The Policy Implications of Corn and Soybean Supply Response to Risk

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Abstract

Risk responsive corn and soybean acreage response models are estimated for the Corn Belt states (1970-1986). The elasticities with respect to risk are used in a stochastic simulation model along with previous estimates for land price. Alternate program scenarios are simulated with and without allowing risk to affect acreage response and land price. The econometric estimates show acreage to be significantly responsive to price risk. The simulations show the effect of risk on supply response to have a quantifiable impact on the level and variation of producer revenues and land prices.

The Policy Implications of Corn and Soybean Supply Response to Risk

One goal of government price and income support programs is to reduce risk to producers (Just; Paarlberg; Sharples). In fact, a survey of agricultural economists by Pope and Hallam stated stabilizing producers' incomes as the most important reason for the continued existence of price support programs. However, much research has not adequately considered risk in policy analysis. For example, most past simulations of alternative government policies have not included risk (e.g. Holland and Sharples). As the reduction of risk to producers is a goal of support programs and as producers are responsive to risk, analysis of such programs in a riskless model may not be appropriate (Just; Pope et al.).

Empirical research suggests that risk is a significant shifter of agricultural supply (Nieuwoudt et al.; Brorsen et al., 1987; Hurt and Garcia) Specifically, increases in risk are found to decrease supply. White and Ziemer examined the impact of risk on farmland using a capital asset pricing model and found risk to be an important factor. Hall and Brorsen also found risk to be a significant determinant of land rent and price for the Corn Belt states. Although risk has been found to be a significant determinant of land value, few efforts have been made to examine the interrelationship of the effect of risk on acreage response and land value. Yet, to determine the distribution of benefits from government programs, determining who receives the benefits of reduced risk is necessary. For example, if benefits from reduced risk are bid away in the competition for land resources this suggests that benefits may accrue to initial landowners rather than present producers. Therefore, to determine the effectiveness of government programs in reducing price and income risk and increasing incomes to producers these interrelationships must be determined.

The purpose of this paper is to determine the impact of price risk on corn and soybean supply response under alternate program scenarios. The effect of price risk on corn and soybean acreage response is estimated using cross section time series data. State level data for the Corn Belt states are used for the period 1970 to 1986. The risk elasticities from these econometric estimates are used in a stochastic simulation model to analyze the impact of risk on supply response under alternate policy scenarios. The effect of risk on land rent and land price are also measured using previously estimated elasticities taken from Hall. The results suggest risk is a significant factor affecting acreage response for corn and soybeans. Although elasticities with respect to risk are small, considering the effect of risk on supply response, through the effect on acreage response and land value, has a quantifiable impact on the level and variability of producer revenues and land values.

Econometric Models of Corn and Soybean Acreage Response

In the econometric model acreage response is measured by the number of acres planted. Only corn and soybean data are considered for this model and a corn-soybean rotation is assumed. One acreage response equation is estimated for corn and one for soybeans. Therefore, the expected price of the competing crop will be included in the equations. Also, the price risk associated with the competing crop is included. In much empirical work estimating acreage response, a major problem has been how to capture the effects of competing crops due to the potentially large number of competing crops (Burt and Worthington 1988). However, for the Corn Belt states, as corn and soybeans combined are 90 percent of crop value, this does not present a serious problem.

State level data for the Corn Belt states for 1970 to 1986 are used. All prices are deflated by the Gross National Price implicit price deflator (1982=100). The econometric equation for acreage response is:

$$(1) \quad Acres_{jit} = B_0 + B_1\, DI_{IL} + B_2\, DI_{IN} + B_3\, DI_{IO} + B_4\, DI_{MO} + B_5 DPIK + B_6\, Acres_{ji,t-1} + B_7\, E(P)_{1it} + B_8\, E(P)_{2it} + B_9\, PI_{jit} + B_{10}\, Risk_{1it} + B_{11}\, Risk_{2it} + B_{12}\, Cov(P_1,P_2).$$

where $Acres_{jit}$ are the acres planted to crop j in state i at time t. The variables DI, subscripted with state abbreviations, are the dummy variables to shift the intercept for the states. Expected price is denoted $E(P)_{jit}$, PI_{jit} is an aggregate input price, $Risk_{jit}$ is price risk, and DPIK is a dummy variable taking on the value of 1 in years of the PIK program and 0 otherwise. The number of acres planted to corn and soybeans is taken from the annual summaries of "Crop Production," USDA.

The model for acres planted is estimated in double log form, due to the differences between states in total acreages. The double log form implies that for a given change in an independent variable, the percent change in acreage across states is equal. The cross section time series method of Parks is used (Drummond and Gallant) to estimate the model. The Parks method assumes a first-order autoregressive model with contemporaneous correlation between cross sections. Due to autocorrelation in the model, an instrumental variable is constructed for the lagged acreage planted variable. The instrumental variable for acreage planted is:

$$(2) \quad Acres_{jit} = B_0 + B_1 E(P)_{1i,t-1} + B_2\, E(P)_{2i,t-1} + B_3\, PI_{ji,t-1} + B_5\, Risk_{1i,t-1} + B_6 Risk_{2i,t-1}.$$

Equation (2) is estimated by Ordinary Least Squares. A separate equation is estimated for each state. The predicted values of acres planted from these equations are the instrumental variables used in the cross-section time series estimates above; i.e., in equation (1).

Expected output prices, E(P), are comprised of two parts: a component for the expected market price and a component for the value of the government program. An expected market price is calculated as follows: First, a seasonal average price is determined as the average of monthly prices for October, November, December, January, and February. Price data is taken from "Agricultural Prices, Annual Summaries," USDA. Second, the expected market price, E(MP), is defined as last year's seasonal average market price.

The government program is modeled as a contingent claim, using an option pricing model. Past research has generally relied on calculating a support price and either selecting the maximum of the market price or the support price or calculating a weighted average of the two prices (Bailey and Womack; Duffy et al.; Houck and Ryan). Using a contingent claim model allows the program to take on a value even if the market price exceeds the support price and avoids the complication of deciding appropriate weights to assign the market and support prices.

The ability to characterize government loan and target price programs as put options lies in the commitments made by the government to the farmer. Option pricing theory may be used to value contracts where the outcome depends on uncertain future events that are quantifiable (Cox et al. 1976). The non-recourse loan program has been characterized as taxpayer subsidized put options (Gardner 1977; Marcus and Modest 1986). Witt and Reid (1987) and Turvey et al. (1988) further show that the deficiency payment program (target price program) may also be examined with the framework of option valuation theory. Modeling government programs as contingent claims, using an option pricing model, allows an implicit value to be estimated for the value of the program (Turvey et al.

1988). Using a contingent claim model allows the program to take on a value even if the market price exceeds the support price and avoids the complication of deciding appropriate weights to assign the market and support prices.

The Black model is used to estimate the value of the program (Black; Turvey et al.). This model assumes that the producer would make the decision to participate in the program on April 15 (i.e., by the last day of sign-up for the program) and that the producer will sell the crop during the harvest season; therefore, storage costs are not included. Based on Black's model,

$$(3)\quad PO_{jit} = (SP_{jt}(N(-d1))-EMP_{jit}(N(-d2)).$$

$$(3a)\quad d1 = [\ln(EMP_{jit}/SP_{jt}) + (SD_{jt}^{2}/2)T]/(SD_{jt})T^{1/2}.$$

$$(3b)\quad d2 = [\ln(EMP_{jit}/SP_{jt}) - (SD_{jt}^{2}/2)T]/(SD_{jt})T^{1/2}.$$

where

N(d) is the value of the cumulative normal density function

j, i, and t are respectively, crop, state, and time,

PO is the implicit value of the government program,

SP is the government support price,

EMP is the expected market price,

SD is the standard deviation of the log of the daily price change for November soybeans futures or December corn futures taken for 90 days prior to the April 15th deadline,

T is time (in years) taken as the number of trading days from April 15 until October 15 for soybeans or November 15 for corn.

Soybeans have only a loan rate and thus their support price is the loan rate. The support price for corn is the loan rate when only a loan rate was in effect (i.e., 1977 and 1981). For the years 1970 through 1973 when the loan rate was in effect and participating producers were paid an additional direct payment on acres diverted, the actual support price is calculated as the loan rate plus the direct support payment. For years when a target price was in effect the target price is the support price. The calculation of the support rate for corn follows earlier work, for example by Houck and Ryan, in incorporating several features of a program into one support value.

To arrive at the expected output price, the value of the government program, PO_{jit}, is added to the expected market price, E(MP); therefore, the expected price becomes:

$$(4) \quad E(P)_{jit} = E(MP)_{jit} + PO_{jit}.$$

In the case of corn the total expected price is adjusted downward by acreage restrictions when present.

$$(5) \quad E(P)_{1it} = (E(MP)_{1it} + PO_{1it}) * (1 - ARP_{1t}),$$

where ARP denotes the required reduction in base acreage to be eligible for program participation. The range of the required acreage reduction during the study period has been from zero to twenty five percent.

Cost of production data are used as a proxy for input prices.[1] These are calculated from farm production expenses published in Lucier et al. (1986). As this is aggregate data for all farming enterprises, including livestock, costs are attributed to an acre of corn or soybeans based on their relative value as a percent of cash receipts. Cash receipts for all enterprises may be found in "Economic Indicators of the Farm Sector, State Financial Summaries", USDA. For example, the category seed, which is unique to crops, is allocated to an acre of corn or soybeans based on their relative value as a percent of crop cash receipts. The category hired labor, which could be attributed to both crops and livestock, is allocated to an acre of corn or soybeans based on their relative value as a percent of total cash receipts and so forth. The categories feed, livestock costs, and net rents are excluded. The cost of production is then put on a per acre basis by dividing by the acres planted to corn or soybeans. This variable is denoted as COP_{jt}.

Price risk is chosen to reflect variation in observed prices. As more recent observations are more important in forming expectations, weighted moving averages or distributed lags of past differences in expected and observed values are commonly found in the literature (e.g. Brorsen et al. 1985, 1987; Lin). Therefore, the risk variable is specified as the square root of a weighted moving average, using a three year lag, of the squared relative deviation of actual price from expected price:

$$(6) \quad Risk_{it} = [\sum_{k=1}^{3} a_k((E(P)_{i,t-k} - P_{i,t-k-1})/ P_{i,t-k-1})^2]^{1/2}.$$

The expected price, $E(P)_{it}$, accounts for both the expected market price and the value of the government program as defined in equations 3.7 and 3.8. The price received, P_{it}, is taken as the the market price plus a payment from the government program; i.e.,

$$(7) \quad P_{it} = MP_{it} + Govpay_{it},$$

where government payments are taken as the payments to feed and oilseeds and are expressed on a per bushel basis by dividing by acres and yield.[2] As government payments are based on an expected, or historical yield, a three year moving average of yields is used for calculating government payments. The weights, a_k, k = 1 to 3, are selected as .5, .3, and .2.

Policy Simulations

The policy simulations are done using FEEDSIM (Holland and Sharples 1982). FEEDSIM is a stochastic simulation model of the United States corn, soybean, soybean meal, and soybean oil markets. This model is specifically designed to evaluate alternate corn policies. FEEDSIM is a partial analysis model; therefore, interaction between corn and soybean production and the production of other crops is ignored. FEEDSIM contains equations estimating corn and soybean production and corn, soybean, soybean meal, and soybean oil demand. Total annual demand for each commodity is the sum of domestic, export, and private ending stock demand. Market clearing prices are determined by equating total demand with production.

Areas planted are nonlinear functions of expected prices with a linear adjustment for area set-aside/diverted. Areas harvested are linear functions of areas planted. Yields are linear functions of areas harvested, adjusted with a time trend. Corn and soybean production are the products of the areas harvested and their yields. Soybean meal and oil production are obtained by applying technical crush coefficients to the quantity of soybeans demanded for crush. The model contains six domestic demand equations and four export demand equations. The domestic demand equations are for corn feed, corn other (i.e, seed and processing), soybean crush, soybean other, soybean meal and soybean oil. The export demand equations are for corn, soybeans, soybean meal, and soybean oil. All equations are nonlinear functions of prices. A detailed description of all equations is available in FEEDSIM (Holland and Sharples 1982).

The supply and demand sector elasticities used in the FEEDSIM model include, in the acres planted equations for corn and soybeans the own expected price elasticity is 0.30 and the cross elasticity is -0.10. In the domestic demand equations corn for feed has an own price elasticity of -0.30 and an elasticity of soybean meal price of 0.20. Soybean meal has a own price elasticity of -0.20 and a corn price elasticity of 0.20. Soybean oil has an own price elasticity of -0.20. Export elasticities are, in the corn export equation, -0.50 for corn own price and 0.30 for soybean price. The soybean export equation has an own elasticity of -1.00. Soybean meal exports have an elasticity of 0.20 for corn price and -0.60 for soybean meal price. Soybean oil exports have an elasticity of -2.00 on soybean oil price.

While FEEDSIM allows risk to enter the model through shocks to yield and exports, it does not provide for quantifying the effect of the exposure to price risk. Thus, the FEEDSIM model is adapted to incorporate price risk as it affects acreage response and land rents and prices.[3] The equations for acres planted to corn and soybeans currently in FEEDSIM are modified by adding a term to capture the effect of price risk. Risk is measured as the standard deviation of the squared past relative changes in price as shown in equation (6) As the acreage equations are nonlinear functions of price, risk is added as a multiplicative term. Equations are then normalized, by adjusting the intercept, so that for the no policy case the no risk and risk included equations will give the same estimate for the adjusted equations.

The Alternative Program Scenarios

In recent years, due to decreasing U.S. agricultural exports, farm financial stresses, and increasingly large government expenditures on farm programs several alternative programs have been suggested. For example, it has been suggested that mandatory supply controls be implemented in lieu of other programs. Other suggestions have included the lowering of loan rates and target prices, removing target prices, or ending government support entirely. This research attempts to simulate these suggestions and measure their effect on U.S. producers, landowners, consumers, and taxpayers. Throughout this research the scenarios will focus on changes in the corn program.

Seven alternative program scenarios are simulated. Scenario one incorporates features of the 1988 corn program; it includes a target price and loan rate, mandatory diversion, and optional paid diversion. Scenarios two and three are target price programs. Scenarios four and five are loan programs. Scenario six is a mandatory supply control program and scenario seven is a free market with no government intervention.

As the policy simulations using FEEDSIM will be started at the long run equilibrium price and stock levels, it is necessary to determine relevant levels of government support. Relevant policy program parameters should include target prices near and above the long run equilibrium and/or a loan rate near the long run equilibrium. For comparison, the parameters of the 1988 program are presented here. The cash price for corn for the 1987-88 crop year was $1.94/bu. The 1988 corn program had a loan rate of $1.77, a target price of $2.93, and a paid diversion rate of $1.75 on optional diverted land. The required diversion was 20% and the optional diversion was 10%. ("Feed: Situation and Outlook Yearbook," USDA, ERS, FdS-305, February, 1988).

Thus, as the long run equilibrium price per bushel for corn was determined to be $2.35, the following parameters will be used for the scenarios. The first program scenario incorporates all of the parameters of the 1988 farm program. The target price for corn is set at $3.00. The loan rate for corn is set at $2.00. The required set-aside is 20%. The acres eligible for diversion and the diversion rate are 10% and $1.90 per bushel.

The second program and third program scenarios are target price programs with the target price set at $3.00 and $2.75 per bushel, respectively. The fourth and fifth program scenarios are non-recourse loan programs. The loan rate is set at $2.25 and $2.00 per bushel, respectively. The sixth program scenario is a mandatory supply control program with a required non-paid acreage diversion only. The required diversion is set at 30%. The seventh program scenario is a free market with no government intervention.

The release price will be set at 115% of the loan rate for all scenarios. The Farmers Owned Reserve (FOR) release price is set at the target price when a target price is in effect and at the loan release price when only a loan program is in effect. The storage payment for the FOR is 26 1/2 cents per bushel, the 1987-88 rate. It is assumed that the CCC storage costs are also 26 1/2 cents per bushel.

Results of the Econometric Models

The results of the econometric models of the acres planted to soybeans and the acres planted to corn, equation (1), are presented in Table 1 and Table 2, respectively. For the acres planted to corn, the cost of production variables, the expected price of soybeans, and the expected price risk of corn are not significant. For the acres planted to soybeans, all variables are significant, with the exception of the corn price risk. In the corn acreage equation, in the short run, a one percent increase in the expected price of corn increases the acres planted to corn by 0.11% while a one percent increase in the expected price of soybeans decreases the acreage planted to corn by 0.05%. The long run elasticities more than quadruple with the long run elasticity of the expected price of corn increasing to 0.45% and the long run elasticity for the expected price of soybeans increasing to -0.22%. In the soybean acreage equation, the elasticity of the expected price of soybeans is 0.43 and the elasticity of the expected price of corn is -0.42. Long run elasticities more than double to 0.93 for the expected price of soybeans and -0.93 for the expected price of corn.

These elasticities are within the range of elasticities found in past research. Nieuwoudt, et al. (1988) estimated elasticities of 0.15 for the expected price of corn and -0.13 for the cross elasticity of soybean price for corn acreage response. Their expected price variable, while calculated differently than this research, is a function of government programs and lagged market prices. In their estimates of soybean acreage response, they found an own price elasticity of 0.74 and a cross price elasticity for corn price of -0.35. Lee and Helmberger (1985) found estimates of corn own price elasticities of 0.12 for free market years to 0.25 for years of government programs. They found estimates of the cross price elasticity of soybean price to be positive and in the range of 0.16 to 0.05. The FEEDSIM model uses elasticities of 0.30 for own expected price and -0.10 for cross expected price in both soybean and corn acreage equations.

The elasticities with respect to risk are considerably smaller than those found for the expected price. Due to the specification of the model and the inclusion of the covariance term, these elasticities cannot be signed a priori. In the corn acreage equation, an increase in the price risk of corn increases the acres planted to corn by 0.004% and an increase in risk of soybean prices increases the acres planted to corn by 0.07%. The long run elasticity for the price risk of corn prices is 0.02 and the long run elasticity for the price risk of soybean prices is 0.23. In the soybean acreage equation, the elasticity of the risk of soybean prices is 0.05 and the elasticity of the risk of corn prices is only -0.015. The long run elasticities are 0.11 for the risk of soybean prices, and -0.03 for the risk of corn prices.

While few estimates of risk elasticities exist for acreage response equations, these elasticities are within the range of previous estimates. For example, Brorsen et al. (1987) found short run elasticities with respect to own price risk for rice acreage in the range of -0.0036 to -0.0362. Winter and Whittaker (1979) found an elasticity of -0.06 on an income risk variable for a pooled data model for state wheat acreage response. Similarly, Lin (1977) found an elasticity of -0.06 for a gross returns risk variable for Kansas wheat acreage.

Results of the Simulation Model

For ease of discussion, the policy simulations without the adaptations to consider risk in acreage response and land price will be designated Group A. The policy simulations with the adaptations to consider risk in acreage response and land price will be designated Group B. If we rank the alternative policy scenarios by producer revenues, with one having the largest producer revenues the rankings are essentially equal for the two risk groupings. The programs rank: (1) Set-aside, 30%, (2) Combination, (3) Target, $3.00, (4) Target, $ 2.75, (5) Loan $2.50, (6) Loan $2.30 and (7) No program. The only exception in this list is that risk Group B ranks the Loan at $2.30 as slightly worse than No program. Producer revenues are presented in Table 3.

If we examine the relative changes between the alternative scenarios, an interesting observation can be made. If for example, the change in producer revenue is calculated relative to the no program scenario, risk Group A consistently estimates larger relative differences in producer revenues than the simulations with adaptations to consider risk. The only exception is the set-aside program. The relative differences in producer revenues between no program and the set-aside program are nearly equal for both risk groups.

For example, the estimates for the target and loan programs, as compared to no program, are estimated in the range of 20 to 50% higher in Group A than in Group B. For example, risk Group A estimates that the target program at $3.00 can increase revenues, over no program, 9%. The loan program estimates this increase as 7%. Thus, the Group A estimates the ability of the target program at $3.00 to increase revenues, relative to no program, 22% higher than Group B does.

If we rank programs by their ability to stabilize producer revenues and rank them by their standard deviations, with number one having the smallest standard deviation, risk Groups A and B again have identical rankings:

(1)Target, $3.00, (2) Loan, $2.50, (3) Target, $2.75, (4) Loan, $2.30, (5)Combination, (6) No program, and (7) Set-aside, 30%. However, if we compare the changes in standard deviations from no program to different policy alternatives, the differences between the risk groupings is dramatic. For example, if we compare the changes between target program at $3.00 and the loan program at $2.50, risk Group A shows a 6.9% improvement in the standard deviation going from the loan program to the target program. However, risk Group B estimates an improvement of only 3.9%. If we compare the loan program at $2.50 to the target program at 2.75 the risk Group A estimates the loan program as improving standard deviations of producer revenues 7%, while the risk Group B estimates an improvement of 13%. Comparing the changes between the loan at $2.50 and the combination program, risk Group A estimates the standard deviations of producer revenues in the combination program as 30% higher than those in the loan program, while the risk Group B estimates it as 33% higher.

Land rents and land prices are presented in Tables 4 and 5, respectively. Land rents and prices are estimated as highest under the set-aside and combination programs for all risk groups. The difference in land rents between the other policy scenarios is very small, being at the largest for risk Groups A, and B, respectively, about 2% and 4%. However, even these small differences are of interest. Group B, with adaptations to consider acreage and land rent risk, estimates relative changes between programs that are twice as large as those for Group A, with no adaptations to consider risk endogenous. It is of considerable interest to examine the magnitude of standard deviations for different risk groups. Even though Group A and Group B estimate land rents that are similar, with differences in estimated rents being from 0.7to 3%, Group B has standard deviations that are 18 to 40% larger than Group A.

It is interesting to compare the changes estimated in producer revenues to the changes estimated in land prices for different policy scenarios. For example, in the combination scenario risk Groups A and B, respectively estimate producer revenues to be 12% and 11% larger than under no program. The estimated differences in land prices for the combination program versus no program are 12% and 13% higher for risk Groups A and B, respectively. Thus, under the combination program the different risk groups estimate the changes in producer revenues and the changes in land price, over no program, to be nearly equal. However, for the loan program at $2.50 the risk Groups A and B, respectively, estimate the change in producer revenue over no program to be 4% and 2%, and the changes in the land price to be 1% and 4%. Thus, the simulations without the adaptations to consider risk estimate the changes in producer revenue to be equal or greater than the changes in land price. The simulations with adaptations to consider risk estimate the changes in the land prices to be larger than the changes in producer revenues. This indicates that much of the variability may be passed into land prices and that the riskless model cannot capture this.

Summary and Conclusions

This research estimated the effect of price risk on acreage response for corn and soybean in the Corn Belt states from 1970 to 1986. The elasticities with respect to risk were utilized in a stochastic simulation model which was adapted to allow risk to affect acreage response and land value. Previously estimated elasticities for land rent and land price were included in the simulation model. The results suggest that even though risk elasticities appear small there is a quantifiable response to the effect of risk under alternate policies.

Specifically, if risk is considered in policy analysis this study indicates that loan programs appear relatively better as compared to target programs than when risk is not considered. This study also indicates that the benefits to producers from all programs may be overstated when risk is not considered. Furthermore, a larger portion of the effect of programs may be felt in the level and variability of land prices than producer revenues.

The value of considering risk endogenously appears in estimating the magnitude of change, particularly in the level and standard deviations of producer revenues and land prices, between programs. While considering risk endogenously does not significantly alter the ranking of the programs in terms of their ability to increase or stabilize producer revenues, it does provide information on the effectiveness of alternative policies.

ENDNOTES

1) Costs of production were deemed more appropriate than input price indexes that were available. Input indexes were felt to include information that is not relevant to the production of corn and soybeans and are not readily available at the state level. Cost of production data does, however, capture changes in input quantities.

2) Beginning in 1986, reported government payments for feeds include PIK payments (USDA; Economic Indicators, State Financial Summaries). To be consistent, and in an effort to capture the effects of the PIK program, data for 1983, 1984, and 1985 are adjusted to reflect PIK payments.

3) The elasticities for land rent and land price were estimated for the same data set and time period as presented in this study. Procedures were also similar. The estimated elasticity with respect to risk for land rent and land price are, in the short run, -0.04, and in the long run -0.20 (Hall).

Table 1 Results of the Econometric Model of Acres Planted to Soybeans in the Corn Belt, 1970 to 1986.

Variable	Parameter estimates	T statistic	Standard error	Long run elasticity
Intercept	3.137	6.96	0.451	
D_{IL}	0.377	6.89	0.055	
D_{IN}	0.058	3.02	0.019	
D_{IO}	0.381	7.31	0.052	
D_{MO}	0.218	6.92	0.032	
$ACRES_{t-1}$	0.528	8.72	0.061	
EP-CORN	-0.423	-10.87	0.039	-0.926
EP-SOYB	0.425	10.12	0.042	0.931
COP-SOYB	-0.037	-1.64	0.022	0.081
COP-CORN	0.122	4.97	0.024	0.267
RISK-CORN	-0.015	-0.79	0.019	0.033
RISK-SOYB	0.051	2.19	0.023	0.112
COV-PRICE	0.014	1.70	0.008	0.031

Notes: The model is estimated as cross section time series, using the Parks method (Drummond and Gallant 1982). The equation is estimated in double log form.

M.S.E. = 1.12
M.S.E. degrees of freedom = 72

Table 2 Results of Econometric Model of Acres Planted to Corn in the Corn Belt, 1970 to 1986.

Variable	Parameter estimates	T statistic	Standard error	Long run elasticity
Intercept	2.053	3.52	0.583	
D_{IL}	0.240	3.10	0.077	
D_{IN}	0.105	3.08	0.034	
D_{IO}	0.291	3.24	0.090	
D_{MO}	-0.114	-3.67	0.031	
DPIK	-0.326	-12.08	0.031	
$ACRES_{t-1}$	0.759	10.44	0.073	
EP-CORN	0.110	2.67	0.041	0.455
EP-SOYB	-0.053	-1.18	0.045	-0.219
COP-CORN	-0.007	-0.25	0.027	0.029
COP-SOYB	0.015	0.57	0.027	0.062
RISK-CORN	0.004	0.18	0.024	0.017
RISK-SOYB	0.067	2.61	0.026	0.277
COV-PRICE	-0.019	-2.14	0.009	-0.079

Notes: The model is estimated as a cross section time series, using the Parks method (Drummond and Gallant 1982). The equation is estimated in double log form.

M.S.E. = 1.13
M.S.E. degrees of freedom = 71

Table 3 Producer Revenue for Alternate Policy Scenarios and Different Risk Groups

Policy Scenarios	Risk Group	
	Group A	Group B
	(million dollars)	
Combination		
Average	34480.5	35113.9
Std. Dev.	3381.6	3593.9
CE	34142.9	34764.6
Target, $2.75		
Average	32169.2	32635.0
Std. Dev.	2547.2	2771.4
CE	31849.1	32310.3
Target, $3.00		
Average	33520.9	33739.4
Std. Dev.	2199.9	2312.3
CE	33187.3	33403.7
Loan, $2.30		
Average	31347.9	31514.8
Std. Dev.	2814.7	2968.4
CE	30688.4	31299.4
Loan, $2.50		
Average	31940.3	32287.1
Std. Dev.	2363.4	2405.7
CE	30885.8	31965.9
Set Aside, 30%		
Average	35471.3	36392.2
Std. Dev.	4386.3	4882.1
CE	35118.4	36030.5
No Program		
Average	30848.8	31571.3
Std. Dev.	3817.5	4037.3
CE	30541.9	31257.2

Notes: The adaptations made to the FEEDSIM model to endogenize risk are: Group A: no adaptations made to endogenize risk; Group B: adaptations to consider acreage and land rent risk.

Table 4 Land Rent for Alternate Policy Scenarios and Different Risk Groups

Policy Scenarios	Risk Group	
	Group A	Group B
	dol. per acre	
Combination		
Average	85.77	87.03
Std. Dev.	3.36	5.11
Target, $2.75		
Average	80.34	78.85
Std. Dev.	3.56	5.32
Target, $3.00		
Average	79.91	78.38
Std. Dev.	3.59	5.33
Loan, $2.30		
Average	81.21	80.17
Std. Dev.	2.86	3.47
Loan, $2.50		
Average	81.48	81.36
Std. Dev.	3.05	4.20
Set Aside, 30%		
Average	89.72	86.86
Std. Dev.	3.81	5.95
No Program		
Average	80.95	79.09
Std. Dev.	3.42	5.20

Notes: The adaptations made to the FEEDSIM model to endogenize risk are: Group A: no adaptations made to endogenize risk; Group B: adaptations to consider acreage and land rent risk.

Table 5 Land Price for Alternate Policy Scenarios and Different Risk Groups

Policy Scenarios	Risk Group: Group A	Risk Group: Group B
	dol. per acre	
Combination		
Average	965.81	938.93
Std. Dev.	44.27	66.57
Target, $2.75		
Average	843.43	820.00
Std. Dev.	46.37	69.45
Target, $3.00		
Average	837.09	813.32
Std. Dev.	46.87	69.72
Loan, $2.30		
Average	856.85	843.09
Std. Dev.	36.64	45.58
Loan, $2.50		
Average	861.34	855.33
Std. Dev.	40.52	54.87
Set Aside, 30%		
Average	979.54	930.43
Std. Dev.	49.89	78.28
No Program		
Average	849.34	820.89
Std. Dev.	44.59	67.78

Notes: The adaptations made to the FEEDSIM model to endogenize risk are: Group A: no adaptations made to endogenize risk; Group B: adaptations to consider acreage and land rent risk.

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