Impacts of the SURE Standing Disaster Assistance Program on Producer Risk Management and Crop Insurance Programs

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Abstract

This research investigates the potential effects of the row crop provisions of the standing disaster assistance program (SURE) in the 2008 Farm Bill. Results suggest little impact on producer crop insurance purchase decisions, though the program does seem to provide an incentive for mid-level coverage. 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.

Key Words: crop insurance, disaster assistance, Farm Bill, SURE

JEL Classifications: Q12, Q18

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

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 had 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 considerably.

Despite the frequent implementation of *ad hoc* disaster payments, there was no standing program that provided disaster payments to farmers and ranchers in the U.S. after 1981. This changed with passage of the Food Conservation and Energy Act of 2008 (hereafter referred to as the Farm Bill). That bill includes the Supplemental Agricultural Disaster Assistance (SADA) program. The SADA program is fairly comprehensive, including components to cover losses in crop production (the Supplemental Revenue Assistance or SURE program), livestock mortality due to adverse weather (Livestock Indemnity Payments), forage losses (Livestock Forage Disaster Program), orchard and nursery tree losses (Tree Assistance Program), and other production losses on livestock, honeybees, or farm-raised catfish (Emergency Assistance program).

This paper focuses on the commercial row-crop provisions of the SURE program. The SURE program differs considerably from the standing disaster program that was in place prior to

1981. For example, the pre-1981 program was based on yield losses. The SURE program is based on revenue losses. Also, the pre-1981 program provided compensation for losses on individual crops while SURE will provide compensation based on shortfalls in “whole farm” revenue, including all crops produced on the farm.

To be eligible for SURE payments, farms will be required to purchase at least the catastrophic level of federal crop insurance. The program will compensate farms for 60 percent of the difference between their disaster payment program guarantee and their realized total farm revenue. For purposes of this program, realized farm revenue includes market revenue, any crop insurance indemnities, 20 percent of any federal direct fixed payments, any federal counter-cyclical payments (price or revenue, depending on which program the farm participates in) [1], and any loan deficiency payments or marketing loan gains.

The research presented in this paper analyzes the impact of the SURE program at the farm level under participation in either the current PCCP program or the new ACRE 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

[1] The 2008 Farm Bill allows producers to continue in the existing price counter-cyclical payment (PCCP) program or to opt into a new revenue counter-cyclical payment program called the Average Crop Revenue Election (ACRE) program. Participation in the ACRE program entails additional changes to the parameters of other farm programs including the Marketing Loan program and the Direct Payment program. These changes are discussed in detail in the following section.

4) Contrasts the SURE 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 positive 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

(1) $$E(R_{portfolio}) = \sum_{i=1}^{n} w_i E(R_i)$$

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:

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

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 *n* crops:

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

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

(4) $$\mathrm{U} = \frac{W_t^{1-r}}{1-r} \quad \text{if } \mathrm{r} \neq 1 \quad \text{and}$$
$$\mathrm{U} = \ln(W_t) \quad \text{if } \mathrm{r} = 1.$$

The farmer's expected utility is

(5) $$\mathrm{E(U)} = \sum_{\mathrm{t}=1}^{\mathrm{n}} \omega_t \frac{W_t^{1-r}}{1-r} \quad \text{if } \mathrm{r} \neq 1 \quad \text{and}$$
$$\mathrm{E(U)} = \sum_{t=1}^{\mathrm{n}} \omega_t \ln(W_t) \quad \text{if } \mathrm{r} = 1$$

where r is a risk aversion coefficient and ω_t is the probability 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 either Price Counter-Cyclical Payments (PCCPs) or Average Crop Revenue Election (ACRE) revenue counter-cyclical payments. For each program crop, commodity program payments, crop insurance indemnities, and disaster program payments are modeled as follows. The LDP is calculated as:

(6) $$LDP_i = \max(0, LR_i - HP_i) \times HA_i \times FY_i$$

where LR_i is the loan rate, HP_i is the harvest time cash price, HA_i is harvested acres, FY_i is the realized farm yield, and the subscript i indicates a specific crop. For farms enrolled in the ACRE program, the loan rate is reduced by 30 percent in the calculation of LDPs. The DP is calculated as:

$$(7) \qquad DP_i = DPR_i \times 83.3\% \times BA_i \times BY_i$$

where DPR_i is the direct payment rate (specified in the Farm Bill), BA_i is the base acreage, and BY_i is the base yield. For farms enrolled in ACRE, direct payments are reduced by 20 percent from the value calculated in equation 7. The PCCP is calculated as:

$$(8) \qquad PCCP_i = \max\left[0, \left(TP_i - DPR_i - \max\left(LR_i, MYA_i\right)\right)\right] \times 85\% \times BA_i \times BY_i$$

where TP_i is the target price, MYA_i is the national marketing year average price, and all other variables are as defined previously[2]. ACRE payments are calculated as:

$$(9) \qquad ACRE_i = \varphi\left[\max[0, \left(SREVB_i - SREVA_i\right)] \times \frac{\overline{FY_i}}{\overline{SY_i}} \times ABA_i\right],$$

where φ is a dummy variable with a value of one if realized farm revenue is below the farm-level benchmark revenue and a value of zero otherwise; $SREVB_i$ is the benchmark state revenue calculated according to ACRE provisions;[3] $SREVA_i$ is actual state revenue to count under ACRE provisions; $\overline{FY_i}$ is the farm-level benchmark yield; $\overline{SY_i}$ is the state level benchmark yield; and ABA_i is the base acreage to which the ACRE payment applies (see footnote 3).

[2] It is technically possible for base yields for direct payments and base yields for counter-cyclical payments to differ; however, in this analysis, they are assumed to be the same.

[3] A full discussion of ACRE provisions is beyond the scope of this paper; however, a brief explanation of the broad outlines of the program is useful in the current context. Basically, the ACRE program provides a payment to the producer when actual state revenue (as defined in the Farm Bill) falls below a benchmark level based on past state level yields and national marketing year average prices. This state-level payment rate is scaled by the ratio of average farm yields to average state yields in order to determine the farm-specific payment rate. The payment is made on base acres; however, base acres for this program are related to actual plantings. The producer must plant a crop to get an ACRE payment. The farm's existing total base acres are allocated (on an annual basis) among the crops actually planted on the farm. The result is that base acres on which an ACRE payment is calculated for any crop cannot exceed planted acres of that crop. For a more detailed explanation of ACRE provisions see Zulauf (2008).

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:

(10) $$INDEM_i = EP_i \times \max\left[0, \left(CL_i \times APH_i\right) - FY_i\right] \times IA_i$$

where EP_i is the crop insurance pre-planting expected price, CL_i is the coverage level selected, and APH_i is the farm's crop insurance actual production history (APH) yield, and IA_i is the insured acreage. The crop insurance products are assumed to be priced at the actuarially-fair rate adjusted by a 35% multiplicative load.[4] The current federal premium subsidy structure is imposed, which ranges from a 67 percent subsidy for the 50 percent coverage level to a 38 percent subsidy for the 85 percent coverage level.[5] All acreage for a particular crop is assumed to be insured as one unit.

The SURE program is designed to interface with crop insurance. This is clearly observed when one examines the SURE payment function for a farm producing i crops:

(11)

$$SURE = \left[115\% \times \sum_i APH_i \times CL_i \times EP_i \times IA_i\right] - \left[\sum_i FY_i \times MYA_i \times HA_i + \sum_i 0.15 DP_i + \delta \sum_i PCCP_i + (1-\delta)\sum_i ACRE_i + \sum_i LDP_i + \sum_i INDEM_i\right]$$

where δ is a dummy variable taking a value of 1 if the farm is enrolled in the current PCCP program and a value of 0 if the farm is enrolled in the new ACRE program. The first term on the

[4] This load factor is somewhat arbitrary; however, some load is required to account for the load that is applied to actual crop insurance rates as well as for other subjective factors that influence producers to purchase lower crop insurance coverage levels (e.g., downward-biased estimates of yield and/or price risk, perceived presence of yield trends, perception of moral hazard influencing rates, etc.). For a more detailed discussion of subjective issues affecting crop insurance coverage level decisions see, Pease (1992), Eales, et al. (1990) and Egelkraut, et al. (2006).

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

right-hand side of the equation is the guarantee equal to 115 percent of the insured value of all crops. Thus, choosing higher crop insurance coverage levels results in a higher disaster guarantee.[6] The second term on the right-hand side is the sum across crops of crop revenue, 15 percent of all direct payments per acre, all PCCP or ACRE payments, all LDPs, and all crop insurance indemnities.

Once 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 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:

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

where $E(U)$ is a value for expected utility calculated from equation 5.

Data and Modeling

A stochastic simulation model is developed to evaluate SURE program payments, crop insurance indemnities, and other farm program payments (i.e., direct payments, loan deficiency payments, price counter-cyclical payments, and revenue counter-cyclical payments) for a representative Mississippi cotton-soybean-corn farm, a representative Illinois soybean-corn farm, a

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

representative Kansas wheat-corn farm, and a representative North Dakota 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. SURE payments were calculated assuming enrollment in the PCCP program and the ACRE program to see what effect this enrollment decision would have on SURE program outcomes. 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 and North Dakota farms, all wheat, all corn, and an equal mix of the two are modeled.

As equation 9 makes clear, to accurately assess the potential impacts of the SURE program, it is necessary also to model returns from crop production, existing government programs, and crop insurance. 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, county-level yields, and state-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[7] as well as harvest time cash prices and marketing year average prices. State-level, 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

[7] 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).

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 SURE program, a disaster declaration for the county is a necessary first condition for producers in the county to be eligible for disaster payments. State-level yields are necessary to calculate payments under the ACRE program.

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 MYA price) for each crop. Yields were simulated from a Beta distribution, with parameters of the distribution for each crop derived from historic data. State and county yields are from the U.S. Department of Agriculture's National Agricultural Statistics Service. Farm yields series were simulated from the county-level series using the method described in Coble and Barnett (2007) to increase county-level yield variability to a level consistent with APH crop insurance rates for that county. The farm yield series was simulated to have a correlation of 0.85 with the county yield series using the procedure described in Iman and Conover (1982)[8]. County yield data were taken from Bolivar County for Mississippi, from McLean County for Illinois, from Logan County for Kansas, and from Barnes County for North Dakota. Correlations between yields, futures price changes, and basis values were also included in the simulation. Data for Mississippi covered the period from 1979 through 2007. Data for Illinois and Kansas covered the period from 1975 through 2007. Data for North Dakota cover

[8] The Iman and Conover procedure permits simulation of a data series that is correlated at the specified level with some existing series. Thus, a farm-level yield series matching the length of the original county yield series was simulated using parameters based on the expanded variance of the county-level series. These farm-level series are used in all subsequent analysis.

the period from 1980 through 2007. 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 Anderson, Harri, and Coble (2009). In this procedure, a rank correlation matrix, ρ_s, is calculated. An eigen decomposition of ρ_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).[9]

Simulated prices and yields, are used to calculate crop returns, crop insurance indemnities, government payments (e.g., LDPs, PCCPs and ACRE payments), and any payments under the SURE 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 1,500 acres of cropland. Base yields are assumed to be the same as farm-level average yields. To compute net returns to crop production, regional cost of production estimates for 2007 published by USDA Economic Research Service were used.

[9] For a more detailed description, see Phoon, Quek, and Huang (2004).

Returns from all sources are converted to utility values using the constant relative risk aversion (CRRA) utility function shown in equation 4 with a risk aversion coefficient of 2, representing a moderately risk-averse decision maker. Initial wealth is assumed to be $450,000.[10] 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 SURE program.

The model developed here can also be used to compare the relative impact of the SURE program across geographic regions and across different levels of diversification. For each representative farm, average annual SURE payments are computed for each crop mix modeled. We hypothesize that, for the same crop, SURE payments will be lower for the Illinois representative farm than for any of the other farms due to the relatively low production risk for that state. Likewise, we expect that SURE payments will be lower for more diversified farms since the 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.[11] In this comparison, an actuarially-fair premium rate for 70 percent whole farm coverage is calculated for the Mississippi farm. For the other 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

[10] Results are not very sensitive to the level of initial wealth chosen. This level of initial wealth was required to avoid negative ending wealth values in the cotton-only production scenario. Negative ending wealth values preclude calculation of utility values with the CRRA utility function (see equation 4).
[11] 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

SURE Impact on Crop Insurance Coverage Levels

Results showing calculated certainty equivalents at each insurance coverage level for each farm with a diversified crop mix and with the primary crop for that farm (i.e., Illinois corn, Kansas wheat, Mississippi cotton, and North Dakota wheat) are presented in Table 2. With respect to the issue of SURE effects on crop insurance purchase decisions, it does not appear that optimal crop insurance coverage levels are greatly influenced by the availability of the disaster program. It is notable, however, that there are no instances of the SURE program resulting in higher optimal coverage levels[12]. In several instances, the optimal coverage level with SURE drops to the next lowest level relative to the optimal coverage level without SURE.[13] Results for secondary crop plantings (not reported but available upon request) were consistent with this finding – no instances of SURE resulting in higher optimal coverage but several instances of SURE resulting in lower optimal coverage.

It is important to note that these changes in optimal coverage levels shown in Table 2 reflect quite small changes in certainty equivalents (i.e., generally 1% difference or less). These changes in certainty equivalents are due mainly to differences in SURE payments and net crop insurance indemnities across coverage levels. These are shown in Table 3 for all states and all

[12] There are several instances of the optimal coverage level increasing under the ACRE program compared to PCCP program. This seems to reflect the fact that the crop insurance premiums are added back into the ACRE farm-level benchmark revenue. This results in a higher ACRE revenue benchmark (and thus a higher expected ACRE payment) with higher coverage levels.
[13] Note that a grid search over finer increments of coverage would likely reveal additional smaller differences 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.

crop combinations. Note here that SURE payments are very small relative to the certainty equivalents in the preceding table. SURE payments are a small portion of total revenue when compared to crop returns and even other program payments (such as the direct payment, ACRE payments, and PCCP payments). It is not at all clear that differences in SURE payments across insurance coverage levels will make enough difference in producer welfare to actually influence coverage level decisions. Certainly, the calculation of the SURE revenue guarantee – guaranteeing 115 percent of insured value but with a cap at 90% of expected revenue – suggests that the program makes the highest crop insurance coverage levels less attractive.

It does seem, on the other hand, that the calculation of the SURE guarantee, based as it is on insurance coverage level, could encourage higher coverage levels for producers initially starting from low coverage levels. To investigate this possibility, the Illinois farm (with equal corn/soybean plantings) was simulated with premium rates loaded to force initial coverage to the 60% level. In this simulation, addition of the SURE program resulted in an increase of the optimal coverage level to 75%. Again, with the SURE program in place, differences in certainty equivalents between the 60% and 75% coverage level were small (about 1.5% with the PCCP program and less than 1% with the ACRE program). Still, taken together, these results on the impact of the SURE program on insurance coverage level present an interesting effect of the program. It appears to provide some incentive (albeit relatively weak) for producers to move to mid-level crop insurance coverage – up from lower levels but down from higher levels. To be more precise, the means by which the SURE program guarantee is calculated favors the 75% coverage level. Above this level, the cap on SURE payments at 90% of expected revenue becomes binding[14]; below this level, SURE payments are reduced by the lower SURE benchmark revenue.

Relationship between SURE Payments and Other Program Payments

A close look at the results in all states reveals some interesting points relative to the interaction between the SURE program and other farm programs. Note in Table 3 that SURE payments are higher for a single crop compared to the diversified crop situation in all but two cases. First, in the North Dakota wheat-only scenario with ACRE program participation, SURE payments at lower insurance coverage levels are slightly lower than for the wheat/corn combination. Differences are very small and appear to be related to differences in crop insurance premiums and ACRE program guarantees across coverage levels. Specifically, for North Dakota wheat, crop insurance premiums at lower coverage levels are relatively high.[15] Since these premiums are added back to expected revenue to calculate the ACRE benchmark (see Zulauf, 2008), this increases the likelihood of receiving an ACRE payment, thus reducing average SURE payments.

The second case in which mono-crop SURE payments are lower than multi-crop SURE payments is the Mississippi cotton-only scenario with PCCP participation. In fact, in this case, cotton-only SURE payments are substantially lower than for the multi-crop case. It is notable as well that the cotton-only SURE payment with PCCP is much lower than the cotton-only SURE payment under ACRE participation and much lower than SURE payment for corn-only or soybeans-only with either PCCP or ACRE participation.

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[14] This is not the same thing as saying that expected SURE payments are highest at the 75% coverage level. Results in Table 3 demonstrate that this is not the case. If SURE pays out more frequently at coverage levels above 75%, the expected SURE payment could be higher at those higher coverage levels. The point is that in any given situation in which a SURE payment is made, there is no benefit (in terms of the SURE payment) to having a coverage level over 75%.

[15] Note that this refers to the actuarially fair premiums calculated within this simulation, not necessarily to actual premiums charged under the federal crop insurance program.

This result points to a rather curious feature of the SURE program as it relates to other farm programs, particularly the PCCP and the marketing loan programs. Under SURE, the farm's payment trigger is essentially 115% of the farm's total insurance liability. Expectations of government program payments are not included in this benchmark revenue. However, program payments are included in revenue to count at the end of the year. When prices are low (as is the case with cotton), the SURE benchmark revenue is also low. However, the likelihood of receiving substantial PCCPs and LDPs is high. Thus, it becomes much more likely that revenue to count will exceed the SURE benchmark revenue, resulting in no SURE payment. When prices are high, the correspondence between benchmark revenue and revenue to count will be greater because PCCPs and LDPs will be a much less significant component of revenue. The interesting result is that *for producers in the PCCP program, SURE will be expected to pay out more when prices are high than when prices are low*.

The effect noted above will be reduced for producers enrolled in the ACRE program because ACRE price guarantees are not fixed. In general, the likelihood of an ACRE payment should be about the same whether prices are high or low. This is reflected in the results in Table 3. Except for the case of cotton-only in Mississippi, SURE payments are much higher under PCCP enrollment than under ACRE enrollment. This suggests that ACRE and SURE payments are largely offsetting. That is, when SURE pays out, ACRE is also generally paying out, thus reducing the amount of the SURE payment. This is not necessarily true under the PCCP program since PCCP programs are based only on price and since the target price for PCCP payments is fixed.

SURE Program Experience across Regions

Results in Table 3 clearly demonstrate substantial differences in expected SURE payments across geographic regions. Because of differences in expected revenue across states, mainly reflecting differences in expected yield, it is somewhat difficult to compare the whole-farm SURE payment levels. To more clearly illustrate differences in payment levels across geographic regions, Table 4 shows SURE payments with PCCP participation as a percent of expected whole-farm revenue. In these terms, SURE payments are smallest in Illinois and largest in Kansas, with Mississippi and North Dakota payments falling between these two. This reflects differences in production risk across these different regions.

To further investigate how differences in risk in different regions might affect 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*):

(12) $$RG = CL \bullet \sum_i E[y_i]E[p_i]ac_i ,$$

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 and North Dakota farms. 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 and North Dakota falling between (with Mississippi rate closer to the Illinois rates and North Dakota rates closer 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 to effects of crop diversification on premium rate for the hypothetical disaster program covering 70 percent of expected whole farm revenue. Table 6 reports actuarially fair premium rates for all possible crop combinations in each state. As an example, consider 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 percent of expected crop revenue would be about 6.76 percent. This is considerably lower than the premium rate for any single crop planting. This result holds in most cases. (In North Dakota, the rate for corn/wheat is higher than for wheat alone, reflecting the relatively high risk on corn relative to wheat in that state).

To further illustrate differences in risk in different areas, a grid search was performed to determine the coverage level that would correspond to the premium rate for 70% whole-farm coverage on the diversified Mississippi farm (i.e., 6.76 percent). For the Illinois corn/soybean farm, that coverage level is about 94%. For the North Dakota wheat/corn farm, the coverage level corresponding to the Mississippi premium rate is about 65%. For the Kansas diversified farm, the coverage level corresponding to the Mississippi premium rate is just 56%.

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 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.

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 rates for the diversified Mississippi farm (6.76%) compared to the soybean-only Mississippi farm (11.99%). Viewed another way, the actuarially fair premium rate for 70% coverage on the diversified Mississippi farm corresponds to a coverage level of just 52% in the case where soybeans is the only crop grown on the Mississippi farm.

Summary and Conclusions

The standing disaster payment program in 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 suggest that SURE payments could have some effect on the optimal crop insurance coverage level, moving producers toward mid-level coverage from either lower or higher levels. Payments are, on average, small relative to crop revenues, other program payments, and insurance indemnities – thus, the actual impact of SURE payments on producer decisions is not likely to be that great.

Results also demonstrate interesting interactions between the SURE program and other federal commodity programs. Surprisingly, for producers who participate in the PCCP program, the method of establishing SURE benchmark revenue (which ignores expected PCCP and marketing loan program payments) will result in lower SURE payments when prices are low and higher SURE payments when prices are high. For producers participating in the ACRE program, SURE and ACRE payments will overlap to a substantial degree, generally resulting in small expected SURE payments. These results provide a useful illustration of the complex inter-relationships that now exist between the various farm programs.

Finally, results illustrate the influence of crop diversification and production risk on SURE payments. 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 by policy makers. To demonstrate the implications of this issue, a comparison of actuarially fair premium rates for Illinois, Kansas Mississippi, and North Dakota representative farms was conducted. 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 94 percent for a diversified (soybeans and corn) Illinois farm, 65 percent for a diversified (wheat and corn) North Dakota farm, and 56 percent for a diversified (wheat and corn) Kansas farm. This example highlights the inequity that is inherent in programs (such as the SURE program modeled in this study) that establish fixed coverage across very diverse production regions.

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

	Illinois		Kansas		Mississippi		North Dakota	
Variable	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
Beginning Futures Price								
Corn	2.665	0.435	2.665	0.435	2.625	0.437	2.677	0.466
Cotton					64.536	9.158		
Soybeans	6.195	0.944			6.242	0.929		
Wheat			3.573	0.604			3.714	0.600
Ending Futures Price								
Corn	2.514	0.501	2.514	0.501	2.506	0.537	2.508	0.530
Cotton					62.886	12.488		
Soybeans	6.131	1.217			6.170	1.145		
Wheat			3.549	0.782			3.720	0.829
Marketing Year Avg. Prices								
Corn	2.410	0.515	2.410	0.515	2.433	0.542	2.430	0.551
Cotton					57.559	10.334		
Soybeans	6.091	1.160			6.094	1.207		
Wheat			3.387	0.790			3.442	0.816
Cash (Harvest) Prices								
Corn	2.294	0.458	2.399	0.465	2.666	0.505	2.135	0.446
Cotton					58.514	9.665		
Soybeans	5.885	1.051			6.055	0.994		
Wheat			3.194	0.745			3.467	0.807
Farm-Level Yields								
Corn	174.0	36.0	84.3	53.2	104.5	45.4	110.6	60.0
Cotton					721.4	239.6		
Soybeans	51.7	11.4			25.8	12.3		
Wheat			28.6	15.0			39.9	15.9
County-Level Yields								
Corn	173.8	22.8	84.1	31.6	104.9	16.6	111.1	22.6
Cotton					745.3	133.1		
Soybeans	51.7	5.3			26.0	6.2		
Wheat			28.6	9.4			41.0	8.3
State-Level Yields								
Corn	159.0	17.2	135.0	16.2	132.4	10.6	100.1	14.5
Cotton					909.9	107.6		
Soybeans	45.9	3.7			32.4	5.3		
Wheat			36.0	6.3			32.8	5.9
ACRE Price Benchmark (all states)								
Corn	4.15	n/a						
Cotton	54.20	n/a						
Soybeans	9.73	n/a						
Wheat	6.64	n/a						

Note: Cotton prices given in cents/lb. Soybean and corn prices given in $/bushel. Illinois and Kansas data are from 1975-2007. Mississippi data are from 1979-2007. North Dakota data are from 1980 - 2007.

Table 2. SURE Program Effect on Optimal Crop Insurance Coverage Levels

Coverage Level	Certainty Equivalents PCCP, No Sure	PCCP, SURE	ACRE, No SURE	ACRE, SURE	Certainty Equivalents PCCP, No Sure	PCCP, SURE	ACRE, No SURE	ACRE, SURE
	Illinois							
	750 ac Corn; 750 ac Soybeans				*1,500 ac Corn*			
50	$ 567,496	$ 568,066	$ 582,982	$ 582,996	$ 705,086	$ 706,145	$ 729,580	$ 729,596
55	$ 567,749	$ 569,469	$ 583,190	$ 583,359	$ 705,331	$ 708,353	$ 729,751	$ 729,949
60	$ 568,586	$ 572,454	$ 583,905	$ 584,779	$ 706,284	$ 712,771	$ 730,467	$ 731,594
65	$ 570,209	$ 577,515	$ 585,318	$ 588,020	$ 708,268	$ 719,865	$ 732,036	$ 735,640
70	$ 573,079	$ 585,193	$ 587,894	$ 594,029	$ 711,776	$ 730,146	$ 734,961	$ 743,237
75	$ 576,794	$ 595,080	$ 591,254	$ 602,561	$ 716,389	$ 743,071	$ 738,881	$ 754,100
80	$ 580,445	**$ 601,534**	$ 594,526	**$ 608,424**	$ 721,136	**$ 751,294**	$ 742,888	**$ 761,529**
85	**$ 582,292**	$ 597,402	**$ 596,006**	$ 604,877	**$ 723,970**	$ 745,889	**$ 744,992**	$ 757,202
	Kansas							
	750 ac Corn; 750 ac Wheat				*1,500 ac Wheat*			
50	$ 100,432	$ 104,617	$ 249,237	$ 250,319	$ 133,323	$ 138,488	$ 389,812	$ 391,501
55	$ 104,827	$ 110,195	$ 256,037	$ 257,734	$ 136,005	$ 142,339	$ 397,286	$ 399,664
60	$ 110,357	$ 117,058	$ 264,059	$ 266,572	$ 139,380	$ 146,963	$ 404,894	$ 408,078
65	$ 113,557	$ 121,745	$ 271,006	$ 274,566	$ 141,592	$ 150,502	$ 414,030	$ 418,163
70	$ 119,124	$ 128,920	$ 280,019	$ 284,798	$ 145,147	$ 155,448	$ 423,076	$ 428,258
75	**$ 122,002**	**$ 133,567**	$ 287,675	$ 293,914	$ 147,232	**$ 158,989**	$ 433,877	$ 440,254
80	$ 121,676	$ 132,838	$ 294,377	$ 300,296	**$ 147,418**	$ 158,696	$ 446,362	$ 452,485
85	$ 116,972	$ 123,626	**$ 299,386**	**$ 302,026**	$ 144,881	$ 152,078	**$ 462,815**	**$ 466,397**
	Mississippi							
	500 ac Cotton; 500 ac Corn; 500 ac Soybeans				*1,500 ac Cotton*			
50	$ 131,006	$ 131,496	$ 120,633	$ 121,258	$ (156,273)	$ (156,271)	$ (320,957)	$ (252,261)
55	$ 135,771	$ 136,723	$ 125,087	$ 126,365	$ (139,066)	$ (139,055)	$ (236,083)	$ (217,639)
60	$ 141,523	$ 143,157	$ 130,534	$ 132,848	$ (124,476)	$ (124,454)	$ (210,713)	$ (194,650)
65	$ 146,258	$ 148,824	$ 134,996	$ 138,796	$ (112,114)	$ (112,067)	$ (192,922)	$ (176,199)
70	$ 152,646	$ 156,403	$ 141,119	$ 146,869	$ (99,494)	$ (99,400)	$ (176,766)	$ (158,364)
75	$ 157,388	$ 162,634	$ 145,644	$ 153,831	$ (88,881)	$ (88,698)	$ (163,835)	$ (142,873)
80	**$ 159,650**	**$ 164,484**	**$ 147,753**	**$ 155,954**	$ (80,975)	$ (80,835)	$ (154,321)	**$ (134,891)**
85	$ 158,007	$ 159,642	$ 146,016	$ 149,774	**$ (77,106)**	**$ (77,081)**	**$ (149,365)**	$ (138,323)
	North Dakota							
	750 ac Corn; 750 ac Wheat				*1,500 ac Wheat*			
50	$ 292,256	$ 295,732	$ 578,460	$ 579,723	$ 253,000	$ 257,395	$ 511,584	$ 512,490
55	$ 296,922	$ 301,838	$ 586,271	$ 588,323	$ 255,628	$ 261,615	$ 518,714	$ 520,340
60	$ 302,755	$ 309,389	$ 596,593	$ 599,652	$ 258,977	$ 266,755	$ 527,157	$ 529,750
65	$ 306,686	$ 315,342	$ 607,859	$ 612,197	$ 261,831	$ 271,608	$ 537,786	$ 541,618
70	$ 312,903	$ 323,857	$ 621,596	$ 627,424	$ 265,805	$ 277,786	$ 549,324	$ 554,651
75	$ 316,632	$ 330,172	$ 636,178	$ 643,795	$ 268,812	$ 283,163	$ 564,579	$ 571,648
80	**$ 317,050**	**$ 330,388**	$ 653,439	$ 660,836	**$ 270,188**	**$ 284,347**	$ 582,302	$ 589,297
85	$ 312,644	$ 320,397	**$ 673,845**	**$ 677,485**	$ 268,867	$ 277,713	**$ 605,847**	**$ 609,690**

Note: Optimal coverage level under each alternative program denoted by bold, underlined text.

Table 3. Crop Insurance Indemnities and SURE Payments at Various Coverage Levels under PCCP and ACRE Program Participation

Coverage Level	Average Net Indem.	SURE w/PCCP	SURE w/ACRE	Average Net Indem.	SURE w/PCCP	SURE w/ACRE	Average Net Indem.	SURE w/PCCP	SURE w/ACRE	Average Net Indem.	SURE w/PCCP	SURE w/ACRE
		Illinois			**Kansas**			**Mississippi**			**North Dakota**	
	750 ac Corn; 750 ac Soybeans			***750 ac Corn; 750 ac Wheat***			***500 ac each: Cotton, Corn, S'beans***			***750 ac Corn; 750 ac Wheat***		
50	$ 8	$ 240	$ 6	$11,088	$ 2,158	$ 536	$ 4,582	$ 179	$ 233	$ 8,651	$ 1,862	$ 469
55	$ 93	$ 815	$ 79	$12,950	$ 2,960	$ 864	$ 6,157	$ 397	$ 551	$10,715	$ 2,827	$ 820
60	$ 414	$ 2,052	$ 468	$15,948	$ 3,919	$ 1,307	$ 8,531	$ 764	$ 1,134	$13,872	$ 4,071	$ 1,307
65	$ 1,036	$ 4,297	$ 1,617	$16,741	$ 5,047	$ 1,881	$ 9,900	$ 1,326	$ 2,078	$15,212	$ 5,624	$ 1,958
70	$ 2,352	$ 7,809	$ 4,040	$19,906	$ 6,349	$ 2,574	$12,846	$ 2,122	$ 3,460	$18,807	$ 7,498	$ 2,767
75	$ 4,011	$12,779	$ 8,073	$20,524	$ 7,828	$ 3,412	$14,295	$ 3,202	$ 5,341	$20,075	$ 9,700	$ 3,765
80	$ 5,271	$15,512	$10,414	$18,064	$ 7,741	$ 3,292	$13,460	$ 3,106	$ 5,629	$18,220	$ 9,821	$ 3,693
85	$ 4,591	$11,200	$ 6,655	$11,336	$ 4,546	$ 1,498	$ 8,970	$ 1,065	$ 2,612	$11,757	$ 5,668	$ 1,736
		1,500 ac Corn			***1,500 ac Wheat***			***1,500 ac Cotton***			***1,500 ac Wheat***	
50	$ 5	$ 438	$ 6	$ 5,423	$ 3,375	$ 744	$ 1,975	$ 0	$ 757	$ 2,542	$ 2,667	$ 393
55	$ 74	$ 1,412	$ 89	$ 6,607	$ 4,308	$ 1,088	$ 3,082	$ 1	$ 1,447	$ 3,641	$ 3,848	$ 745
60	$ 381	$ 3,401	$ 583	$ 8,434	$ 5,353	$ 1,510	$ 4,812	$ 4	$ 2,505	$ 5,292	$ 5,268	$ 1,250
65	$ 1,033	$ 6,747	$ 2,104	$ 9,130	$ 6,500	$ 2,015	$ 6,155	$ 12	$ 4,050	$ 6,368	$ 6,942	$ 1,928
70	$ 2,436	$11,734	$ 5,348	$11,150	$ 7,750	$ 2,599	$ 8,656	$ 34	$ 6,167	$ 8,491	$ 8,883	$ 2,787
75	$ 4,253	$18,502	$10,704	$11,769	$ 9,093	$ 3,263	$10,293	$ 84	$ 8,957	$ 9,662	$11,054	$ 3,807
80	$ 5,707	$22,059	$13,788	$10,573	$ 8,886	$ 3,138	$10,249	$ 80	$ 9,701	$ 9,261	$11,202	$ 3,797
85	$ 5,050	$16,207	$ 9,032	$ 6,758	$ 5,674	$ 1,776	$ 7,164	$ 16	$ 5,988	$ 6,261	$ 7,052	$ 2,022
		1,500 ac Soybeans			***1,500 ac Corn***			***1,500 ac Soybeans***			***1,500 ac Corn***	
50	$ 15	$ 461	$ 132	$16,873	$ 6,390	$ 3,762	$ 5,263	$ 4,529	$ 1,049	$14,894	$ 6,812	$ 2,969
55	$ 120	$ 1,268	$ 590	$19,404	$ 7,976	$ 5,072	$ 6,693	$ 5,784	$ 1,670	$17,939	$ 8,785	$ 4,220
60	$ 460	$ 2,755	$ 1,647	$23,572	$ 9,739	$ 6,598	$ 8,838	$ 7,189	$ 2,486	$22,650	$11,019	$ 5,755
65	$ 1,059	$ 5,103	$ 3,552	$24,451	$11,663	$ 8,317	$ 9,841	$ 8,723	$ 3,494	$24,268	$13,514	$ 7,569
70	$ 2,277	$ 8,412	$ 6,470	$28,772	$13,757	$10,244	$12,310	$10,382	$ 4,696	$29,357	$16,265	$ 9,701
75	$ 3,723	$12,753	$10,486	$29,389	$16,003	$12,353	$13,264	$12,156	$ 6,080	$30,718	$19,253	$12,128
80	$ 4,756	$14,779	$12,346	$25,651	$15,207	$11,579	$12,131	$11,935	$ 5,985	$27,383	$18,533	$11,540
85	$ 4,056	$10,651	$ 8,267	$15,976	$ 8,545	$ 5,724	$ 7,877	$ 7,793	$ 3,310	$17,378	$10,748	$ 5,763
								1,500 ac Corn				
50							$ 6,510	$ 5,782	$ 3,193			
55							$ 8,690	$ 7,765	$ 4,741			
60							$11,933	$10,043	$ 6,620			
65							$13,711	$12,624	$ 8,841			
70							$17,599	$15,501	$11,398			
75							$19,376	$18,659	$14,288			
80							$18,056	$18,513	$14,011			
85							$11,917	$11,715	$ 7,511			

Table 4. SURE Program Payments as a Percent of Expected Crop Revenue (with PCCP Participation)

Coverage Level	Illinois corn/soybeans	Kansas corn/wheat	Mississippi corn/cotton/soybeans	North Dakota corn/wheat
50	0.040%	1.429%	0.219%	0.758%
55	0.136%	1.960%	0.486%	1.151%
60	0.341%	2.596%	0.936%	1.657%
65	0.715%	3.343%	1.623%	2.290%
70	1.299%	4.205%	2.598%	3.052%
75	2.126%	5.185%	3.920%	3.949%
80	2.581%	5.127%	3.802%	3.998%
85	1.863%	3.011%	1.303%	2.308%

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

Coverage Level	Illinois	Kansas	Mississippi	North Dakota
50%	0.019%	7.814%	2.692%	2.610%
60%	0.248%	10.805%	5.143%	4.892%
70%	1.110%	13.932%	8.179%	7.749%

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 and North Dakota farms.

Table 6. Actuarially Fair Premium Rates for 70% Whole Farm Revenue Coverage by State and Crop Combination

Crops Grown	Illinois	Kansas	Mississippi	North Dakota
Corn	1.110%	17.929%	9.533%	13.754%
Cotton			8.179%	
Soybeans	1.341%		11.990%	
Wheat		13.932%		7.749%
Corn/Cotton			6.700%	
Corn/Soybeans	0.849%		8.737%	
Corn/Wheat		10.954%		8.014%
Corn/Cotton/Soybeans			6.758%	
Cotton/Soybeans			7.394%	