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GOVERNMENT PROGRAMS AND ADOPTION OF CONSERVATION TILLAGE PRACTICES ON NON-IRRIGATED WHEAT FARMS

1987

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Tillage

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AAEA paper, 1987

Bailey, D., T.F. Glover, and G. Helms--Government Programs and Adoption of Conservation Tillage Practices on Non-Irrigated Wheat Farms

A whole-farm simulation analysis was used to investigate producer preferences for adoption of separate tillage practices (minimum-till, combination-till, or no-till) under provisions of both the 1981 and 1985 Farm Bills. An analysis of preference for participation or non-participation in government programs under both farm bills was also considered. For risk averse producers, a combination-tillage practice with program participation was found to dominate (as measured by stochastic dominance) the other strategies considered under both the 1981 and 1985 provisions.

Key Words: Conservation tillage, government programs, computer simulation, wheat, non-irrigated farms.

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Government Programs and Adoption of Conservation Tillage
Practices on Non-Irrigated Wheat Farms

Much research has focused on the effects of alternative tillage practices on farmers' revenue over time. Most of these studies have focused on the relationship of soil loss and/or crop yields to tillage practices (Taylor, et al; McCool, et al; Burt; Taylor and Young). Although soil erosion is important for farmers, other management considerations reflect the complex interrelationships between tillage practices and the farm's financial organization. Included are prices, yields, storage possibilities, and beginning debt situation, etc.

An important consideration in the conservation tillage decision is its effect on government payments to the producer. If the adoption decision expands planted acreage, it may preclude or reduce the ability (eligibility) of the producer to participate in paid acreage diversions (set asides), price support loans, etc. This is especially important on non-irrigated farms where a systematic summer fallow rotation is followed. Under these conditions, usually only 50% to 70% of land under cultivation is eligible for program participation. Any attempt by a producer to spread the costs of new tillage investments over planted acreage beyond the established farm base would render the producer ineligible under current program provisions.

One goal of this study was to ascertain if participation in specific government programs (set-aside and commodity loans) would significantly affect investments by wheat farmers with non-irrigated land in new tillage technology and methods. Since government programs are partially designed to stabilize farm prices (Tweeten), a less risky price environment may aid in the adoption of minimum-till or no-till practices.

A second goal was to examine the impacts of the Food and Security Act of 1985 (1985 Farm Bill) on tillage adoption decisions relative to the 1981 program. Loan rates for grains (e.g., wheat and barley) in the 1985 Farm Bill are considerably lower than the 1981 program. Thus, lower cash grain prices closer to competitive world prices are anticipated. Lower cash prices (at least in the short-run) and lower overall returns, in turn, may decrease incentives to invest in new tillage technology.

A third goal was to examine the interaction of government program provisions and the selection of tillage and crop-mix systems. This is especially important on non-irrigated farms that practice a systematic fallow rotation. Most farmland in a fallow rotation has only a portion of total acreage considered as base acreage for farm programs. This restricts the ability of dryland farmers to expand acreage to spread the costs of purchasing new equipment and/or technology (e.g., no-till systems), especially under the new, more restrictive set-aside measures of the 1985 Farm Bill. Also, more restrictive provisions regarding other program crops (e.g., barley) can affect program participation for wheat even though the farmer participates only in the government wheat program.

These goals are addressed in this study using a whole-farm approach (production, marketing, finance) to determine government program impacts on tillage practice. The following section presents the rationale for model selection and also explains the economic characteristics of the "typical" farm used in the analysis. A subsequent section presents the methodology used in the study. The results of the study are then reported followed by the summary and conclusions.

Model Selection

Studies analyzing the economics of alternative tillage practices fall into three major categories: those using mathematical programming methods, those using computer simulation techniques, and those using an optimal control theory approach. Burt's control theory approach found that high wheat prices tend to accelerate soil erosion on wheat farms, but that "intensive wheat production with good cultural and fertilization practices is economically justified in the long run, as well as for immediate net returns" (page 91). McConnell used control theory to measure potential divergence between social and private optimal rates of soil erosion. Bhide, et al., also used control theory to analyze soil erosion in Iowa.

Mathematical programming studies dealing with soil conservation and/or minimum tillage practices are numerous (e.g., Harker, et al.; Alt and Heady; Osteen and Seitz). Many of these studies have examined long run scenarios reflecting the lengthy nature of changes in top soil depths due to erosion. Other studies by Rosenberry, et al., and D. Walker used simulation models to evaluate long run soil conservation practices. Taylor and Young used simulation to test the economic desirability of alternative tillage practices under conditions of technological change and soil erosion in the Palouse region of southeastern Washington.

Computer simulation allows one to incorporate the interaction between production, marketing, and financial activities at the farm level without specifying an explicit objective function. Computer simulation has also been used to analyze the impacts of various government farm programs on farm management decisions (Boehlje and Griffin; Richardson and Condra; Smith; Richardson and Nixon (1982)). The ability to monitor this complex interaction supported computer simulation as the method of analysis in this study.

This study departed from the more traditional long run analysis in favor of a shorter time horizon (five years). A five year analysis depicts the decisions a farmer may face in difficult economic times when decisions are of a short- to intermediate-term nature to meet cash-flow requirements.

Methodology

This study used a dynamic, stochastic, Monte Carlo simulation model (FLIPSIM V) to evaluate alternative tillage practices on mid-sized non-irrigated farms in Utah. FLIPSIM has been used extensively in farm management analysis (Richardson and Nixon (1982); Smith; and Bailey). It offers considerable flexibility in analyzing farm problems while still allowing detailed specifications of typical farm situations.

FLIPSIM recursively simulates a typical farm over a multiple-year planning horizon using the ending financial position for one year as the beginning financial position for the following year.[1] In this study, the farm operator could participate in the CCC non-recourse loan program if participation offered a greater return than non-participation and if the farmer participated in the government set-aside program. Deficiency payments occurred when the season average cash price was less than the target price for wheat.

The five-year planning horizon was simulated for three selected tillage practices under both the 1981 and 1985 Farm Bills. This allowed for comparisons to determine if incentives to adopt different tillage practices changed since the 1985 Bill became operative. Comparisons of the selected tillage strategies were based on their impacts on the typical farm's net cash farm income, producer's ending net worth, ending equity ratio, and after-tax net present value. A discount rate of 7% was used in this study to calculate present values.[2]

Fifty replications of each strategy were simulated with the model. Random prices and yields for the non-irrigated wheat operation were generated for each replication assuming multivariate normal distributions using the approach described by Clements, et al. In addition, the model developed cumulative density functions (cdf's) for the after-tax net present values generated by the 50 replications for each of the alternative tillage practices.

Stochastic dominance with respect to a function (Meyer) was used on the after-tax net present value cdf's to determine the relative preference of the strategies analyzed for different categories of risk attitudes. Klemme also investigated preferences for separate tillage systems under risk using stochastic dominance. He found that conventional and minimum tillage practices were preferred to no-till tillage practices for corn and soybeans. However, Klemme's results may not apply to arid regions and, specifically, dryland operations. Klemme's results also do not account for other financial considerations besides mean returns to land and management (i.e., debt load, marketing, government programs, etc.).

The Typical Farm

The typical farm was developed from survey data and is located in Box Elder County, Utah (90 miles northwest of Salt Lake City). The farm consists of 2,324 acres, all of which are non-irrigated. Of this 2,324 acres, 1,627 acres are owned and 697 are leased. Farms of approximately this size are also common in the main wheat production areas of the midwest, including western Kansas and the Texas Panhandle (Tierney, Fuller). The study area is a major producer of grain in Utah, especially winter wheat (Utah Department of Agriculture). Levels and variability of yields in the study area are also similar to those in most western states based on mean state yields between 1980-1986 and coefficients of variation (USDA, ASB). Many western states have over 90% of their wheat acreages in non-irrigated situations. Thus, this analysis is expected to yield results applicable to farms of this size for most of the non-irrigated wheat regions of the country.

Two crops -- wheat and barley -- were assumed to be grown on the farm. The typical crop mix of 80% wheat and 20% barley was held constant over time. This crop mix was predetermined based on normal crop mixes and crop rotation patterns in the study area. Expected yields for wheat and barley were assumed initially as 33 bu./acre and 42 bu./acre, respectively.

Identical yield distributions were specified for all tillage practices analyzed. This specification occured for two reasons: 1) inadequate yield data over time for the different tillage practices were available for the study area (test plots grown by agronomists at Utah State University are only in their second year of testing for the separate tillage practices); and 2) sensitivity analyses revealed that only minor changes occurred in the results when variation was increased substantially for non-typical tillage practices (e.g., no-till).[3]

Interviews with agronomists at Utah State University provided fertilizer and herbicide requirements for the separate tillage systems to produce approximately the same yield across systems (Rasmussen). Production costs then were adjusted according to variable and fixed input requirements for the separate tillage practices. Following Richardson and Bailey, expected yields increased by 1% per year to allow for technological advancements. Random yields and prices were generated assuming multivariate normal distributions as described above.

The farmer was assumed to store his grain on the farm and sell 80% of the harvest in December each year. The remainder of the crop was sold in January of the following year. This strategy approximated a typical marketing strategy in the study area. Prices received were adjusted up or down for 12% protein hard red winter wheat and seasonalized with a seasonal price index. Annual loan rates, target prices, and set-aside levels for the planning horizon were obtained from values specified in the 1985 Farm Bill, assuming continued high stocks. Annual interest rates and percentage changes in inflation rates for the planning horizon were obtained from the commodity specific general equilibrium model (COMGEM) developed by Penson, et al. The values for annual crop prices were also obtained from COMGEM assuming continuation of the 1985 Farm Bill, a macroeconomic policy consisting of high federal budget deficits and rapid growth in the money supply (Knutson, et al.) (Table 1).

Most farmers in the area are well established, having either farmed the better part of a generation or inherited much of their land from other family members. The beginning net worth of the farmer is about $600,000 with a beginning leverage ratio (total liabilities/net worth) of 0.78 and a total debt to asset ratio of 0.44.

In recent years, farmers in Box Elder County and other parts of Utah have expressed considerable interest in minimum- and no-till practices, in part to reduce soil erosion. However, alternative tillage practices also are believed to reduce variable and fixed costs and to increase yields on non-irrigated farmland in this particular area (J. Walker).

Non-irrigated farms have typically put up to 50% of their acreage annually into summer fallow for weed control, reduction of fuel and labor costs over conventional tillage methods, and/or to participate in government set-aside programs (W. Helms, J. Walker). Producers in the study area

TABLE 1. COMGEM Estimates for Selected Economic Variables, 1986-1990.

	Annual Percentage Change in Price or Value				
	1986	1987	1988	1989	1990
Farmland	-2.0	-2.0	-2.0	-2.0	-2.0
New Farm Machinery	4.3	4.0	4.0	3.6	3.4
Used Farm Machinery	-2.0	-2.0	-2.0	-2.0	-2.0
Fixed Costs	4.0	4.4	4.8	4.7	4.6
Seed	-0.1	-1.0	4.9	5.9	5.0
Fertilizer and Lime	-1.5	-0.5	-1.3	-2.2	-2.7
Chemicals	-1.5	-0.5	-1.3	-2.2	-2.7
Fuel and Lube	2.1	3.4	2.9	2.8	2.8
Repairs	7.3	7.6	8.0	7.8	7.2
Other Production Costs	4.4	4.7	4.7	4.8	4.6
Harvesting Costs	4.4	4.7	4.0	3.2	2.4
Hired Labor	7.3	7.6	8.0	7.8	7.2
Market Value of Off-Farm Investment	4.4	4.7	4.0	3.2	2.4
CCC Storage Costs	4.4	4.7	4.0	3.2	2.4

	Annual Average Interest Rate (%)				
	1986	1987	1988	1989	1990
Outstanding Long-term	8.5	8.5	8.5	8.5	8.5
Outstanding Intermediate Term	13.0	13.0	13.0	13.0	13.0
New Long-term	13.4	13.6	13.2	12.9	12.7
New Intermediate Term	14.0	14.6	14.8	15.2	15.7

TABLE 1. Continued.

	Annual Average Interest Rate (%)				
	1986	1987	1988	1989	1990
Refinancing Long-term	13.4	13.6	13.2	12.9	12.7
Refinancing Intermediate Term	14.0	14.6	14.8	15.2	15.7
Operating Loans	14.0	14.6	14.8	15.2	15.7
Received for Cash Balances	7.0	7.3	7.4	7.7	7.8
	Crop Prices ($/bu)				
	1986	1987	1988	1989	1990
Cash Wheat[a]	2.50	2.46	2.27	2.29	2.29
Cash Barley[b]	1.86	1.83	1.69	1.70	1.70
CCC Wheat Loan Rate	2.30	2.16	2.04	1.94	1.85
CCC Wheat Target Price	4.38	4.38	4.29	4.18	4.00

Source: Knutson, et al.

a Localized for 12% protein hard red winter wheat.

b Based on average ratio of wheat and barley prices for past eight years in the study area.

have followed varying degrees of minimum tillage practices for a number of years. Low yields due to low precipitation, as well as the high costs of heavy-till, have generally precluded the use of heavy-till practices in the study area.

Some producers in the study area have adopted no-till practices. However, most of those farmers using no-till actually use a combination minimum- and no-till practice (hereafter defined as a "combination-till practice"). The practice of combination-till specifies that the required fraction of the farm's acreage (25% in 1986) will be diverted to government set-aside programs, while the remainder of the planted acreage is equally divided between minimum- and no-till in a systematic rotation. Of course, a combination-till practice exposes the farmer to the additional risk associated with planting more land than the typical minimum tillage practice of the farmer who does not participate in government programs.

New technological developments have allowed for efficient placement of seed and fertilizer under no-till procedures. New, less expensive no-till drills have also been developed which may enhance the economic feasibility of a no-till procedure.

Some studies have shown that yields are likely to decrease from minimum-till levels if no-till is practiced (Harker, et al). However, other studies have shown little or no reduction in yields and/or more efficient fertilizer placement between new minimum- and no-till practices on non-irrigated grain farms although increased fertilizer is needed for no-till (J. Walker). This may be due to the low yields experienced on dryland in the tillage study area relative to irrigated land regardless of the practice followed. However, additional herbicides are needed since no-till practices may foster greater weed, disease, and germination problems

(Young, et al). No-till practices also require specialized equipment (e.g., no-till drill). Thus, additional costs are incurred with no-till, but more acres could be planted each year. If a strict no-till procedure is followed, all acreage could be planted as long as proper weed control is practiced. However, a producer planting all of his acreage would be ineligible to participate in a paid set-aside and/or CCC loan program.

Typically, farmers in the study area have participated in government programs for wheat with 50% of their acreage as base acres (1,162 acresin this case). However, these farmers typically have not participated in the barley program (USDA, ASCS). Under the 1981 Farm Bill, these producers could plant acreage not included in their wheat acreage diversion into barley. Under the 1985 farm bill, farmers may not plant barley (or any other program crop) or wheat beyond their respective base acreage levels even if the farmer only participates in the wheat program. The required acreage diversion is also increased from 25% in 1986 to 27.5% in 1987.

Under 1981 provisions, a producer adopting no-till could plant additional acres in barley and still participate in the wheat program. Under 1985 rules, this is not allowed unless the farmer foregoes participation in the wheat program (cross compliance). The farmer is, therefore, precluded from spreading the additional fixed costs of the investment in no-till equipment over additional acres if he still chooses to participate, unless additional land with an acreage base is purchased.

Strategies Analyzed

The following six tillage practices were analyzed under both the 1981 and 1985 program provisions to determine their relative economic merits and producer preference (Table 2). Strategy 1 is a basic minimum-till procedure with a 50% summer-fallow rotation. The farmer participated in a paid

TABLE 2. Strategies Analyzed.

Strategy	Tillage System	Participation in Government Program (Y/N)	Crop Mix (Acres)	Change in Machinery Complement
		1985 Program		
1	Minimum-till	Y	872 W[a] 232 B	None
2	Combination-till	Y	872 W 232 B	Purchase inexpensive no-till drill.
3	No-till	Y	872 W 232 B	Sell all equipment not necessary for no-till operation. Puchase no-till drill (air seeder).
4	Minimum-till	N	872 W 232 B	None
5	Combination-till	N	1325 W 232 B	Same as Strategy 2.
6	No-till	N	2092 W 232 B	Same as Strategy 3.

TABLE 2. Continued.

		1981 Program		
1	Minimum-till	Y	872 W 232 B	None
2	Combination-till	Y	872 W 685 B	Same as Strategy 2 for 1985 program.
3	No-till	Y	872 W 1162 B	Same as Strategy 3 for 1985 program.
4	Minimum-till	N	872 W 232 B	None
5	Combination-till	N	1325 W 232 B	Same as Strategy 2.
6	No-till	N	2092 W 232 B	Same as Strategy 3.

[a] W = Wheat; B = Barley.

government set aside. Under both 1985 and 1981 rules, the farmer plants the same acreage (i.e., 872 acres of wheat and 232 acres of barley). Under 1981 provisions, cash prices were assumed to have an expected value equal to the old 1981 loan rate ($3.30/bu), while cash prices under the 1985 program were the COMGEM estimates. Mean cash price for barley was assumed to be $2.19/bu. for the 1985 program. The higher prices for both wheat and barley were assumed for all scenarios under the 1981 farm program provisions.

Strategy 2 is a combination-till procedure with participation in the paid set-aside. Switching to this strategy from Strategy 1 required the purchase of an inexpensive no-till drill for approximately $17,000 while holding the remaining machinery complement constant. Financing for this investment increased the intermediate debt-to-asset ratio to about 0.40 from 0.36 for Strategy 1. Under 1985 provisions, the same crop mix as in Strategy 1 was used with an equal division between minimum and no-till procedures on the planted acreage (552 acres for each). Under 1981 provisions, one-third of the land was summer fallowed (767 acres which included set aside requirements) with the remaining two-thirds divided equally between minimum and no-till practices. This allowed more barley to be planted (685 acres) but wheat acreage was held constant to comply with program requirements (872 acres).

Strategy 3 is an exclusive no-till procedure using the newest no-till technology (efficient seed and fertilizer placement with a less expensive no-till drill [Concord air-seeder type]). The farmer also participated in government programs. Under 1985 provisions, the same acreage and crop mix as in Strategy 1 were planted. Under 1981 provisions, 872 acres of wheat were planted and 1,162 acres of barley. The machinery complement for the farm changed considerably since all equipment used in minimum-till (e.g., grain drill and all smaller tractors) were traded. A new no-till drill and 375 horsepower tractor were purchased for approximately $207,000. This increased the intermediate debt-to-asset ratio to approximately 0.49.

Strategy 4 involved a repeat of Strategy 1 with no participation in government farm programs. Strategy 5 involved a repeat of Strategy 2 with no participation in government farm programs. The crop mix changed to 1,325 acres of wheat and 232 acres of barley.[4] This allowed the farmer to build wheat base and also represented the higher expected returns to wheat over barley. Strategy 6 involved a repeat of Strategy 3 with no participation in government farm programs. The crop mix changed to 2,092 acres of wheat and 232 acres of barley.

Results

Using FLIPSIM, the three tillage practices were analyzed under participation and non-participation for both the 1981 and 1985 farm programs for the typical dryland grain farm in Box Elder County, Utah. These strategies generally fell into two categories: 1) crop rotation methods; and 2) tillage practices.

Table 3 presents the performance results of the six tillage strategies under both programs. The results indicate that no matter which strategy is followed, the producer would experience larger returns under the 1981 program than under the 1985 program as measured by the after-tax net present value. This result, however, was expected since loan rates decreased considerably under the 1985 program.

None of the tillage strategies under either farm program yielded a positive mean after-tax net present value. This indicates that producers in the study area with approximately the same costs of production, financial structure, and management abilities assumed here will probably

TABLE 3. Probability of Survival, Success, and Economic Characteristics of the 2324-Acre Non-Irrigated Grain Farm in Box Elder County, Utah.

	Strategy for 1981 Program						Strategy for 1985 Program					
	1[a]	2	3	4	5	6	1	2	3	4	5	6
Probability of Survival (%)[b]	100	100	96	62	76	76	98	98	98	2	4	4
Probability of Success (%)[c]	0	0	0	0	0	2	0	0	0	0	0	0
After-Tax Net Present Value[d]												
Mean ($1000's)	-243.0	-226.3	-287.9	-550.1	-366.9	-343.3	-317.5	-312.5	-346.5	-665.1	-653.5	-674.0
Std. Dev. ($1000's)	38.7	64.4	109.4	150.8	176.7	198.7	62.3	62.1	68.3	115.7	116.3	115.2
C.V. (%)[e]	-15.9	-28.5	-38.0	-27.5	-48.2	-57.9	-19.6	-19.9	-19.7	-17.4	-17.8	-17.1
Present Value of Ending Net Worth[f]												
Mean	399.9	411.9	331.5	94.5	275.6	278.4	321.3	331.6	281.0	-18.5	-4.8	-43.6
Std. Dev.	37.4	60.2	102.9	149.6	174.3	191.3	61.1	61.2	67.6	116.1	117.0	114.7
C.V. (%)	9.6	14.6	31.1	158.4	63.2	68.7	18.7	18.5	24.0	-625.9	-2429.5	-263.0
Equity Ratio[g]												
Mean	.47	.47	.43	.11	.32	.36	.38	.38	.36	-.05	-.02	-.11
Std. Dev.	.05	.07	.13	.21	.20	.24	.07	.07	.08	.18	.18	.22

TABLE 3. Continued.

	Strategy for 1981 Program						Strategy for 1985 Program					
	1	2	3	4	5	6	1	2	3	4	5	6
C.V. (%)	11.30	13.80	29.60	185.50	63.30	66.40	17.30	17.10	22.60	-351.80	731.10	-204.50
Net Cash												
<u>Farm Income</u>												
Mean	1.6	2.5	-9.9	-44.5	-28.9	-29.5	-19.4	-18.9	-25.8	-74.2	-76.4	-98.0
Std. Dev.	12.1	15.9	20.7	17.3	22.1	34.2	10.0	10.1	10.1	14.8	15.9	31.0
C.V. (%)	731.1	638.7	-209.4	-38.8	-76.4	-115.7	-51.4	-53.6	-39.0	-19.9	-20.9	-31.4

a See Table 2.

b Probability of surviving is the probability the farm will remain solvent through 1990.

c Probability of success is the probability the farm operator will receive at least a 7% return on beginning owner's equity.

d After-tax net present value represents the present value (discounted value) of the net income (receipts - costs) received by the producer after taxes.

e Coefficient of variation.

f Present value of ending net worth is the value of net worth in the fifth year discounted to the present.

g Equity Ratio = Owner equity/total assets in year 5 (1990).

experience negative returns over the next five years and that the new farm program provisions have only accentuated the current dismal outlook for these wheat producers.

Clearly, participation in government programs is more essential under 1985 rules than 1981 rules. This is exhibited by the low probabilities of survival for Strategies 4, 5, and 6 (non-participation strategies for the 1985 program relative to the 1981 program). Higher price supports under the 1981 program would keep cash prices high enough to make non-participation more attractive. This result suggests that more dryland wheat farmers are likely to participate in the 1985 program which will probably increase government deficiency payments to these farmers over the next five years. This is especially true since loan rates were decreased substantially in the 1985 legislation while target prices remained constant.

Participation in government programs should yield higher returns to producers than non-participation no matter which tillage practice is followed and regardless of which farm bill is being considered (Table 3). If a farmer did not participate in government programs and the 1981 provisions were still in effect, a straight no-till procedure (Strategy 6) would yield higher mean returns than the other non-participation strategies (Strategy 4 or 5). Higher wheat prices under the 1981 price supports likely would make no-till more attractive since planting additional acreage would yield a positive return to the no-till procedure. This result changes dramatically under 1985 program provisions because of lower wheat prices. For example, Strategy 6, under the 1985 provisions, has the lowest mean after-tax net present value of any of the strategies considered.

Under both farm programs the critical decision is whether to participate or not based on the large differences between the after-tax net present values for each strategy for participation and non-participation. For example, the mean after-tax net present value for Strategy 1, a minimum-till strategy with participation, is nearly three times larger than its non-participation counterpart (Strategy 4) for both the 1981 and 1985 programs.

Strategy 2 offered the highest mean return (after-tax net present value) under both farm programs, indicating a short-run incentive to adopt conservation tillage methods in the study area. Although returns to all strategies are reduced under the 1985 rules, the difference between minimum-till (Strategy 1) and combination-till (Strategy 2) has become more pronounced for those farmers participating in government programs. This difference probably reflects the result that, with lower barley cash prices (1985 program), wheat farmers in the study area would experience a reduction in income if they increased barley acreage.

Stochastic Dominance Analysis

Table 4 indicates the stochastic dominance results for the tillage alternatives for each farm program.[5] Strategy 2 (combination-till with participation) is highly preferred by all risk preference categories under both farm bills.[6] However, Strategy 2 is more preferred by highly risk averse producers under the 1985 bill than the 1981 bill where indifference occurred between Strategies 1 and 2. This indifference is because no additional barley was planted under 1985 provisions which served to reduce the overall risk the producer was facing.

In all tillage cases, the 1981 program is preferred to the 1985 program (e.g., Strategy 1 is preferred to Strategy 4 for all risk prefer-

TABLE 4. Preference for Different Management Strategies by Risk Preference Group for the 2324-Acre Non-Irrigated Grain Farm in Box Elder County, Utah.

Rank of Preference for Strategy[a]	Risk Lover[b]		Risk Neutral		Risk Averse		Highly Risk Averse	
Program:	1981	1985	1981	1985	1981	1985	1981	1985
Efficient Set	2,6	2	2	2	2	2	1,2	2
2nd Most Preferred	1	1	1	1	1	1	3	1
3rd Most Preferred	3	3	3	3	3	3	5,6	3
4th Most Preferred	5	5	6	5	5	5	4	4,5
5th Most Preferred	4	4	5	4	6	4	N/A	6
6th Most Preferred	N/A[c]	6	4	6	4	6	N/A	N/A

a Definitions of Strategies are found in Table 2.

b The intervals selected for Pratt's absolute risk aversion coefficient ((-U"/U') where U is the utility function) in the present study were -0.00001 to 0.0 for a risk lover, 0.0 to 0.00001 for a risk averse producer, 0.0 to 0.00005 for a highly risk averse producer, and 0.0 for a risk neutral producer.

c Not applicable.

ence categories). This is due to the lower loan rates and consequently lower expected cash prices associated with the 1985 program.

According to these results, a farmer who is not participating in government programs would be more likely to adopt a no-till practice of some sort (Strategy 5 or 6) under the 1981 program than under the 1985 program. This decision is explained by the lower cash prices associated with the 1985 bill. Under the 1981 bill the farmer could better justify planting additional acreage because most costs could be covered. Thus, the 1985 program should reduce incentives to drop out of the program to build base acreage regardless of the tillage practice followed.

Generally, the new provisions of the 1985 farm bill will likely place dryland wheat farmers with economic and management characteristics similar to the typical farmers discussed in this article in a more precarious position than the 1981 provisions. While the provisions of the 1985 bill were likely designed to make U.S. producers more competitive in world markets, the natural result will likely be that many mid- to highly-leveraged dryland wheat producers in this size category will eventually exit the industry.

Summary and Conclusions

This study used a whole-farm simulation approach to monitor the complex interaction between the components of farm management (financial, marketing, production, and tillage practices), while analyzing alternative tillage practices under the 1981 and 1985 Farm Bills. The study area was located in northern Utah and the typical farm represented a mid-sized, non-irrigated, moderately-leveraged grain farm common to the study area and similar to other non-irrigated operations throughout the western and midwestern United States. Three separate tillage practices (strategies) were analyzed under participation and non-participation in government programs. These strategies included variations in crop rotation methods (summer fallow, set-asides, etc.) and tillage practices (minimum-till, no-till and a combination minimum- and no-till).

Yields in the study area have not decreased significantly for non-irrigated wheat and barley when a no-till strategy is used. Thus, the decision to use no-till depends on the ability of no-till to yield additional returns, through increasing planted acreage, that equal or exceed the costs of increasing the farmer's debt load to purchase specialized no-till equipment and increased herbicide costs.

Government payments appear to play a significant role in decisions about tillage and other production practices. Tillage practices, coupled with government program participation, have significant impacts on the ability of mid-size farmers on non-irrigated grain farms in the study area to financially survive under both the 1985 and 1981 Farm Bills. However, there will be less incentive to adopt conservation tillage practices and drop out of government programs to build base acreage under the 1985 program.

Mid-sized dryland grain farmers will likely see an erosion in their equity bases during the next five years. This will cause many to adopt more efficient tillage methods (combination-till). However, a critical issue for financial survival for these farmers involves possible participation in available government programs.

Footnotes

1. A more detailed description of FLIPSIM V is found in Richardson and Nixon (1981).

2. The 7% discount rate represented the return available to non-risky assets (such as CD's) in 1986 when this study was completed.

3. To test the sensitivity of the results to greater variation for the no-till and combination-till procedures relative to minimum-till, two sensitivity analyses were conducted assuming increases in the standard deviation for no-till of 50% and 100% over minimum till (the most common tillage system in the study area). Combination-till (1/3 of land under no-till, 1/3 under minimum-till, and 1/3 under summer fallow) was tested by increasing its standard deviation by 25% and 50% over minimum-till. Only minor changes in the results occurred for highly risk averse producers; an indifference between Strategy 1 and Strategy 2 was observed if yields under combination-till were much more variable.

4. The initial crop-mix was determined using a typical mix for the study area. However, wheat offered a larger return per acre than barley under both farm bills based on published enterprise budgets at Utah State University. Consequently, if it was possible to expand wheat acreage (i.e., the farmer did not participate in government programs), it was assumed that wheat would be the only crop expanded.

5. The risk preference levels were based on past work by Richardson and others at Texas A&M University (Richardson and Nixon (1982)). Also, the relatively large magnitudes of the after-tax net present values (six figures) and the number of observations in each distribution (50) necessitated selecting values for Pratt's risk aversion coefficient of

at least five decimal places. Otherwise, character overflows occurred in the computer program when the integrations were performed.

6. Sensitivity tests revealed that for farmers carrying substantially greater debt (25 percent greater) than the farmer in this study, a preference is shown for minimum-till (Strategy 1) by all risk preference categories.

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