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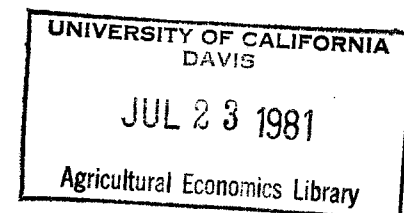
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Risk

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FEDERAL ALL-RISK CROP INSURANCE AND DISASTER ASSISTANCE
AS RISK MANAGEMENT TOOLS FOR COLORADO DRYLAND
WHEAT FARMERS

By

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ABSTRACT

A stochastic simulation model is used to evaluate a range of risk management strategies for dryland wheat producers in Colorado. The analysis focuses in the ASCS Disaster Assistance Program and federal All-Risk Crop Insurance Programs, with special attention given to the proposed elimination of the Disaster Assistance Program.

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Introduction

Since 1933, with the passage of the Agricultural Adjustment Act, the federal government has provided partial protection for agricultural producers from the adverse effects of price and yield variability on incomes. The need for government assistance in agriculture is now being re-evaluated by the new administration, and major program changes are being considered. Proposed changes may have a significant impact on the viability of farm operations in high-risk areas and on the ease of entry into agriculture by individuals who must depend extensively on borrowed capital.

One major change in existing farm programs that is currently being considered is the elimination of the ASCS Disaster Assistance Program. Established in 1973, the Disaster Assistance Program is part of the larger farm commodity program administered by the ASCS designed to protect farmers against both price and yield fluctuations through farmer-owned storage, deficiency payments, and disaster assistance. For farmers who comply with the regulations of the overall commodity program, including possible set-asides and other acreage restrictions, the Disaster Assistance Program provides compensation when yields fall below specified levels.

A second government administered risk management program, federal crop insurance, has been available to agricultural producers since 1938. Major changes were made in the program in 1980, however. Coverage has been extended to all risks, including those such as drought and natural disasters that are

generally not covered in most insurance programs. In addition, the program has been extended to crops and regions not previously included. Finally, substantial subsidies on premiums have been introduced for those who waive disaster assistance. These changes should help to make federal crop insurance a viable alternative to the Disaster Assistance Program.

In this paper the role of All-Risk Crop Insurance in the risk management strategies of dryland wheat farmers is evaluated. Particular attention is given to the impact of eliminating the Disaster Assistance Program, and the extent to which federal crop insurance can replace this program is investigated. In the sections that follow, the study area and case farm used in this analysis and the current structure of both the ASCS and federal crop insurance programs will first be described. The model used to evaluate alternative risk management strategies will then be explained and the strategies considered will be identified. The results of the analysis will then be presented, and the implications of these results will be discussed.

Study Area, Case Farm, and Current Structure of Risk Management Programs

The study area for this analysis is northern Weld County, Colorado. This part of the county is almost exclusively under dryland cultivation. Though some acreage is planted in millet, sunflowers, and dryland milo, hard red winter wheat is the predominant crop grown. In 1980, 233,000 acres of winter wheat, nearly all grown under dryland cultivation, were harvested in the county as a whole (Colorado Crop and Livestock Reporting Service).

Average annual precipitation in Weld County is 15.5 inches. Precipitation levels vary considerably from year to year and from location to location, however, which, in turn, makes dryland wheat yields quite variable. Widespread drought conditions have been experienced in three of the past thirty years. In those instances only about 40 percent of the acreage planted in

the county could be harvested. Hail is another factor that contributes to yield uncertainty in the county. Hailstorms are common in the spring and early summer and can cause severe damage to maturing wheat.

The case farm used in this analysis is typical of those found in northern Weld county. Of 2,500 tillable acres, none of which are rented, 1,250 are planted in wheat. The remaining 1,250 acres are kept in summer fallow. Variable cash pre-harvest production costs, including fuel and repair costs for machinery, purchased inputs, and interest on operating expenses, were set at \$30 per acre. The farmer is assumed to combine his own wheat. A fixed cost of \$8 per acre and a marginal harvest and hauling cost of 20 cents per bushel are charged for harvest operations. Cash fixed costs, which include land payments, machinery payments, and property taxes, are set at \$65,000.

At the present time nearly all dryland wheat operators in the study area participate in the ASCS commodity program for wheat. Because the set-aside provision of the program is not currently in effect, participation is essentially costless. On the other hand, few have purchased Federal Crop Insurance. The low participation rate may be due to a lack of knowledge of program changes or to a sense that the premiums are too high given the coverage provided.

All producers who participate in the ASCS commodity program for wheat automatically become eligible for the Disaster Assistance Program. No out-of-pocket expenses are required for participation, but all program regulations must be adhered to. These regulations may limit planted acreage to a normal crop acreage, which is established for each farm by the ASCS county committee, and may also call for further acreage reductions in the form of a set-aside. Both of these restrictions have been waived for Colorado in 1981, and it appears unlikely that they will be reimposed in the near future. Under the

program provisions, a farmer may receive compensation for any natural disaster that results in substantially reduced yields or prevented planting. For dryland winter wheat prevented plantings are almost unheard of in Colorado and so are not considered here. Payments for low yields are made when yield per planted acreage falls below 60 percent of the farm's established yield. In such instances the participating farmer receives a payment equal to 50 percent of the target price times the production deficit below the 60 percent level. A typical established yield in northern Weld County is 27 bushels per acre.

Though not related to yield risk, the program also calls for deficiency payments to participants in years when the national average price for the five months following harvest falls below the target price. The payments are equal to the difference between the target price and average market price times established yield multiplied by planted acreage.

Participation in the federal crop insurance program requires the payment of a premium by the farm operator. One of three yield guarantee levels--50, 65, and 75 percent of the average yield for the area established by the Federal Crop Insurance Corporation--is chosen by the participant. In the study area for this analysis, the average wheat yield is set at 23 bushels per acre, so the three yield guarantees are 11.5, 15.0 and 17.5 bushels per acre, respectively. The participant also selects one of three price levels. For wheat in 1981 these levels are \$2.50, \$3.00, and \$3.50. Payments are made whenever yield per planted acre falls below the chosen yield guarantee. They are determined by multiplying the product of the yield deficiency and the price guarantee by the number of acres planted. Premiums are based on the selected price and yield guarantee levels, with higher premiums being charged for higher guarantees. Premiums are reduced for participants who chose to

waive the right to receive disaster assistance payments. For Weld County wheat farmers in the study area who do not waive the Disaster Assistance Program, premiums in 1981 range from \$3.70 per acre for the low-yield, low-price guarantee to \$11.90 per acre for the high-yield, high-price guarantee. For those who do waive the program, premiums range from \$2.60 per acre to \$9.35 per acre. Both sets of premiums include hail and fire protection, which can be waived. Waiver of hail and fire coverage was not considered in this study.

The Model

In designing a risk management strategy that employs the ASCS commodity program and/or federal crop insurance, a total of 29 distinct alternatives are currently available to the Colorado dryland wheat farmer. First, he may choose not to participate in either program, though this is unlikely under current program provisions since participation in the commodity program is costless. Second, he may choose to participate in the commodity program but not in the crop insurance program. This strategy was prevalent among farmers interviewed in the study area. Next, there are nine coverage levels for individuals who choose to purchase crop insurance and participate in the commodity program, nine for those who purchase crop insurance and waive the Disaster Assistance Program, and nine for those who purchase crop insurance but do not participate at all in the ASCS commodity program. Of these 27 coverage options, strategies in the first nine are the most widely selected now. Those in the second nine may also be selected by some individuals. They have added importance in this analysis, however, because they represent a set of options that will be available to producers if the Disaster Assistance Program is eliminated. The final nine insurance strategies, though logically possible, would almost never be selected under current conditions, again

because participation in the commodity program is costless. A thirtieth strategy was also considered in this analysis--participation in the commodity program alone without the Disaster Assistance Program. Should the Disaster Assistance Program be eliminated, this will be a risk management strategy available to producers who do not purchase crop insurance.

In selecting a risk management strategy, producers consider the distribution of outcomes possible under each alternative and their own risk preferences. In this study the performance criterion used to evaluate alternative risk management strategies is net cash farm income--i.e., receipts from crop sales plus government payments minus fixed and variable costs. A stochastic simulation model was used to generate 30 sample observations from the distribution of net cash farm income for the case farm under each of the 30 strategies considered in this study. These sample observations, when arrayed in ascending order, can be used as an approximate representation of the cumulative distribution function of the underlying distribution (Barnett). ASCS commodity program provisions and federal crop insurance premium and payment schedules were programmed into the model, so the effect of these risk management tools was accurately represented.

Wheat price and yield were the only two random factors in the model. Sample observations for the wheat price distribution were generated using probabilistic price forecast information from the National Agriculture Sector Simulation Model at Michigan State University (Armstrong, Mitchell, and Black). This forecast distribution was for the national average wheat price for the 1981 crop year. An indexing procedure was used to convert these price levels to July Weld County prices. Sample observations for the wheat yield distribution were generated using detrended Weld County yield per planted acre

data for the period 1950-1979. The cumulative distribution function constructed with these observations conformed closely with a cumulative distribution function elicited in a group interview with farmers in the study area. Wheat prices and yields were assumed not be correlated, so the two distributions were generated independently.

The 30 strategies considered were ordered using the criterion of stochastic dominance with respect to a function (Meyer). This stochastic efficiency criterion provides a partial ordering of choices for decision makers whose absolute risk aversion functions (Pratt) fall within specified lower and upper bounds. In this analysis three decision maker classes having low ($-.0001, .0001$), moderate ($.0001, .0003$), and high ($.0003, \infty$) levels of absolute risk aversion were considered.

Results

Under current program provisions, which include the Disaster Assistance Program, the efficient set for the low absolute risk aversion class of decision makers includes the strategy that calls for participation in the ASCS commodity program without the purchase of crop insurance and seven of the nine insurance coverage options that do not waive participation in the Disaster Assistance Program. The risk neutral decision maker, whose level of absolute risk aversion is everywhere equal to zero and who maximizes expected net return, prefers efficient strategy 1, which calls for no insurance. It is of interest to note, however, that such a large number of strategies with insurance enter the efficient set for this class of decision makers. Further analysis of the distributions for these strategies indicates that decision makers whose level of absolute risk aversion is everywhere greater than $.00003$ --a relatively low level given empirical estimates from other studies (see Young, et. al.)--will prefer strategies that call for crop insurance. This additional analysis

Table 1 Efficient Strategies Given Current Program Provisions

	Efficient Strategy							
	1	2	3	4	5	6	7	8
ASCS participation	yes	yes	yes	yes	yes	yes	yes	yes
Disaster program waived	no	no	no	no	no	no	no	no
Crop insurance purchased	no	yes	yes	yes	yes	yes	yes	yes
Yield guarantee	--	11.5	11.5	15.0	15.0	17.5	17.5	17.5
Price guarantee	--	2.50	3.50	2.50	3.00	2.50	3.00	3.50
Maximum net return	88,460	83,911	82,067	80,961	79,485	78,010	75,920	73,830
Minimum net return	-58,152	-43,191	-43,965	-40,861	-42,039	-37,180	-39,211	-41,241
Expected net return	15,258	11,770	10,350	10,038	9,031	8,604	7,273	5,942
Standard deviation of net return	38,738	37,044	36,484	35,369	34,844	33,469	32,620	31,854

Table 2 Efficient Strategies When Disaster Assistance Program is Eliminated

	Efficient Strategy									
	1	2	3	4	5	6	7	8	9	10
ASCS participation	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Crop insurance purchased	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
Yield guarantee	--	11.5	11.5	11.5	15.0	15.0	15.0	17.5	17.5	17.5
Price guarantee	--	2.50	3.00	3.50	2.50	3.00	3.50	2.50	3.00	3.50
Maximum net return	88,460	85,264	84,587	83,973	83,235	82,190	81,145	80,284	78,624	76,965
Minimum net return	-86,471	-66,477	-62,515	-58,491	-58,099	-52,425	-46,750	-53,616	-47,070	-40,524
Expected net return	12,970	10,834	10,370	9,867	10,034	9,447	8,860	8,590	7,690	6,789
Standard deviation of net return	42,698	40,590	40,209	39,844	38,636	37,921	37,244	36,516	35,432	34,411

also indicates that the selection of coverage levels is quite sensitive to changes in absolute risk aversion.

For decision makers in both the moderate and high absolute risk aversion classes, only strategy 6 is in the efficient set. This strategy, which calls for insurance with the maximum yield guarantee and the minimum price guarantee, has the highest minimum net return of all strategies considered.

Elimination of the Disaster Assistance Program will make all the strategies for which information is given in Table 1 infeasible. Information on efficient strategies for the low absolute risk aversion class under these conditions is given in Table 2. All of these strategies call for participation in the ASCS commodity program, but under these revised program provisions deficiency payments will be the only benefits received. As is the case under the program provisions that are currently in place, the strategy that maximizes net returns is that which calls for ASCS program participation and no crop insurance. It should be noted, however, that both the minimum and expected net returns are considerably less than those for the corresponding strategy in Table 1. All nine crop insurance options that call for participation in the ASCS commodity program are also in the efficient set for this class of decision makers. Further analysis of the outcome distributions associated with these strategies indicates that strategies with insurance are preferred by decision makers whose level of absolute risk aversion is everywhere greater than .000015. Crop insurance becomes attractive, then, at lower levels of absolute risk aversion when the Disaster Assistance Program is eliminated. Again, the level of coverage selected is quite sensitive to changes in absolute risk aversion.

Only strategy 10 is in the efficient set for decision makers in the moderate and high risk aversion classes. This strategy calls for the highest

yield and price guarantees available and has the highest minimum net return of all feasible strategies under these revised program provisions.

Each of the efficient strategies in Table 2 is dominated by at least one strategy in Table 1 for all decision maker classes. This means that, in the absence of additional subsidies on premiums or policy changes in other programs, all dryland wheat producers in the study area will be made worse off by the elimination of the Disaster Assistance Program. This is to be expected since this program is currently available at no cost to the producer. The important policy question, however, is how much worse off are individual decision makers.

Welfare gains and losses are difficult to measure under conditions of perfect knowledge, and these difficulties are compounded under uncertainty. Robison and Carman have suggested that changes in the certainty equivalent of a decision maker's preferred plan can serve as a valid indicator of welfare changes under uncertainty. The certainty equivalent of an uncertain choice is the non-stochastic level of the performance measure--net returns in this study--which has a utility equal to the expected utility of the uncertain choice. This is a convenient welfare measure because its level is dependent upon the nature of the decision maker's utility function and because it is expressed in the same units as the performance measure.

For risk neutral decision makers the certainty equivalent of a strategy with uncertain outcomes is the expected value of the outcome distribution. Comparing the preferred strategy for this decision maker under each set of program provisions--strategy 1 in Tables 1 and 2--it can be seen that the certainty equivalent is reduced by \$2,288 when the Disaster Assistance Program is eliminated. On a per planted acre basis this represents a \$1.83 reduction in the certainty equivalent of net returns. In percentage terms, this is a 2.9 percent reduction in returns above variable costs.

The calculation of certainty equivalents is more difficult for decision makers who are not risk neutral, since the exact form of the utility function must be known. Without direct measurements of risk preferences for producers in the study area, guesses at the shape of a typical utility function would be highly conjectural. Some preliminary analysis has been done with a negative exponential utility function, which exhibits constant absolute risk aversion. The one consistent result that has emerged is that welfare losses due to elimination of the Disaster Assistance Program increase as absolute risk aversion increases. This implies that risk averse decision makers will be more adversely affected by the proposed program changes. Through the moderate absolute risk aversion range, however, the magnitude of the welfare losses is still relatively small on a per acre basis. Because premiums are lower in the absence of the Disaster Assistance Program, crop insurance helps to alleviate the adverse effects of losing disaster assistance for those more risk averse decision makers. Since it is highly unlikely that the Disaster Assistance Program will be eliminated without some compensatory policy changes in other areas, then, the loss of this program may not be as serious as many fear. It should be emphasized, however, that those hurt the most by this policy change are likely to be those who can least afford it, those marginal operators who are highly risk averse because they may go out of business if losses in any one year are too great.

Concluding Remarks

The results presented in this paper indicate that federal crop insurance is potentially a valuable risk management tool for some decision makers under current policy conditions and it may become still more important if the Disaster Assistance Program is eliminated. Though this analysis focuses on a single study area, it seems likely that these results could be generalized to a much

larger number of dryland wheat farmers. Further work is needed, however, to gain a more complete understanding of the role of disaster assistance and crop insurance in the overall risk management strategies of dryland wheat farmers. First, the sensitivity of risk management strategies to changes in farm size, fixed cost structure, tenure arrangements, and risk preferences needs to be explained in greater detail. Because insurance decisions are so sensitive to risk preferences, information on this factor is especially critical. Equally important, other risk management tools need to be considered. This is especially true with regard to forward pricing strategies--either hedging or forward contracting--since these may interact in a complex manner with other means by which the adverse impacts of uncertainty are reduced.

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