Impacts of a Standing Disaster Payment Program on U.S. Crop Insurance

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Paper prepared for presentation at the 108th EAAE Seminar 'Income stabilisation in a changing agricultural world: policy and tools', Warsaw, February 8-9, 2008

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Abstract

This research investigates the potential effects of the standing disaster assistance program proposed in the Senate version of the 2008 Farm Bill. Results suggest no significant impact on producer crop insurance purchase decisions. Payments under the program should be expected to differ considerably across geographic regions and levels of diversification, with the program providing the greatest benefit to undiversified producers in more risky production regions (e.g., the Southern Plains).

In 1887 then U.S. President Grover Cleveland vetoed an emergency appropriation of $10,000 for drought victims in Texas. He explained his decision by saying that the federal government had no " . . . warrant in the Constitution . . . to indulge a benevolent and charitable sentiment through the appropriation of public funds . . . (for) relief of individual suffering which is in no manner properly related to the public service" (Barry, 1997:369). Over time, public perceptions of the federal role in disaster relief changed considerably. By the mid-1970s the federal government provided more than 70 percent of the disaster relief funding in the U.S. (Clary, 1985).

The U.S. government's role in providing agricultural disaster relief expanded greatly in 1949 when Congress established a program that would provide low-interest loans to individual farmers and ranchers who suffered losses due to natural disasters. Later the secretary of agriculture was given the authority to make direct disaster relief payments to producers who participated in federal price and income support programs. This authority was suspended in 1981 (and by legislation adopted in subsequent years) for all situations where federal crop insurance was available. Due to the widespread availability of federal crop insurance, this implied that future federal agricultural disaster payments would require *ad hoc* authorizing legislation.

Since 1981, Congress provided such *ad hoc* legislation is most years. Between 1987 and 1994, more than 60 percent of U.S. farms received federal disaster payments at least once with many farms receiving payments every year (Barnett, 1999). In some cases the *ad hoc* legislation authorized disaster payments only for specific crops in specific areas that were affected by specific natural disasters. In other cases, the legislation authorized payments for all crops in all areas that have been affected by any disaster (including the explosion of the space shuttle Columbia over Texas in 2003). Payments have also been made to livestock producers (primarily for forage losses) and to crop producers who were affected by economic emergencies (low prices) rather than natural disasters. All of these *ad hoc* payments were funded by off-budget emergency supplemental appropriations.

These ad hoc payments were also made in a context of increasing on-budget funding for subsidized crop insurance. Crop insurance reform legislation was adopted in 1980, 1994 and 2000 each time with the expressed intent of eliminating or at least reducing the need for *ad hoc* disaster payments (Glauber). These reforms generally increased crop insurance premium subsidies to stimulate higher levels of participation. As a result the cost of the program to the government (indemnities net of premiums, premium subsidies, and delivery cost) rose from an average of $559 million per year during the period 1981-1993 to an average of $1,919 million per year during the period 1994-2003. Thus, it seems evident that the U.S. has created a dual system of subsidized crop insurance and *ad hoc* disaster payments — programs that would seem to be at least somewhat redundant.

Despite the frequent implementation of ad hoc disaster payments, there has been no standing program that would provide disaster payments to farmers and ranchers in the U.S. since 1981. This will almost certainly change in 2008. As this is being written in mid-December 2007, the U.S. Senate has just adopted its version of the “farm bill” – omnibus legislation that authorizes a number of federal agricultural, conservation, food, and rural programs for subsequent years (generally, 5 years). The Senate farm bill contains authorization for a standing disaster payment program. The House farm bill (adopted in July) does not contain similar authorizing language; however, the chairman of the House Committee on Agriculture, Congressman Collin Peterson, has expressed his support for a standing disaster payment program. Thus, most political observers believe that a standing disaster payment program will be included in the farm bill that emerges from the House-Senate conference committee (which will likely convene in January 2008).

The standing disaster payment program being proposed in the Senate farm bill is significantly different than the program that was in place prior to 1981. For example, the pre-1981 program was based on yield losses. The proposed program is based on revenue losses. Also, the pre-1981 program provided compensation for losses on individual crops while the proposed program would provide compensation based on shortfalls in “whole farm” revenue, including all crops produced on the farm.

To be eligible for the proposed standing disaster payment program, farms would be required to purchase at least the catastrophic level of federal crop insurance. The disaster payment program would compensate farms for 52 percent of the difference between their disaster payment program guarantee and their realized total farm revenue. For purposes of the proposed program, realized farm revenue would include market revenue, any crop insurance indemnities, and 20 percent of any federal direct fixed payments. Other federal income support payments (e.g., price or revenue counter-cyclical payments and loan deficiency payments) would not be included in revenue to count against the disaster payment program guarantee.[1]

The research presented in this paper analyzes the impact of the proposed standing disaster payment program. Specifically, the research:

1) Investigates the impact of the proposed standing disaster payment program on federal crop insurance purchase decisions;
2) Analyzes expected disaster payment benefits for different crops and regions;
3) Analyzes expected disaster payment benefits for different degrees of on-farm crop diversification; and
4) Contrasts the proposed standing disaster payment program with an alternative disaster payment structure, specifically focusing on how geographic differences in production risk will affect disaster program experience.

Conceptual Framework

When farmers plant crops they are making financial investments in a portfolio of enterprises that they hope will generate net income. In this sense, farmers are no different than those who invest in stocks, bonds, or other financial assets.

Consider a portfolio consisting of *n* different crop enterprises. The expected return on the portfolio is

$$E\left(r_{portfolio}\right) = \sum_{i=1}^{n} w_i E\left(r_i\right) \tag{1}$$

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[1] The proposed standing disaster payment program would also provide authority for a permanent livestock indemnity program. This program would compensate livestock producers for death losses in excess of normal mortality that are caused by adverse weather conditions. The livestock indemnity program is not included in the analysis presented here.

where $E(r_i)$ is the expected return for crop *i*, w_i is the proportion of the total value of the portfolio that is in crop *i*, and $\sum_{i=1}^{n} w_i = 1$.

For a portfolio consisting of two crops, *j* and *k*, the variance in returns for the portfolio would be measured as:

$$\sigma^2_{portfolio} = w_j^2\sigma_j^2 + w_k^2\sigma_k^2 + 2w_j w_k \sigma_j \sigma_k \rho_{j,k} \tag{2}$$

where $\rho_{j,k}$ is the correlation coefficient between returns on crop *j* and crop *k*. By changing the notation for variance from σ^2_{crop} to $\sigma_{crop,crop}$, equation 2 can be generalized to allow for portfolios of more than two crops:

$$\sigma^2_{portfolio} = \sum_{g=1}^{n}\sum_{h=1}^{n} w_g w_h \sigma_g \sigma_h \rho_{gh} \ . \tag{3}$$

Following standard financial theory we assume that farmers manage their portfolios by making decisions that weigh expected returns against risk. Specifically, it is assumed that farmers maximize a constant relative risk aversion (CRRA) utility function, which is represented mathematically as

$$\begin{aligned} &\mathrm{E(U)}_r = \sum_{\mathrm{t}=1}^{\mathrm{n}} \omega_t \frac{W_t^{1-r}}{1-r} \quad \text{if } \mathrm{r} \neq 1 \quad \text{and} \\ &\mathrm{E(U)}_r = \sum_{t=1}^{\mathrm{n}} \omega_t \ln(W_t) \quad \text{if } \mathrm{r} = 1 \end{aligned} \tag{4}$$

where *r* is a risk aversion coefficient and ω_t is the weight associated with each possible wealth outcome *t*. If W_0 represents initial wealth then $W_t = W_0 + NR_t$ where NR_t is a stochastic annual net return, which in the present context would include returns from crop production, commodity program payments, crop insurance indemnities, and disaster program payments.

The commodity program payments included in the analysis are Direct Payments (DPs), Loan Deficiency Payments (LDPs), and Counter-Cyclical Payments (CCPs). For each program crop, commodity program payments, crop insurance indemnities, and disaster program payments are modeled as follows. LDPs are calculated as:

(5) $$LDPs = \max(0, LR - MYA) \times PA \times y_f$$

where LR is the loan rate, MYA is the marketing year average price, PA is planted acres, and y_f is the realized farm yield.[2] DPs are calculated as:

(6) $$DP = DP_R \times 85\% \times BA \times \bar{y}_f$$

where DP_R is the direct payment rate, BA is the base acreage, and $\bar{y}_f$ is the program yield. CCPs are calculated as:

(7) $$CCP = \left(CCP_{TP} - DP_R - \max\left(LR, MYA\right)\right) \times 85\% \times BA \times \bar{y}_f$$

where CCP_{TP} is the target price and all other variables are as defined previously.

Crop yield insurance is modeled at coverage levels ranging from 50 to 85 percent coverage in five percent increments – as in the actual crop insurance program. Indemnities are computed as:

(8) $$Indemnity = EP \times \max\left[0, \left(\left(CL \times APH_f\right) - y_f\right)\right]$$

where EP is the crop insurance pre-planting expected price, CL is the coverage level, and APH_f is the farm's crop insurance actual production history (APH) yield. The crop insurance products are assumed to be actuarially-fair so the associated federal transfer is simply the premium

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[2] LDPs are actually paid based on posted county prices at the time the LDP is exercised. However, to simplify the modeling we use MYA instead of posted county prices. Assuming markets are efficient, this simplifying assumption should not greatly bias the results.

subsidy, which currently ranges from 67 percent for the 50 percent coverage level to 38 percent for the 85 percent coverage level.[3]

The standing disaster payment program proposed in the Senate legislation is designed to interface with crop insurance. This is clearly observed when one examines the proposed payment function:

$$
\begin{aligned}
(9)\qquad \begin{matrix}\mathit{Disaster}\\ \mathit{Payment}\\ /\mathit{Acre}\end{matrix} = & \left[115\% \times \sum_i \begin{matrix}\mathit{Expected}\\ \mathit{Crop}\\ \mathit{Yield}_i\end{matrix} \times \begin{matrix}\mathit{Crop}\\ \mathit{Insurance}\\ \mathit{Coverage}_i\end{matrix} \times \begin{matrix}\mathit{Crop}\\ \mathit{Insurance}\\ \mathit{Price}_i\end{matrix}\right] \\
& - \left[\sum_i \begin{matrix}\mathit{Actual}\\ \mathit{Crop}\\ \mathit{Yield}_i\end{matrix} \times \begin{matrix}\mathit{Harvest}\\ \mathit{Crop}\\ \mathit{Price}_i\end{matrix} + \sum_i 0.2 \times \begin{matrix}\mathit{Direct}\\ \mathit{Payment}_i\end{matrix} + \sum_i \begin{matrix}\mathit{Crop}\\ \mathit{Insurance}\\ \mathit{Indemnity}_i\end{matrix}\right]
\end{aligned}
$$

where *i* represents the farm's crop enterprises. The first term on the right-hand side of the equation is the guarantee equal to 115 of the insured value of all crops. Thus, choosing higher crop insurance coverage levels results in a higher disaster guarantee.[4] The second term on the right-hand side is the sum across crops of revenue per acre plus 20 percent of all direct payments per acre plus crop insurance indemnities per acre.

Once the net returns are calculated, certainty equivalents (CEs) can be calculated by inverting equation 4. The CE represents the highest sure payment a decision maker would be willing to take to avoid a risky outcome (Hardaker, Huirne, and Anderson, 1997). For any two alternatives *l* and *m*, if $CE_l > CE_m$, then alternative *l* is preferred to *m*.

For this investigation, the optimal crop insurance coverage level is that which results in the highest CE. Comparing optimal coverage levels with and without the proposed disaster

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[3] Free catastrophic coverage crop insurance is available with a 50 percent guarantee with the crop value capped at 55 percent of the expected price.

[4] Note the guarantee is capped at 90% of expected crop revenue.

payment will reveal what effect, if any, the disaster program is likely to have on insurance purchase decisions. The equations for calculating the CE from the CRRA utility functions used here are:

$$(10)\quad \begin{aligned} CE_r &= \left[\overline{U}(1-r)\right]^{\left(\frac{1}{1-r}\right)} - W_0 \quad \text{if } r \neq 1\text{, and} \\ CE_r &= e^{\overline{U}} - W_0 \quad \text{if } r = 1 \end{aligned}$$

where $\overline{U}$ is a value for utility calculated from equation 4.

Data and Modeling

A stochastic simulation model is developed to evaluate crop insurance indemnities and disaster program payouts for a representative Mississippi cotton-soybean-corn farm, a representative Illinois soybean-corn farm and a representative Kansas wheat-corn farm. Certainty equivalents are calculated for each crop insurance coverage level from 50 to 85 percent both with and without the proposed disaster payment program to determine any impact of the program on optimal crop insurance purchase decisions by producers. For the Mississippi farm the effect of the disaster program is evaluated assuming production of all cotton, all soybeans, all corn, and a mix of cotton, soybeans and corn. For the Illinois farm, the program is evaluated assuming production of all soybeans, all corn, and a mix of the two. Similarly, for the Kansas farm, all wheat, all corn, and an equal mix of the two are modeled.

To accurately assess the potential impacts of the proposed disaster program, it is necessary to model returns from crop production, existing government programs (i.e., direct payments, counter-cyclical payments, and loan deficiency payments), and crop insurance as well as from the proposed program. Simulating outcomes for these different revenue streams requires the simulation of a relatively large number of variables including futures prices, cash prices, farm-level yields, and county-level yields for each of the crops considered.

The price data used in the model consist of beginning and ending prices as defined in the crop revenue coverage (CRC) insurance product provisions[5] as well as harvest time cash prices and marketing year average prices. Both county-level and farm-level yields are simulated in this model. Clearly, farm-level yields are required to calculate crop returns, crop insurance indemnities, and loan deficiency payments. County-level yields are simulated in order to define an event triggering a disaster program payment. If county-level yields for any crop fall below a defined threshold, a disaster declaration will be assumed. Under the proposed program, a disaster declaration for the county is a necessary first condition for producers in the county to be eligible for disaster payments.

To simulate price outcomes, a beginning futures price was assumed for each crop. Futures price changes over the production season and harvest time basis values were simulated using parameters calculated from historic data obtained from the Commodity Research Bureau (CRB) database. This information was used to calculate ending futures prices and harvest time cash prices (as well as a marketing year average price) for each crop. Yields were simulated from a Beta distribution, with parameters of the distribution for each crop derived from historic data. County yields are from the U.S. Department of Agriculture's National Agricultural Statistics Service while farm yields are derived from the county-level series using the method described in Coble and Barnett (2007). Correlations between yields, futures price changes, and

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[5] The CRC Commodity Exchange Endorsement describes how base (i.e., beginning) and harvest (i.e., ending) prices are to be established for each crop and location. For example, for corn, in counties with a March 15 cancellation date for CRC policies, the base price is the average daily settlement price on the Chicago Board of Trade's December corn contract during the month of February. The harvest price is the average daily settlement price on that same contract during the month of October. Additional details about the beginning and ending prices used in this study can be found in the CRC Commodity Exchange Endorsement (USDA Risk Management Agency).

basis values were also included in the simulation. Data for Mississippi covered the period from 1979 through 2004. Data for Illinois and Kansas covered the period from 1975 through 2004. Table 1 provides names and descriptive statistics for the data used in the Mississippi representative farm model.

A total of 100,000 correlated price changes, basis values, and yields were simulated for each representative farm. Correlated price variables were simulated using the procedure described by Phoon, Quek, and Huang (2004). In this procedure, a rank (Spearman) correlation matrix, $\boldsymbol{\rho}_s$, is calculated. An Eigen decomposition of $\boldsymbol{\rho}_s$ results in a matrix of Eigen values ε and Eigen vector $\hat{\varepsilon}$. Correlated standard normal deviates ($\hat{Z}$) are generated using:

(11) $\hat{Z} = \sqrt{\varepsilon} Z \hat{\varepsilon}$,

where *Z* is a vector of independent standard normal deviates. These correlated standard normal deviates are converted to correlated uniform deviates on the (0,1) interval by a transformation on the standard normal cumulative distribution function. The uniform deviates are used as probabilities in an inverse transformation on each of the marginal distributions for the variables being simulated (in this case, price changes, basis values, and yields). The notable feature of this simulation routine is that is allows the simulation of correlated variables with mixed marginal distributions, permitting the simulation of correlated prices and yields.

Simulated prices and yields, are used to calculate crop returns, crop insurance indemnities, government payments (e.g., LDPs and counter-cyclical payments), and any payments under the proposed disaster payment program. To calculate the direct and counter-cyclical payments, crop base acres and yields must be assumed. In this model, base acres and planted acres are assumed to be the same. All three representative farms are assumed to have 3,000 acres of cropland.

Returns from all sources are converted to utility values using the constant relative risk aversion (CRRA) utility function shown in equation 4. Utility values are calculated for a risk aversion coefficient of 2, representing a moderately risk-averse decision maker. Initial wealth is assumed to be $50,000. Certainty equivalents (CEs) for crop insurance coverage levels from 50% to 85% are then calculated to define the optimal coverage level both with and without the disaster payment program.

The model developed here can also be used to compare the relative impact of the proposed disaster payment program across geographic regions and across different levels of diversification. For each representative farm, average annual disaster program payments will be computed for each crop mix modeled. We hypothesize that, for the same crop, disaster payments will be lower for the Illinois representative farm than for either the Mississippi or Kansas farms. Likewise, we expect that disaster payments will be lower for more diversified farms since the disaster payment trigger is based on whole farm revenue, which should be less variable on a diversified operation.

To gain further insight into geographic differences in potential disaster payments, the model developed here is then modified to compute payments under a hypothetical program that provides protection at the level of 70 percent of expected whole farm revenue.[6] In this comparison, an actuarially-fair premium rate for 70 percent whole farm coverage is calculated for the Mississippi farm. For the Illinois and Kansas farms, a grid search is performed to find the whole farm coverage level that would correspond to the actuarially-fair premium rate for 70 percent coverage on the Mississippi farm. This exercise illustrates the degree to which imposing

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[6] The rationale for establishing a 70% whole farm coverage program is that such a program would be considered WTO green box.

consistent coverage levels across dissimilar geographic regions actually leads to inequities in program payouts due to differences in production risk.

Results and Discussion

Simulation results for the Mississippi, Illinois, and Kansas representative farms are presented in Tables 2, 3, and 4, respectively. With respect to the issue of disaster program effects on crop insurance purchase decisions, it does not appear that optimal crop insurance coverage levels are influenced by the availability of the disaster program. Payments under the disaster program are relatively small in relation to crop insurance indemnities at all coverage levels – too small to affect certainty equivalents by enough to shift the optimal coverage level by 5 percentage points. Note that a grid search over finer increments of coverage would likely reveal some small difference in the true optimal coverage; however, the coverage levels modeled here are the only ones that are relevant to the actual crop insurance purchase decision.

Results in all three tables demonstrate an effect of diversification on disaster program payments. In general, disaster payments are higher for a single crop compared to the diversified crop situation. The exception to this is that disaster payments are smaller for soybeans in Illinois as a single crop than for the corn/soybean crop combination. This likely reflects the relatively low yield risk for Illinois soybeans along with the relatively low revenue guarantee associated with that crop. In Mississippi, the revenue guarantee on soybeans would still be relatively low, but yield risk is considerably greater compared to Illinois. Specifically, the simulated coefficient of variation on farm-level yield for soybeans in Mississippi is 0.579 while in Illinois it is 0.221.

To further investigate geographic differences in disaster program experience, the model developed here was used to calculate an implied premium rate for a disaster program that makes payments whenever realized whole farm revenue is less than some percentage of the expected whole farm revenue. That is, the producer would receive the following revenue guarantee (*RG*):

$$RG = CL \bullet \sum_{i} E[y_i]E[p_i]ac_i \ , \qquad (12)$$

where $E[y_i]$ is the expected yield for crop *i*, $E[p_i]$ is the expected price for crop *i* (represented by the beginning futures price defined in crop insurance provisions), ac_i is the number of acres planted to crop *i*, and *CL* is the percent of expected revenue guaranteed by the program. In this analysis, premium rates are calculated for coverage levels of 50, 60, and 70 percent. To begin, in order to focus more directly on geographic differences in program payments, planting of only the dominant crop is considered: cotton for the Mississippi farm, corn for the Illinois farm, and wheat for the Kansas farm. Premium rates estimated for each farm and coverage level are reported in Table 5. Not surprisingly, premium rates are much higher in Kansas than in Illinois, with rates for Mississippi falling between (though much closer to the Illinois rates than to the Kansas rates). These results illustrate significant differences in premium rates across geographic regions due to differences in revenue risk across regions and, of course, crops.

Further analysis was conducted to incorporate the effects of crop diversification on premium rate for the hypothetical disaster program covering 70 percent of expected whole farm revenue. For the Mississippi representative farm (in the case of a diversified crop mix with equal plantings of cotton, soybeans, and corn), the actuarially fair premium rate for a program covering 70% of expected crop revenue would be about 2.66%. For the Illinois representative farm (also assuming a diversified crop mix), a grid search was performed to determine the coverage level that would correspond to a 2.66% premium rate. That coverage level is about 82%. For the

Kansas diversified farm, the coverage level corresponding to the Mississippi premium rate is just 23.5%.

Differences in premium rates noted above largely reflect differences in production risk across regions. For example, despite the fact that the Mississippi farm is more diversified than the Illinois farm, the implied premium rate for 70% coverage in Mississippi is too high for that same level of (whole-farm) coverage in Illinois. Production risk is lower in the heart of the Corn Belt than in the Mid-South. On the other hand, the Mississippi implied premium rate is far too low for the Kansas farm, reflecting both the reduced amount of diversification on that farm and the higher risk associated with production in the Southern Plains.

Another factor – in addition to level of diversification and production risk – that will influence differences in implied premium rates is price/yield correlation differences across locations. A negative price/yield correlation has the effect of reducing variability in farm-level revenue. Table 6 presents price/yield correlations for the crops and locations. Consistent with the implied premium rates noted above, negative correlations are highest in Illinois and lowest in Kansas, with Mississippi correlations falling between.

The significance of these results comparing implied premium rates is that they highlight the inherent inequity of government programs that impose consistent coverage levels (or revenue triggers) across regions that may differ greatly in terms of production risk. Similarly, imposing consistent coverage across different levels of diversification can also be problematic. Note the quite large difference between the actuarially-fair premium rates for the diversified Mississippi farm (2.66%) compared to the cotton-only Mississippi farm (6.39%). Viewed another way, the actuarially fair premium rate for 70% coverage on the diversified Mississippi farm corresponds to a coverage level of just 58% in the case where cotton is the only crop grown on the Mississippi farm.

Summary and Conclusions

The standing disaster payment program proposed in the Senate version of the 2008 Farm Bill represents an attempt by the federal government to provide a systematic means of compensating producers for losses associated with production (as opposed to price) shortfalls. Because the revenue trigger established under this proposed program is tied to the producer's crop insurance coverage level and because the program would function in much the same way as a crop insurance product, it is quite possible that the program could influence crop insurance purchase decisions.

Results of this research suggest that payments under this disaster program, as proposed, would not be likely to affect optimal crop insurance coverage levels. Payments are, on average, small relative to crop insurance indemnities – too small to exert much influence on the choice of insurance coverage level.

Further results of this study illustrate the influence of crop diversification and production risk on payments under this program. In general, the program will pay more to less diversified operations in areas characterized by greater production risk. This may seem an intuitively obvious finding, but it has implications for the distribution of farm program benefits that are often overlooked or ignored by policy makers. To more clearly demonstrate the implications of this issue, a comparison of actuarially fair premium rates for Mississippi, Illinois, and Kansas representative farms was conducted. In this comparison, an implied actuarially fair premium rate for a hypothetical disaster program with a 70 percent whole-farm revenue guarantee was calculated for a diversified (cotton, soybeans, and corn) Mississippi farm. That rate was found to be consistent with a coverage level of 79 percent for a diversified (soybeans and corn) Illinois farm and only 23.5 percent for a diversified (wheat and corn) Kansas farm. This example highlights the inequity that is inherent in programs (such as the proposed disaster program modeled in this study) that establish fixed coverage across very diverse production regions.

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Table 1. Descriptive Statistics of Date used in Representative Farm Models

	Mississippi		*Illinois*		*Kansas*	
Variable	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
Beginning Futures Prices						
Cotton	65.456	9.112				
Soybeans	6.236	0.957	6.155	0.918		
Corn	2.605	0.392	2.633	0.369	2.633	0.369
Wheat					3.544	0.609
Ending Futures Prices						
Cotton	63.955	12.605				
Soybeans	6.101	1.115	6.030	1.080		
Corn	2.497	0.539	2.477	0.468	2.477	0.468
Wheat					3.447	0.677
Marketing Year Average Prices						
Cotton	58.296	10.495				
Soybeans	5.944	0.976	5.961	0.949		
Corn	2.359	0.420	2.343	0.398	2.343	0.398
Wheat					3.253	0.561
Cash (Harvest) Prices						
Cotton	59.362	9.822				
Soybeans	5.984	0.954	5.808	0.972		
Corn	2.638	0.484	2.264	0.429	2.356	0.430
Wheat					3.100	0.667
Farm-level Yields						
Cotton	1,049.8	348.4				
Soybeans	38.6	22.3	47.3	10.4		
Corn	140.1	63.4	165.9	37.4	97.3	84.5
Wheat					27.6	19.3
County-level Yields						
Cotton	1,015.5	123.6				
Soybeans	37.3	5.4	49.5	5.4		
Corn	142.6	10.9	165.9	23.4	97.1	31.4
Wheat					26.4	9.0

Note: Cotton prices given in cents/lb. Soybean and corn prices given in $/bushel. Cotton data are from 1979-2004. Illinois and Kansas data are from 1975-2004.

Table 2. Disaster Program Summary: Mississippi Cotton, Soybean, Corn Farm

Crop Ins. Coverage Level	Avg. Crop Ins. Indemnities	Avg. LDPs	Avg. CCPs	Supplemental Disaster Payments	Optimal Crop Ins. Coverage Level	
					w/Disaster Program	w/ No Disaster Program
		1,000 ac cotton, 1,000 ac soybeans, 1,000 ac corn				
50	$ 22,156.95	$ 58,827.18	$ 79,106.29	$ 247.66	80%	80%
55	$ 31,658.65	$ 58,827.18	$ 79,106.29	$ 487.54		
60	$ 43,781.66	$ 58,827.18	$ 79,106.29	$ 847.56		
65	$ 58,611.65	$ 58,827.18	$ 79,106.29	$ 1,358.09		
70	$ 76,188.89	$ 58,827.18	$ 79,106.29	$ 2,032.73		
75	$ 96,500.97	$ 58,827.18	$ 79,106.29	$ 2,880.41		
80	$ 119,625.73	$ 58,827.18	$ 79,106.29	$ 3,083.04		
85	$ 145,538.57	$ 58,827.18	$ 79,106.29	$ 1,902.65		
			3,000 ac cotton			
50	$ 3,307.05	$ 174,059.19	$ 234,220.29	$ 1,144.19	80%	80%
55	$ 9,725.10	$ 174,059.19	$ 234,220.29	$ 1,911.19		
60	$ 19,832.86	$ 174,059.19	$ 234,220.29	$ 2,860.39		
65	$ 33,834.24	$ 174,059.19	$ 234,220.29	$ 4,000.90		
70	$ 51,867.06	$ 174,059.19	$ 234,220.29	$ 5,339.00		
75	$ 73,996.97	$ 174,059.19	$ 234,220.29	$ 6,875.75		
80	$ 100,255.95	$ 174,059.19	$ 234,220.29	$ 7,279.03		
85	$ 130,745.63	$ 174,059.19	$ 234,220.29	$ 5,340.33		
			3,000 ac soybeans			
50	$ 20,401.32	$ 16.21	$ 895.06	$ 3,156.61	80%	80%
55	$ 32,261.40	$ 16.21	$ 895.06	$ 3,944.47		
60	$ 47,168.06	$ 16.21	$ 895.06	$ 4,791.48		
65	$ 65,150.72	$ 16.21	$ 895.06	$ 5,704.37		
70	$ 86,219.91	$ 16.21	$ 895.06	$ 6,680.53		
75	$ 110,360.52	$ 16.21	$ 895.06	$ 7,704.93		
80	$ 137,547.94	$ 16.21	$ 895.06	$ 7,174.43		
85	$ 167,762.52	$ 16.21	$ 895.06	$ 3,988.79		
			3,000 ac corn			
50	$ 42,108.25	$ 1,850.77	$ 2,325.26	$ 2,069.84	75%	75%
55	$ 52,188.27	$ 1,850.77	$ 2,325.26	$ 2,477.53		
60	$ 63,463.03	$ 1,850.77	$ 2,325.26	$ 2,912.63		
65	$ 75,903.82	$ 1,850.77	$ 2,325.26	$ 3,368.79		
70	$ 89,574.00	$ 1,850.77	$ 2,325.26	$ 3,845.81		
75	$ 104,465.09	$ 1,850.77	$ 2,325.26	$ 4,338.31		
80	$ 120,554.03	$ 1,850.77	$ 2,325.26	$ 4,016.05		
85	$ 137,819.64	$ 1,850.77	$ 2,325.26	$ 2,233.59		

Table 3. Disaster Program Summary: Illinois Corn and Soybean Farm

Crop Ins. Coverage Level	Avg. Crop Ins. Indemnities	Avg. LDPs	Avg. CCPs	Supplemental Disaster Payments	Optimal Crop Ins. Coverage Level w/Disaster Program	Optimal Crop Ins. Coverage Level w/ No Disaster Program
			1,500 ac corn, 1,500 ac soybeans			
50	$ 1,004.52	$ 1,887.13	$ 1,420.52	$ 30.17	80%	80%
55	$ 2,372.61	$ 1,887.13	$ 1,420.52	$ 126.45		
60	$ 4,867.02	$ 1,887.13	$ 1,420.52	$ 302.14		
65	$ 8,903.54	$ 1,887.13	$ 1,420.52	$ 520.77		
70	$ 14,972.25	$ 1,887.13	$ 1,420.52	$ 827.36		
75	$ 23,678.21	$ 1,887.13	$ 1,420.52	$ 1,221.33		
80	$ 35,598.18	$ 1,887.13	$ 1,420.52	$ 1,245.90		
85	$ 51,286.43	$ 1,887.13	$ 1,420.52	$ 613.51		
			3,000 ac corn			
50	$ 1,693.66	$ 229.97	$ 1,177.60	$ 1,962.64	80%	80%
55	$ 3,816.03	$ 229.97	$ 1,177.60	$ 3,163.38		
60	$ 7,409.59	$ 229.97	$ 1,177.60	$ 3,979.68		
65	$ 12,984.63	$ 229.97	$ 1,177.60	$ 4,324.20		
70	$ 21,142.76	$ 229.97	$ 1,177.60	$ 4,670.82		
75	$ 32,597.23	$ 229.97	$ 1,177.60	$ 5,022.00		
80	$ 47,986.24	$ 229.97	$ 1,177.60	$ 4,439.19		
85	$ 67,862.31	$ 229.97	$ 1,177.60	$ 2,320.13		
			3,000 ac soybeans			
50	$ 193.59	$ 3,553.31	$ 1,612.60	$ 2.91	80%	80%
55	$ 696.53	$ 3,553.31	$ 1,612.60	$ 12.28		
60	$ 1,851.59	$ 3,553.31	$ 1,612.60	$ 35.48		
65	$ 4,022.53	$ 3,553.31	$ 1,612.60	$ 82.29		
70	$ 7,716.45	$ 3,553.31	$ 1,612.60	$ 158.93		
75	$ 13,367.40	$ 3,553.31	$ 1,612.60	$ 279.26		
80	$ 21,468.02	$ 3,553.31	$ 1,612.60	$ 341.73		
85	$ 32,611.48	$ 3,553.31	$ 1,612.60	$ 224.50		

Table 4. Disaster Program Summary: Kansas Wheat and Corn Farm

Crop Ins. Coverage Level	Avg. Crop Ins. Indemnities	Avg. LDPs	Avg. CCPs	Supplemental Disaster Payments	Optimal Crop Ins. Coverage Level	
					w/Disaster Program	w/ No Disaster Program
			1,500 ac wheat, 1,500 ac corn			
50	$ 79,882.91	$ 7.46	$ 487.85	$ 4,137.43	80%	80%
55	$ 94,080.96	$ 7.46	$ 487.85	$ 5,428.98		
60	$ 109,208.31	$ 7.46	$ 487.85	$ 6,927.39		
65	$ 125,232.77	$ 7.46	$ 487.85	$ 8,624.06		
70	$ 142,134.97	$ 7.46	$ 487.85	$ 10,519.37		
75	$ 159,902.28	$ 7.46	$ 487.85	$ 12,615.40		
80	$ 178,492.25	$ 7.46	$ 487.85	$ 12,214.14		
85	$ 197,882.92	$ 7.46	$ 487.85	$ 6,961.39		
			3,000 ac wheat			
50	$ 43,097.75	$ 0.47	$ 5.52	$ 5,632.41	75%	75%
55	$ 51,363.39	$ 0.47	$ 5.52	$ 6,894.68		
60	$ 60,281.29	$ 0.47	$ 5.52	$ 8,272.19		
65	$ 69,843.92	$ 0.47	$ 5.52	$ 9,764.62		
70	$ 80,029.96	$ 0.47	$ 5.52	$ 11,376.99		
75	$ 90,819.87	$ 0.47	$ 5.52	$ 13,113.47		
80	$ 102,222.30	$ 0.47	$ 5.52	$ 12,544.13		
85	$ 114,231.18	$ 0.47	$ 5.52	$ 7,439.09		
			3,000 ac corn			
50	$ 117,190.83	$ 18.18	$ 949.56	$ 15,955.68	80%	80%
55	$ 137,316.26	$ 18.18	$ 949.56	$ 18,821.64		
60	$ 158,632.56	$ 18.18	$ 949.56	$ 21,830.75		
65	$ 181,100.56	$ 18.18	$ 949.56	$ 24,972.67		
70	$ 204,693.53	$ 18.18	$ 949.56	$ 28,202.98		
75	$ 229,357.89	$ 18.18	$ 949.56	$ 31,526.66		
80	$ 255,041.17	$ 18.18	$ 949.56	$ 29,394.59		
85	$ 281,730.72	$ 18.18	$ 949.56	$ 16,887.13		

Table 5. Actuarially Fair Premium Rates for Three Different Expected Revenue Coverage Levels on Representative Mississippi, Illinois, and Kansas Farms

	Farm[a]		
Coverage Level	Mississippi	Illinois	Kansas
50%	1.002%	0.264%	17.320%
60%	3.178%	1.017%	20.298%
70%	6.390%	2.657%	23.194%

a Planting is assumed to be to a single crop: cotton for the Mississippi farm, corn for the Illinois farm, and wheat for the Kansas farm.

Table 6. Price/Yield Correlations for Mississippi, Illinois, and Kansas Representative Farms

	Cotton Price	Soybean Price	Corn Price	Wheat Price	Cotton Yield	Soybean Yield	Corn Yield	Wheat Yield
Mississippi								
Cotton Price	1.00							
Soybean Price	0.63	1.00						
Corn Price	0.58	0.73	1.00					
Cotton Yield	-0.09	-0.11	0.18		1.00			
Soybean Yield	-0.21	-0.27	-0.14		0.09	1.00		
Corn Yield	-0.27	-0.42	-0.26		-0.11	0.194	1.00	
Illinois								
Soybean Price		1.00						
Corn Price		0.84	1.00					
Soybean Yield		-0.33	-0.08			1.00		
Corn Yield		-0.53	-0.49			0.07	1.00	
Kansas								
Corn Price			1.00					
Wheat Price			0.68	1.00				
Corn Yield			0.17	0.28			1.00	
Wheat Yield			-0.40	-0.44			-0.20	1.00

Note: Prices used for all crops are harvest time cash prices for the location specified. Yields are farm level yields.