio
.... Wheat Acreage Response			
Intercept	1.2222	0.9590	0.13
Wheat Acres$_{t-1}$	1.1173	0.0323	34.63*
Barley Acres	−0.0752	0.0855	−0.88
Participation Wheat	1.9432	0.4768	4.08*
CRP Enrollment	2.6561	3.4584	0.77
K-Factor	−4.1364	1.9400	−2.13*
T-Factor	0.2205	0.1878	1.17
Acre Diversion Wheat	−0.2275	0.0388	−5.87*
Acre Diversion Barley	0.2355	0.0946	2.49*
County Acres	−0.0018	0.0139	−0.13
D86	−1.3241	0.2747	−4.82*
D87	−2.3833	0.4274	−5.58*
D88	−1.7426	0.7336	−2.38*
D89	1.6466	0.3989	4.13*
D90	−0.2400	0.3193	−0.63
D91	−2.6185	0.3193	−8.20*
D92	1.9149	0.2978	6.43*
D93	0.1776	0.3433	0.52
.... Barley Acreage Response			
Intercept	2.3331	0.3663	6.37*
Barley Acres$_{t-1}$	1.0202	0.0349	29.23*
Wheat Acres	−0.0451	0.0102	−4.42*
Participation Barley	0.2566	0.1692	1.52
CRP Enrollment	−8.3476	1.2554	−6.65*
K-Factor	−2.5852	0.7354	−3.52*
T-Factor	−0.1365	0.0700	−1.95*
Acre Diversion Barley	−0.1020	0.0410	−2.49*
Acre Diversion Wheat	0.0701	0.0119	5.90*
County Acres	0.0044	0.0055	0.80
D86	−0.4337	0.1114	−3.89*
D87	−0.5105	0.1685	−3.03*
D88	0.5125	0.2814	1.82*
D89	−0.3671	0.1634	−2.25*
D90	−0.8884	0.1523	−5.83*
D91	−0.8551	0.1385	−6.17*
D92	−1.4315	0.1148	−12.47*
D93	−1.0609	0.1320	−8.04*

Table 3. (continued)

Variable	Estimate	Standard Error	t-Ratio
……CRP Enrollment……			
Intercept	−0.0177	0.0100	−1.77*
Rental Rate	−0.0005	0.0003	−1.89*
Cost Share	0.0003	0.0002	1.57
Erosion Index	−0.0051	0.0016	−3.10*
County Acres	0.0017	0.0005	3.53*
D86	0.0376	0.0151	2.49*
D87	0.1318	0.0160	8.21*
D88	0.2299	0.0158	14.56*
D89	0.1226	0.0155	7.89*
D90	0.1043	0.0155	6.73*
D91	0.0262	0.0143	1.83*
D92	0.0319	0.0144	2.18*
D93	0.0314	0.0005	2.18*
……Input Usage……			
Intercept	0.0306	0.0018	16.89*
Particpation Wheat	−0.0406	0.0056	−7.21*
Particpation Barley	0.0090	0.0051	1.78*
Wheat Acres	0.0001	0.0001	1.34
Barley Acres	0.0008	0.0001	6.42*
Grass_{82}	−0.0024	0.0085	−0.28
Pasture_{82}	0.0233	0.0094	2.46*
Land Capability	−0.0058	0.0032	−1.80*
D86	0.0002	0.0016	0.10
D87	0.0010	0.0016	0.61
D88	0.0086	0.0016	5.32*
D89	0.0011	0.0016	0.69
D90	0.0076	0.0017	4.40*
D91	0.0086	0.0018	4.78*
D92	0.0036	0.0017	2.05*
D93	0.0075	0.0017	4.48*
System Degrees of Freedom		6,679	
System R^2		0.8986	

Asterisks indicate statistical significance at the $\alpha = .10$ or smaller level.

Table 4. 3SLS Estimates of Corn/Soybean Model

Variable	Estimate	Standard Error	t-Ratio
............Corn Insurance Participation............			
Intercept	0.4706	0.0378	12.46*
Revenue Liability	0.4550	0.0245	18.55*
Premium	−0.3058	0.3363	−0.91
Premium*LR	0.3185	0.1273	2.50*
Fertilizer	−5.2767	0.4369	−12.08*
Land Capability	−0.1079	0.0218	−4.95*
Livestock Sales	0.0619	0.0151	4.09*
CV Yield	0.0027	0.0004	6.97*
LR	−0.0026	0.0047	−0.56
Corn Acres	0.0057	0.0006	9.01*
County Acres	−0.0043	0.0017	−2.58*
D97	0.0432	0.0063	6.85*
............Soybean Insurance Participation............			
Intercept	0.3806	0.0382	9.97*
Revenue Liability	0.5612	0.0209	26.77*
Premium	−0.8818	0.2699	−3.27*
Premium*LR	0.3521	0.1605	2.19*
Fertilizer	−4.3567	0.4670	−9.33*
Land Capability	−0.0767	0.0201	−3.81*
Livestock Sales	0.0517	0.0140	3.70*
CV Yield	0.0030	0.0005	6.02*
LR	−0.0029	0.0059	−0.48
Soybean Acres	0.0047	0.0007	6.70*
County Acres	−0.0039	0.0026	−1.53
D97	−0.0186	0.0056	−3.29*
............Corn Acreage Response............			
Intercept	−0.6267	0.5188	−1.21
Corn Acres$_{t-1}$	0.9134	0.0086	106.07*
Soybean Acres	0.0756	0.0092	8.26*
Participation Corn	0.4687	0.2324	2.02*
K-Factor	0.4688	0.7123	0.66
T-Factor	0.0734	0.0762	0.96
County Acres	0.0125	0.0269	0.46
D97	0.1455	0.0468	3.11*

Asterisks indicate statistical significance at the $\alpha = .10$ or smaller level.

Table 4. (continued)

Variable	Estimate	Standard Error	t-Ratio
.... Soybean Acreage Response			
Intercept	−0.6244	0.4678	−1.33
Soybean Acres_{t-1}	0.9111	0.0082	111.60*
Corn Acres	0.0539	0.0081	6.62*
Participation Soybeans	0.5686	0.2187	2.60*
K-Factor	−0.2602	0.6576	−0.40
T-Factor	0.0775	0.0694	1.12
County Acres	0.2028	0.0240	8.44*
D97	0.2425	0.0424	5.73*
.... Corn Revenue Insurance Participation			
Intercept	0.1376	0.0161	8.53*
Insurance Participation $_{t-1}$	0.6058	0.0334	18.16*
Revenue Premium	−0.9224	0.1666	−5.54*
D97	0.0166	0.0102	1.63
.... Soybean Revenue Insurance Participation			
Intercept	0.0627	0.0145	4.32*
Insurance Participation $_{t-1}$	0.7667	0.0294	26.05*
Revenue Premium	−0.2473	0.1544	−1.60
D97	−0.0009	0.0094	−0.09
.... Input Usage			
Intercept	0.0836	0.0014	59.87*
Particpation Corn	−0.0296	0.0092	−3.23*
Particpation Soybeans	−0.0269	0.0092	−2.94*
Corn Acres	0.0010	0.0001	7.54*
Soybean Acres	−0.0009	0.0001	−5.77*
Grass_{82}	0.0101	0.0088	1.15
Pasture_{82}	0.0229	0.0039	5.82*
Land Capability	−0.0222	0.0026	−8.51*
D97	−0.0011	0.0006	−3.52*
....			
System Degrees of Freedom		7,573	
System R^2		0.9598	

Asterisks indicate statistical significance at the $\alpha = .10$ or smaller level.

Table 5. Premium Rate Change Simulation Results Corn and Soybeans

Premium Change	Percent Change in: Corn Insurance	Soybean Insurance	Corn Acreage	Soybean Acreage	Corn Revenue	Soybean Revenue
.... Total Acreage Exogenous, Loss Ratio Increases						
-50% Corn, 0% Soybean	5.03	0.83	0.09	0.02	10.08	0.00
0% Corn, -50% Soybean	0.83	5.30	0.02	0.11	0.00	2.57
-50% Corn, -50% Soybean	5.83	6.08	0.11	0.13	10.08	2.57

Table 6. Premium Rate Change Simulation Results Wheat and Barley

Premium Change	Percent Change in: Wheat Insurance	Barley Insurance	Wheat Acreage	Barley Acreage
.... Total Acreage Exogenous, Loss Ratio Increases				
-50% Wheat, 0% Barley	53.64	6.48	4.15	−0.56
0% Wheat, -50% Barley	−8.68	35.88	−0.52	1.02
-50% Wheat, -50% Barley	48.65	40.45	3.66	0.47

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