LENDERS' RESPONSE TO CROP INSURANCE: COMPATIBILITY OR CONFLICT

David J. Leatham
James W. Richardson
Bruce A. McCarl

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Farm income has not been sufficient in the 1980's for many producers to service debt obligations contracted in the 1970's. Thus, financial stress is prevalent among highly leveraged producers. The increase in loan delinquencies, and problem loans has also resulted in stressed conditions for agriculture banks. Reductions in financial and business risk would enhance producer's and lender's welfare.

In this study we focus on analyzing Federal Crop Insurance as a risk reduction tool for both the farm firm and the lender. The Federal Crop Insurance Act of 1980 authorized an expansion of the insurance program to become the primary form of disaster protection for farmers. Crop insurance primarily protects producers from yield shortfalls and theoretically, stabalizes income while providing liquidity when crop losses occur. Consequently, crop insurance can potentially reduce lenders' credit risk by reducing the likelihood of delinquent and defaulted loan payments. However, the insurance premium depletes the firm's liquidity and income. The producer's choice of crop insurance depends on whether or not the yield protection overshadows its cost and accompanying decrease in liquidity. The lender's choice depends on whether or not the crop insurance will reduce credit risk.

Lenders' have an interest in maintaining producers in profitable and liquid positions. However, at times, risk/return preferences may be different between a producer and his lender. A lender may recommend or require crop insurance to reduce credit risk but the producer may feel the cost of insurance is too high in relation to the risk reduction. This difference in preference will be referred to as a conflict.

Prior studies (Gardner and Kramer; King and Oamek; Kramer and Pope; and Lee and Djogo) have focused on the farm-level effects of crop insurance but have not discussed effects on the lender. Pflueger surveyed the attitudes of nonreal estate lenders towards borrower's participation in the crop insurance program. Lender's credit responses to borrower participation were evaluated using a farm-level simulation model. Simulation results showed that the use of crop insurance improved the level and stability of a firm's profitability and liquidity position. However, the effect of borrowers participation in crop insurance on lender's welfare was not modeled. More work is needed to evaluate lender's welfare in the face of yield variability and the choice of crop insurance. In this study the issues of when a lender should encourage the purchase of crop insurance and when potential

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The authors are, respectively, Assistant Professor, Associate Professor, and Professor, all in the Department of Agricultural Economics, Texas A&M University. This research was funded by the Texas Agricultural Experiment Station (Project H3616). Typing assistance by Linda Conti is sincerely appreciated.

conflicts arise are addressed. Both interest rate differentials and credit requirements will be considered: wherein lenders may add or subtract a premium to the interest rate and change the maximum allowable debt-to-asset position. The empirical focus was on the use of wheat crop insurance by wheat/sorghum producers in the Texas Northern Plains. The design of the study, simulation results and conclusions are presented in the following sections.

Modeling Approach

Characteristics of the Problem

Crop insurance was designed to reduce a producer's business risk associated with yield variability. The reduction in yield variability is especially important for highly leveraged producers with low credit reserves. A crop loss, in this case, could force the producer to liquidate productive assets or declare bankruptcy. However, the reduction in yield variability must be compared to the increase in costs due to the price of the crop insurance. In some cases, the cost of insurance may outweigh the benefits from risk reduction.

Crop insurance can affect the credit risk of lenders. From the lender's standpoint, the ultimate risk is the loss associated with a defaulted loan. The default rate in turn is a function of a borrower's net income, net income variability, and leverage position. Because crop insurance will affect both the firm's expected returns and variability, it is clear crop insurance will affect the default rate.

When a lender believes crop insurance will reduce credit risk, he could encourage crop insurance by refusing or reducing credit to those without it as well as increasing the interest rate on loans made to those without it. However, if the lender reduces available credit, losses on defaulted loans are reduced, but, the likelihood of loan default may increase due to the decrease in firm liquidity. In addition, an interest premium increases lender returns but this reduces the borrower's profitability which in turn may increase the default rate. Thus, lenders face tradeoffs between return and risk.

Simulation Model

Analysis of the problem requires information on the probability distribution of net present value of farm income and debt payments. Whole-farm simulation over six years was used to generate these distributions under alternative yield variabilities, and initial leverage positions. Specifically, the FLIPSIM model was used (Richardson and

Nixon; Richardson, Lemieux, and Nixon; and Perry, Rister, Richardson, and Leatham). The FLIPSIM model recursively simulates farming operation by using the current year's ending financial position as a beginning financial position for the following year. Stochastic crop prices and yields were simulated annually over six years using a multivariate probability distribution of prices and yields in the study area.

Cumulative net present value (NPV) distributions for the producer and his lender, under alternative scenarios, were developed from the simulation results. The cumulative distributions of NPV were used to compare farming situations which used crop insurance to those that did not. The farm NPV was figured using an after-tax discount rate of 8 percent.[1] In addition, a separate NPV was calculated for value of debt repayments to the lender. The lender's NPV represents all discounted cash outflows and inflows to and from the borrower associated with loans made to the producer. No adjustments were made for taxes. The interest rate charged on operating loans each year was used as the discount rate. This total accounting of cash flows required treatment of the costs of foreclosure as discussed in the next section.

Costs of Foreclosure

Costs of foreclosure need to be considered in the calculation of NPV for both the producer and the lender. The cost of foreclosure can be broken down into five categories: a) loss in farm asset values, b) cost of selling assets, c) legal expenses, d) opportunity cost of the time spent by the bank's personnel who are involved with the foreclosure, and e) opportunity cost of funds tied up in a nonproducing loan during foreclosure. The cost of foreclosure may be written as

$$(1) \quad C_f = a+imD+bA$$

where C_f is the cost of foreclosure, a is the fixed costs associated with foreclosure (i.e., legal expenses, and opportunity cost of time), i is the interest rate on outstanding debt tied up in the foreclosure, m is the length of time the foreclosure requires before completion, D is the outstanding debt at the time the foreclosure is initiated, b is the percent loss in value of assets associated with the sale of assets, and A is the market value of assets at the time foreclosure is initiated.

By convention, the loan note would include a clause which requires the borrower to compensate the lender for costs and expenses incurred by the lender to collect any past due payments. This implies that all

costs of foreclosure would be borne by the borrower. However, in this study, we assumed all foreclosure costs in excess of the borrower's ending equity, would be borne by the lender. This would occur due to farm bankruptcy or "goodwill" considerations by the lender. Thus, the foreclosure cost to the borrower $C_{f,b}$ is

$$(2) \quad C_{f,b} = \text{Min } (E, C_f)$$

and the foreclosure cost to the lender $C_{f,l}$ is

$$(3) \quad C_{f,l} = \text{Max } (0, C_f - E)$$

where E is the firm's ending equity before foreclosure.

Estimates of foreclosure costs were obtained through telephone conversations with agricultural lenders, attorneys and auctioneers who had been involved with foreclosures in the study area . Based on these interviews, it was estimated that irrigated land sold for a 40 percent discount in a forced sale (Table 1). Likewise, nonirrigated cropland and grassland lost 30 percent of their normal value. It was estimated that machinery would be subject to a 30 to 50 percent discount. Fixed auctioneer fees for real estate auctions ranged from $750 to $1,500 while fixed costs associated with machinery auctions ranged from $2,500 to $3,700. Commissions (percent of sale value) ranged from 5 to 6 percent and 6 to 9 percent on real estate and machinery auctions, respectively. Estimates of the liquidation discounts and auctioneer commissions (Table 1) were used to derive an estimate of 40 percent for coefficient b in Equation 1. Fixed auctioneer costs of $4,000 were included in the fixed cost of foreclosure (a in Equation 1).

Legal expenses associated with farm foreclosures vary depending on whether foreclosure is disputed or whether the farmer declares bankruptcy. Estimates of legal fees ranged from $75 to $2,000 and $250 to $2,000 for undisputed real estate and machinery foreclosures, respectively (Table 2). Estimates of legal fees for undisputed real estate and machinery foreclosures and foreclosures involving bankruptcy ranged from $2,000 to $25,000. In this study, an average legal fee of $6,000 ($3,000 for real estate and $3,000 for machinery) was considered a fixed cost of foreclosure and was added to a in Equation 1.

The opportunity cost of a lender's time spent in handling foreclosures was difficult to quantify. The approach taken here was to assign a value to the time spent by bank personnel working on a farm foreclosure. Survey results showed that the time spent by bank personnel

Table 1. Estimates of Liquidation Discounts and Auctioneer Costs Associated with Farm Foreclosure[a]

Item	Respondents 1	2	3	4
Liquidation Discounts (percent of Market Value):				
Irrigated Land	40	40	40	40
Non-irrigated Land	-	30	30	-
Grass Land	-	30	-	-
Machinery	40	30	30	50
Auctioneer Fees:				
Real Estate:				
Commission (percent of sale value)	5	6	6	6
Advertising ($)	1,000	1,500	1,500	750
Machinery:				
Commission (Percent of sale value)	7	6	7	9
Advertising ($)	1,500	-	1,000	1,200
Set-up costs ($)	1,000	-	2,000	2,500

[a]Obtained from telephone interview with selected auctioneers.

Table 2. Estimates of Legal Fees Associated with Farm Foreclosure[a]

Item	Low	Average	High
Real Estate:			
Undisputed	$ 75	$1,500	$ 2,000
Disputed	2,000	5,000	25,000
Machinery:			
Undisputed	250	1,000	2,000
Disputed	2,000	5,000	25,000
Bankruptcy:	2,500	4,000	20,000

[a]Obtained from telephone interviews with selected attorneys.

working on a farm foreclosure ranged from 5 to 30 percent of total time (Table 3). Estimates of the length of time between the initiation and completion of a foreclosure ranged from 1 to 12 months (Table 4). In this study, it was estimated that 80 hours (5 hours a week over an average length of foreclosure of 16 weeks) of bank personnel time was spent on any farm foreclosure. This time was valued at an opportunity cost of $50 per hour. Thus the final equation for the cost of foreclosure was

$$(4) \quad C_f = 14,000 + i(4/12)D + .4A.$$

Farm Situation

A representative Northern High Plains wheat/sorghum farm was analyzed. The representative farm, located in Ochiltree county, Texas, consisted of 1400 acres. Six hundred and forty acres of cropland was owned and the same amount was leased on a 1/4 share lease contract. One-half the land was irrigated. The other half was planted in dryland wheat. One hundred and twenty acres of pastureland was owned and leased out. The representative farm had an initial asset position valued at $580,150. The producer was allowed to sell cropland to avoid insolvency but was not allowed to purchase or lease additional cropland. It was assumed that the producer received $6,000 off-farm income annually.[2]

The representative farm was simulated 50 times over a six-year planning horizon beginning in 1985. It was assumed that the 1985 farm program provisions will hold for the next six years. The annual mean price of wheat and sorghum was assumed to be $3.20 and $4.10 per bushel respectively. The annual mean yield for irrigated wheat, dryland wheat, and sorghum was assumed to be 60, 18, and 60 bushels, respectively. The cumulative distribution of deviates about the mean yield and price (Table 5), expressed as a fraction of mean, are based on historical observations for a farm in the area. Deviates were drawn from these distributions to generate stochastic price and yield values in the model. Interest rates on farm debt averaged 10 percent over the planning horizon. Expenses, inputs, labor requirements, and other necessary information were obtained from Agricultural Extension Service budgets, and Extension Specialists.

The representative farm was simulated under conditions using or not using crop insurance on total wheat production. When crop insurance was purchased, 75 percent of the actual production history (APH) yield was insured at an insured price of $2.80. This level of insurance was consistent with a study by Lovell, Knight, and Richardson. They found

Table 3. Estimates of Time Spent by Bank Personnel Involved with a Farm Foreclosure[a]

Item	Respondents 1	2	3	4
	Percent of Total Time			
Low	5	5	5	5
Average	10	10	15	15
High	15	20	20	30

[a]Obtained from personal and telephone interviews with bank lending officers.

Table 4. Estimates of the Length of Time Between Initiation and Completion of a Farm Foreclosure

Item	Respondents 1	2	3
Real Estate:			
Undisputed (months)	3	2	3
Disputed (months)	6	12	12
Machinery:			
Undisputed (months)	6	1	1
Disputed (months)	6	6-12	6-12
Percentage of foreclosures that convert to a Chapter 11 Bankruptcy (%)	30	60	40

Table 5. Cumulative Distributions of Deviates About the Mean Crop Yield and Crop Prices, Expressed as a Fraction of Mean

Period	Yields			Prices	
	Irrigated Wheat	Dryland Wheat	Irrigated Sorghum	Wheat	Sorghum
1	-0.336	-0.567	-0.128	-0.381	-0.216
2	-0.226	-0.387	-0.035	-0.252	-0.167
3	-0.025	-0.357	-0.029	-0.096	-0.116
4	0.041	-0.191	-0.025	-0.055	-0.074
5	0.068	-0.014	-0.004	0.005	-0.068
6	0.076	-0.144	0.027	0.015	-0.067
7	0.107	-0.101	0.036	0.067	0.056
8	0.128	0.072	0.039	0.079	0.137
9	0.153	0.700	0.056	0.165	0.235
10	0.205	0.819	0.064	0.463	0.281

that the after-tax NPV for a representative wheat farm in Ochiltree County was highest when the highest yield protection and the medium price option was chosen. The insurance premium, obtained from the regional field office of the FCIC and based on the APH yield, was 6.1% on irrigated wheat and 18.4% on dryland wheat.

Farm Lender Situation

The farm lender was assumed to be the producers sole source of borrowed funds from private sources (CCC loans were also available).[3] This simplification allowed the study to focus on the effects of crop insurance with loan arrangements held constant. It was also assumed that the lender would allow the producer at least one more year of operation. But, whenever the producer's debt-to-asset ratio increased above a prespecified level, the lender initiated foreclosure.

Simulation Results

The crop insurance alternative was analyzed for 50 and 60 percent debt-to-asset positions. The maximum allowable debt-to-asset position was .67. The insurance loss ratio was .364.[4] The representative farm was also simulated using alternative insurance loss ratios. A range of insurance loss ratios were generated (Table 6) by parametrically increasing the variability of crop yields (Table 5). Interest rate differentials and changes in the maximum allowable debt-to-asset positions were introduced into the farming situations when model results indicated the producer's and lender's preferences for crop insurance were different.

Farm Situation (50 percent equity)

The base representative farm (50 percent equity) had a 100 percent chance of surviving for six years regardless of whether crop insurance was used or not (Table 7). Thus, we can infer that credit risk to the lender was zero over the six year planning horizon. Only, minor changes in the lender's performance measures were noted when no crop insurance was used.5

Simulation results showed that the farm's average NPV decreased $13,100, the standard deviation of NPV decreased $3,200, and the coefficient of variation (CV) of NPV, increased 19 percentage points when crop insurance was used (Table 7). The increase in the farm's CV of NPV occurred because the cost of insurance was far greater than the insurance indemnities. The farm's standard deviation of NPV was reduced when

Table 6. Estimated Loss Ratios Over a Range of Percentage Increases in Deviates about the Mean Yields for a Representative Texas Wheat Farm, Ochiltree County

Percentage Increases in Deviates About the Mean Yield of Wheat	Irrigated	Dryland	Average
0.0	0.35	0.37	0.36
10.0	0.50	0.46	0.47
20.0	0.64	0.56	0.58
30.0	0.79	0.65	0.70
40.0	0.93	0.75	0.81
50.0	1.07	0.85	0.92
60.0	1.21	0.96	1.04

[a]One third irrigated and two thirds nonirrigated wheat.

Table 7. Performance Measures for Producers of Simulation Runs for Representative Farms with a Debt-to-Asset Ratio of .50 and Selected Levels of Insurance Loss Ratios

Insurance Loss Ratio	--- Net Present Value --- Mean	Standard Deviation	Coef. of Variation	Probability of Survival[a]	Pratt Risk Coef.	Prob. Lower Confidence Interval
	----------$1,000----------			--Percent--		--Percent--
No Crop Insurance:						
.36	42.7	29.0	.68	100	.000143	1.5
.47	43.2	30.8	.71	100	.000105	5.4
.58	43.6	32.7	.75	100	.000066	14.0
.70	44.0	34.7	.79	100	.000042	23.6
.81	44.9	36.6	.81	100	.000026	31.9
.92	44.9	38.5	.86	100	.000010	42.9
1.04	44.7	40.5	.91	100	b	
Crop Insurance:						
.36	29.6	25.8	.87	100		
.47	31.7	27.0	.85	100		
.58	34.9	28.4	.81	100		
.70	37.8	30.1	.80	100		
.81	40.3	31.4	.77	100		
.92	42.9	32.6	.76	100		
1.04	45.5	34.0	.75	100		

[a]Probability of survival is the probability that the farm will maintain its equity-to-asset ratio at or greater than minimum levels established by local financial institutions.

[b]The strategy of using crop insurance dominated not using crop insurance for risk averse farm operators.

crop insurance was used; but the $13,100 reduction in the average NPV overshadowed the modest decline in the standard deviation. Assuming the E-V utility function of the form $E-(\phi/2)\sigma^2$ where ϕ is the Pratt risk aversion parameter, then a Pratt risk aversion coefficient of .000149 was required before the farm operator would be indifferent between purchasing crop insurance or not (Table 7).[6] The farm operator would have to be concerned with the lower 1.5 percent tail of the distribution. We conclude that very few producers who conformed to this farming situation would use crop insurance because it is expected that few producers would be that risk averse. However, producers who experience greater yield variability or are subject to a higher probability of foreclosure may find crop insurance more attractive.

Parametric increases in Loss Ratio. The farm's yield variability was parametrically increased to evaluate the relationship between the insurance loss ratio and the farm operators preference for crop insurance. Increases in the insurance loss ratio increased the farm's average NPV, standard deviation, and CV when no crop insurance was used (Table 7). When crop insurance was used, the farm's average NPV increased but its standard deviation and CV decreased. The decrease in CV of NPV when crop insurance was used was expected because the probability of higher or lower yields was increased but losses associated with low yields were truncated at the prespecified crop insurance levels.

E-V based Pratt risk aversion coefficients required for a farm operator to be indifferent between purchasing crop insurance or not declined as the insurance loss ratio was increased (Table 7). The farm operator would have to be concerned with the lower 5.4, 14.0, 23.6, 31.9 and 42.9 percent tail of the distribution for loss ratios of .47, .58, .70,. .81, and .92, respectively. At a loss ratio of 1.04, crop insurance dominated no crop insurance. The average NPV and the standard deviation of NPV were higher and lower, respectively, for the scenario with crop insurance.

The farm's average NPV was greater for simulation runs that did not use crop insurance versus those that did (comparing runs with the same insurance loss ratio) until the insurance loss ratio was greater than 100 percent (Table 7). Thus, the profit maximizing producer would not purchase crop insurance until the the expected indemnities of crop insurance exceeded the cost of insurance. The choice of crop insurance for farm situations with insurance loss ratios below 1.04 depended on the level of producer's risk aversion. The choice of crop insurance required high levels of risk aversion at low insurance loss ratios (.36) and moderate levels of risk aversion at higher insurance loss ratios (.92).

Implicit in the previous conclusion was the fact that there was a zero percent chance of foreclosure regardless of the choice of crop insurance. Because there was no chance of foreclosure, the use of crop

insurance did not affect to lender's credit risk. Lenders therefore would be indifferent to whether or not crop insurance is used under these data. The representative farm was next simulated with a higher leverage ratio to evaluate the choice of crop insurance when there was an increased probability of foreclosure.

Farm Situation (40 percent equity)

The increase in debt-to-asset ratio to .6 did not increase the probability of foreclosure of the representative farm with normal yield variability, even when no crop insurance was used (Table 8). The farm operator had to be concerned with the the lower .38 percent tail of the distribution before he preferred using crop insurance. Again, few farmers in this situation would choose crop insurance. Increases in the farm's yield variability was needed to evaluate the choice of crop insurance when there was a nonzero probability of foreclosure.

Parametric Increases in Loss Ratio. The probability of survival declined as the insurance loss ratios were increased to .58 and above (Table 8). When no crop insurance was used and the farm had a insurance loss ratio of .58, the lender's average NPV decreased by $340 (Table 9). The standard deviation of the lender's NPV and CV of NPV increased by $930 and 38 percentage points, respectively. The lender's performance measures worsened as the insurance loss ratio was increased. For example, at an insurance loss ratio of 1.04, the lender's expected NPV decreased by $2,240, the standard deviation increased by $10,780, and the CV increased by 459.1 percentage points. In this case, the lender was not indifferent. From the lender's perspective, crop insurance dominated no crop insurance when the firm's insurance loss ratio was .58 or higher (i.e., the lender's expected NPV was greater and the standard deviation of NPV was lower when crop insurance was used).

Simulation results showed that a farm's average NPV decreased sharply and the standard deviation and CV increased sharply when representative farms with insurance loss ratios greater than .58 did not use crop insurance (Table 8). This was largely a result of decreases in the probability of survival. When crop insurance was used, the probability of survival was 100 percent. The farms average NPV increased. The standard deviation of the NPV also slightly increased but the CV declined. The choice of crop insurance dominated the risk averse farm operator's choice of no crop insurance whenever the loss ratio was .70 or higher.

Lender's Response to Borrower's Nonuse of Crop Insurance

A potential Conflict in the choice of crop insurance between a risk averse farm operator and his lender was found for the farming

Table 8. Performance Measures for Producers of Simulation Runs for Representative Farms with a Debt-to-Asset Ratio of .60 and Selected Levels of Insurance Loss Ratios

--- Net Present Value ---					
Mean	Standard Deviation	Coef. of Variation	Probability of Survival[a]	Pratt Risk Coef.	Prob. Lower Confidence Interval
-------$1,000--------			--Percent--		--Percent--
No Crop Insurance:					
30.7	29.7	.96	100	.000180	.38
31.3	31.1	1.0	100	.000143	1.3
27.8	47.5	1.7	98	.000007	43.3
25.3	58.46	2.3	96	b	
26.0	59.7	2.29	96	b	
19.1	77.0	4.0	92	b	
19.3	79.3	4.1	92	b	
Crop Insurance:					
17.9	27.2	1.5	100		
20.2	28.5	1.4	100		
22.9	30.1	1.3	100		
25.6	31.8	1.24	100		
28.0	32.8	1.17	100		
30.7	33.8	1.1	100		
33.8	35.5	1.0	100		

[a]Probability of survival is the probability that the farm will maintain its equity-to-asset ratio at or greater than minimum levels established by local financial institutions.

[b]The strategy of using crop insurance dominated not using crop insurance for risk averse farm operators.

Table 9. Performance Measures for Lenders of Simulation Runs for Representative Farms with a Debt-to-Asset Ratio of .60 and Selected Levels of Insurance Loss Ratios

Insurance Loss Ratio	Net Present Value		
	Mean	Standard Deviation	Coef. of Variation
		--$1,000--	
No Crop Insurance:			
.36	4.61	.28	.06
.47	4.61	.30	.065
.58	4.34	1.19	.44
.70	3.80	3.96	1.04
.81	3.65	4.76	1.30
.92	2.29	10.52	4.59
1.04	2.37	11.10	4.66
Crop Insurance:			
.36	4.72	.24	.05
.47	4.7	.25	.05
.58	4.68	.26	.056
.70	4.67	.28	.06
.81	4.64	.29	.062
.92	4.60	.31	.066
1.04	4.61	.32	.069

situation with a debt-to-asset ratio of .6 and a loss ratio of .58. The crop insurance alternative dominated the nonuse of crop insurance from the lender's perspective. However, results showed that modestly or slightly risk averse producers would prefer not using crop insurance (Table 8). Potential conflicts were not found in the other farming situations modeled.

Two possible responses by the lender to overcome this conflict were evaluated: first, the lender's response of adding a premium to the interest rate and second, the reduction of the maximum debt-to-equity that the lender would allow the producer to incur before foreclosure was initiated. The representative farm with a debt-to-asset ratio of .6 and an insurance loss ratio of .58 was simulated with and with out the use of crop insurance separately incorporating these two responses.

Price Response. The use of crop insurance dominated not using crop insurance, from the producer's perspective, when his lender added a small premium to the interest rate (1/10th of 1 percent). The producer's average NPV increased $500 when crop insurance was used (Table 10). In addition, the standard deviation of the producer's average NPV decreased $26,100. We conclude that if a lender set a policy of charging a small interest rate premium on loans in this situation, borrowers would chose to purchase crop insurance. Thus under this case interest rate premium would be sufficient disincentive for risk averse producers to purchase crop insurance.

However, irrational or risk loving borrowers may chose to pay the premium to avoid purchasing crop insurance. For farm operators that did not use crop insurance, the added premium to interest rates increased the lender's average NPV $1390 due to the added interest payments (Table 11). Also, the standard deviation of NPV and CV increased $1,740 , and 7 percentage points, respectively, due to the increase in the frequency of foreclosure. Lenders that were concerned with the lower 38.6 percent tail of the distribution would prefer not charging the interest premium.

We conclude from these results that lenders should encourage their borrowers with debt-to-asset positions of .6 and insurance loss ratios of .58 to buy crop insurance by adding a premium to the interest rate charged borrowers that did not use crop insurance. However, only the less risk averse lenders should use this strategy on borrowers that are not likely to use crop insurance when an interest premium is charged.

Credit Response. A reduction in the maximum allowable debt-to-equity ratio was not a viable response by risk averse lenders. The average cost of foreclosure increased because of the increase in frequency of foreclosure. The lender's average NPV decreased and standard deviation of NPV increased when the maximum allowable debt-to-asset ratio was reduced and the farm operator chose not to use crop insurance Table

Table 10. Performance Measures for Producers of Simulation Runs for Representative Farms with a Debt-to-Asset Ratio of .60, Insurance Loss Ratio of .58, and Selected Lender's Responses to Borrower's Nonuse of Crop Insurance

Net Present Value			
Mean	Standard Deviation	Coef. of Variation	Probability of Survival[a]
$1,000			Percent
Crop Insurance:			
Base:			
22.9	30.2	1.3	100
Interest Premium =.001:			
22.4	56.3	2.5	96
Minimum Allowable Debt-to-Asset =.66:			
24.2	57.1	2.4	96

[a]Probability of survival is the probability that the farm will maintain its equity-to-asset ratio at or greater than minimum levels established by local financial institutions.

Table 11. Performance Measures for Lenders of Simulation Runs for Representative Farms with a Debt-to-Asset Ratio of .60, Insurance Loss Ratio of .58, and Selected Lender's Responses to Borrower's Nonuse of Crop Insurance

Net Present Value				
Mean	Standard Deviation	Coef. of Variation	Pratt Risk Coef.	Prob. Lower Confidence Interval
$1,000				Percent
Crop Insurance:				
Base:				
4.68	.26	.05		
No Crop Insurance:				
Base:				
4.34	1.19	.44		
Interest Premium =.001:				
5.73	2.93	.51	.388	.386
Minimum Allowable Debt-to-Asset =.66:				
3.99	3.18	.80		

(11).

SUMMARY AND CONCLUSIONS

The Federal Crop Insurance Act of 1980 authorized an expansion of the crop insurance program to become the primary form of disaster protection for farmers. The purpose of this paper was to evaluate producer's choice of crop insurance and to investigate the implication of this choice on his lender's performance. Under conditions where the farm's lender preferred the borrowers use of crop insurance contrary to the producer's preference, there was a conflict. Two lender's responses were considered: a) adding a premium to the interest rate charged borrowers that did not use crop insurance and b) reducing the maximum debt-to-asset position the lender would allow the borrower to incurr.

The characteristics of the problem required information on the distribution of farm income and debt cash flows from and to lenders under alternative yield distributions, interest rates, and with/without crop insurance. The FLIPSIM model was used to simulate a representative wheat/sorghum farm in the Texas Northern Plains. Commodity prices and yields were modeled stochastically. The farm's lender initiated foreclosure whenever the farm's debt-to-asset ratio exceeded a prespecified level. The costs of foreclosure were obtained from telephone conversations with lenders, lawyers, and farm autioneers in the study area. The representative farm was simulated with/without crop insurance for two initial debt-to-asset positions (.5 and .6) and seven levels of insurance loss ratios. When a conflict between the borrower and his lender occurred regarding the use of crop insurance, a premium was added to the interest rate charged borrowers who did not use crop insurance, and a reduction was made in the borrower's credit reserves.

The simulation results indicated that only extremely risk averse producers would chose crop insurance at the base initial debt-to-asset position (.5) and insurance loss ratio (.36). Increases in yield variabilility and corresponding insurance loss ratios, resulted in the requirement of lower levels of risk aversion before producers preferred the use crop insurance. The use of crop insurance was not preferred by risk averse producers unless the yield variability was increased 60 percent above the base. This increase corresponded to an insurance loss ratio of 1.04. The probability of the farm remaining solvent for 6 years (survival) was 100 percent over all levels of insurance loss ratios regardless of whether crop insurance was used. Therefore, any changes in the farm lender's performance was due to different patterns of debt flow and were shown to be insignificant. Thus, under the specifications of the representative farm, the lender was indifferent to the borrower's use/nonuse of crop insurance.

We conclude from these results that crop insurance favors producers with higher levels of yield variability. The choice of crop insurance by producers will depend principally on their expected insurance loss ratio and risk aversion.

An increase in the farm's initial debt-to-asset ratio to .6 resulted in a nonzero probability of farm foreclosure when yield variability was increased 20 percent or more above the base (insurance loss ratio of .58 or greater) and crop insurance was not used. The probability of survival remained at 100 percent when crop insurance was used. Only at an insurance loss ratio of .58 was there any potential conflict between a risk averse producer and his lender. At insurance loss ratios below .58, the probability of survival was 100 percent, thus, the lender was indifferent between the use/nonuse of crop insurance. At insurance loss ratios above .58, the producer and the lender preferred the use of crop insurance.

The lender could resolve the conflict by adding a small premium to interest rates charged borrowers who did not use crop insurance. Risk averse producers preferred buying crop insurance rather than paying the interest rate premium. However, risk loving or irrational producers may choose not to use crop insurance. Only the less risk averse lenders should use this strategy on borrowers that are not likely to use crop insurance. The added premium to the interest rate results in a higher expected NPV to the lender but also increases the lender's credit risk due to increased probability of foreclosure. The lender's decision to require nonusers of crop insurance to pay an interest rate premium depends on the lender's risk preference and his expectations of the borrowers risk preference.

Decreasing a borrower's available credit when crop insurance was not used, was not a successful response for the lender. The decrease in allowable debt-to-asset positions before foreclosure was initiated resulted in an increase in the frequency of foreclosure, overshadowing any reduction in a lender's foreclosure costs.

FOOTNOTES

1. NPV represents the present value of ending net worth for the farm, plus yearly family withdrawals minus off-farm income discounted to the present, minus beginning net worth. All cash flows were adjusted for taxes.

2. The minimum and maximum family living expense was assumed to be $18,000 and $40,000, respectively. Marginal consumption was 25 percent of disposable income over the minimum amount.

3. The assumption of one lender servicing all the credit needs of a producer may not be as limiting as it first seems. There is currently a strong movement to consolidate the separate banks in the Farm Credit System into one unit.

4. The loss ratio is the ratio of expected insurance indemnity payments and the expected cost of the crop insurance. The expected insurance indemnity, used in this study, was the mean indemnity based on the representative farm's yields over the past 10 years and the insured price of $2.80. The expected cost of the crop insurance was the current cost of crop insurance. The insurance loss ratio was a weighted average based on one third crop insurance on irrigated wheat and two thirds on dryland wheat.

5. The average and standard deviation of the lender's NPV did not change significantly when crop insurance was not used if the probability of firm survival was 100 percent. Small increases in the NPV occurred when more debt was used since the discount rate used was slightly smaller than the interest rate on intermediate and long term loans. Thus, the lender's average NPV was slightly larger when the borrower purchased crop insurance because it increased debt requirements. Also, the lender's standard deviation of NPV increased slightly when no crop insurance was purchased because the fluctuations in debt requirements increased as a result financing yield losses.

6. Values of the Pratt coefficient ϕ interpreted probabilistically following the arguments of McCarl and Bessler and assuming normality. Namely given a Pratt coefficient of ϕ and assuming that the risk premium which $(\phi\sigma^2)$ is a multiple z times the standard error then $z=(\sigma\phi)/2$. In turn we looked up the probability of values below this in the normal table.

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