The Effects of Area-based Revenue Protection on Producers' Choices of Farm-level Revenue Insurance

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Abstract

Producers' increased reliance on crop insurance has led to concerns about losses producers could incur that are not covered by crop insurance. In the current farm bill debate, several proposals that would be based on area (county) revenue and are intended to cover a portion of producers' crop insurance deductibles, referred to as "shallow loss" programs, have been advanced. We analyze, using an empirically-based simulation model and a certainty equivalent criterion, how shallow loss coverages might affect optimal coverage levels of farm-level revenue insurance for a moderately risk-averse producer. Our analysis suggests that area-based revenue insurance designs have some potential for causing producers to reduce coverage levels for farm-level revenue insurance, though the marginal differences in the certainty equivalents are often relatively small on a percentage basis.

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Introduction

Due at least in part to premium subsidization and an increase in crop prices, federal crop insurance has become the major risk management and income support program for field crop producers. Under premium subsidy rates set by the Agricultural Risk Protection Act of 2000 (ARPA) and the Food, Conservation and Energy Act of 2008 (the 2008 farm bill), federal crop insurance participation and program costs have reached record levels. In 2012 about 85 percent of the planted acres of corn, soybeans, wheat and cotton were insured.[1] Because the dollar amount of insurance adjusts with market prices it is an effective risk management tool and a means of producer support, particularly during periods of high or increasing crop prices (Dismukes and Young 2008). In 2012, high participation and high prices lifted the total value of federal crop insurance coverage (liability) to about $117 billion (Risk Management Agency, USDA 2013); total government crop insurance program costs were estimated to be about $12.5 billion, of which nearly $7 billion was premium subsidies paid on behalf of producers (Congressional Budget Office 2013).

Producers' increased reliance on crop insurance, however, has led to concerns about losses producers could incur that are not covered by crop insurance. In the current farm bill debate, several proposals intended to cover a portion of producers' crop insurance deductibles, generally referred to as "shallow loss" programs, have been advanced. In June 2012 the U.S. Senate passed a farm bill, S. 3240, which would have offered producers choices among a revenue program, called Agriculture Risk Coverage (ARC), additional revenue insurance

[1] Corn, soybeans, wheat and cotton are the top four crops in the federal crop insurance program. They account for about 75 percent of the acres insured.

coverage, called Supplemental Coverage Option (SCO), and, in place of ARC for cotton production, a revenue insurance product, Stacked Income Protection Plan (STAX). In July 2012 the U.S. House of Representatives agriculture committee passed H.R. 6083, which would have offered producers a choice between Revenue Loss Coverage, which is similar to ARC, or Price Loss Coverage. Although neither the legislation passed by the Senate or by the House committee resulted in a fully enacted 2012 farm bill, Congress is considering proposals for "shallow loss" revenue coverage as it resumes farm bill deliberations in May 2013.

A common feature of the proposals is the use of average revenue over an area, usually a county, as the basis for the coverage. In contrast, by far the most popular plan of insurance for corn, soybean, wheat, and cotton producers is revenue insurance based on yields of an individual farm or sub-unit of an individual farm.[2] This leads to questions of how area revenue coverage would affect individual revenue insurance. How would an area-based shallow loss program affect producers' demand for crop insurance? Would the availability, at little or no cost, of area-based shallow-loss protection change the coverage levels that producers select at the farm level under the subsidized crop insurance program?

In this paper, we analyze how shallow loss coverages modeled on ARC, SCO and STAX might affect optimal coverage levels of revenue insurance for a moderately risk-averse producer. We develop an empirically-based simulation model of revenue variability (yield multiplied by price) and use a certainty equivalent criterion to evaluate combinations of area-based revenue coverage and farm-level revenue insurance. Because revenue variability and policy preferences tend to vary by location and crop we examine how the interaction between the revenue programs

[2] In 2012, individual farm Revenue Protection accounted for more than 80 percent of the insured acres of corn, soybeans and wheat and for about for 75 percent of the insured acres of cotton.

and revenue insurance differs for a wide range of counties and farms for corn, soybean, wheat, cotton and rice (Dismukes, Arriola and Coble 2010; Barnett and Coble 2012; Wailes *et al*. 2013).

In contrast with a study by Bulut and Collins (2013), which examined a small number of farms, we use an extensive set of representative farms. Like Cooper, Delbecq and Davis (2012), we include all areas for which data are available, and while Cooper, Delbecq and Davis (2012) analyzed changes in average payments and producers' downside risk in relation to changes in the maximum coverage level of a shallow loss program, we focus on farm- or individual-level insurance choices in relation to several proposed shallow loss programs.

Conceptual Framework

We evaluate the relative benefits of different coverage levels of revenue insurance when combined with the proposed shallow loss coverage by assuming that producers maximize the certainty equivalent of stochastic revenue outcomes. We assume that producers maximize a constant relative risk aversion (CRRA) utility function, represented mathematically as:

(1) $$E(U) = \sum_{t=1}^{n} \omega_t \frac{W_t^{1-r}}{1-r}$$

where $r > 1$ is a risk aversion coefficient, set to 2 in order to represent a moderately risk-averse producer, 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, that includes market returns from crop production, revenue insurance indemnities and program payments. Per-acre net returns are multiplied by 1,000 to translate them a 1,000 acre farm. We set the farm's initial wealth equal to $1,000,000. Certainty equivalents (CE) are calculated as:

(2) $$CE = [(1-r)E(U)][(1-r)E(U)]^{\left(\frac{1}{1-r}\right)}$$

For any two alternatives *l* and *m*, if $CE_l > CE_m$, then alternative *l* is preferred to *m* in our analysis.

Farm-level revenue insurance is modeled at coverage levels that range from 50 to 85 percent of expected revenue in five percentage point increments. Indemnities for an individual producer, *i*, per planted acre are calculated as:

$$(3) \quad RevInsIndem_i = \max[0, ((CL_i \text{ x} \max(EP, HP) \text{ x } APH_i) - (HP \text{ x } FY_i))]$$

where *EP* and *HP* are the crop insurance pre-planting expected price and the harvest time price, respectively; CL_i is the coverage level; and APH_i is the farm's actual production history (APH) yield. Revenue insurance is assumed to be actuarially fair, so on average the net indemnity to the producer is the expected indemnity amount (estimated through simulations) minus producer-paid premium. Crop insurance premiums are subsidized at rates that vary by coverage level. The subsidy rates are 64 percent of the premium for 60 percent coverage, 59 percent for 65 and 70 percent coverages, 55 percent for 75 percent coverage, 48 percent for 80 percent coverage and 38 percent for 85 percent coverage. Under a provision in the 2008 farm bill a producer can also obtain a higher subsidy rate, up to 80 percent, at a particular coverage level by insuring all acres of a particular crop on the farm as a single, aggregate "enterprise unit." [3] Participation in enterprise units has become widespread since this subsidy modification.

The revenue program options that we analyze are defined as follows:

[3] The same dollar amount of premium subsidy at a coverage level for a crop insured at a sub-division of the farm acres, called "basic units" or "optional units," may be paid if the crop is insured as an "enterprise unit." Because yield variability on "basic units" or "optional units" would be greater than the "enterprise unit" they would have a higher premium. Thus, the dollar amount of subsidy applied to the lower premium "enterprise unit" would result in a subsidy rate higher than the regular subsidy rate for a coverage level.

(a) ***A revenue program similar to the county-based ARC proposal.*** This program would provide a payment to the producer when market revenue measured at the county level for a particular crop falls within a fixed range of 89 to 79 percent of expected county revenue, which is determined from Olympic average (highest and lowest values are dropped) of yields and prices over the previous five years. The payment function for all producers of the crop in county c is:

(4)

$$AveRevPmt_c = 0.8\ x\ \min\{max\{0, [(0.89\ x\ OlyAveRev_c) - \ Rev_c]\}, (0.10\ x\ OlyAveRev_c)\}$$

where $OlyAveRev_c$ is the expected revenue and Rev_c is the market revenue for the producer's county, c. The 0.8 factor reduces the total payout of the program and acts as a co-payment in that the producer would receive $0.80 for every dollar of loss. The range of 10 percent of the Olympic average revenue bounds this program to shallow losses. All enrolled producers in the county would receive a payment, and no premium would be charged for the coverage. An individual triggered version of this program was also allowed in the 2012 Senate bill S. 3240 but is not included in the options modeled in this paper.

(b) ***County-based additional crop insurance coverage similar to the SCO proposal*** (for those not participating in the proposed ARC). This insurance program would provide an indemnity payment when market revenue measured at the county level falls below 90 percent of the expected county revenue as determined from county yield histories and futures prices. The payment size would be determined by the proportion of the range of the loss below 90 percent down to the nominal coverage level of the producer's farm-level crop insurance. The indemnity function for producer *i* in county *c* is:

$$(5)\ \ SCOIndem_i = \left\{ \min(\max\left[0, \frac{(0.9 - \frac{Rev_c}{ExpRev_c}}{(0.9 - CL_i)}\right], 1) \right\} \text{ x } (0.9 - CL_i) \text{ x } ExpRev_c$$

where Rev_c is market revenue for the producer's county, $ExpRev_c$ is expected revenue for the county and CL_i is the producer's coverage level for farm-level revenue insurance. All producers with the supplemental coverage would receive a payment when the county trigger is met but the amount of the payment would depend on an individual's crop revenue insurance coverage level. A producer would pay 30 percent of the actuarially-fair premium (70 percent subsidy) for this supplemental coverage.

(c) ***County-based additional income insurance that would be available only for upland cotton.*** This program would be similar to the STAX proposal. The additional insurance coverage would be similar in structure to the supplemental coverage in item b, indemnities would be based on actual revenue relative to expected revenue at the county-level and the producer would select the range, within limits, of expected county revenue to insure. This additional insurance, however, would differ from that for other crops in the prices used to determine expected revenue, the use of a multiplier that would allow a producer to increase the amount of insurance and in the premium subsidy rate. The indemnity function for the county-based additional revenue for cotton insurance is:

$$(6)\ \ STAXIndem_i = M_i \text{ x } \left\{ \min(\max\left[0, \frac{(0.9 - \frac{Rev_c}{ExpRev_c}}{(0.9 - StaxCL_i)}\right], 1) \right\} \text{ x } (0.9 - StaxCL_i) \text{ x } ExpRev_c$$

where M_i is a payment multiplier value selected by the producer from the range of 1.0 – 1.2, Rev_c is market revenue at the county level, $ExpRev_c$ is expected revenue at the county level and $StaxCL_i$ is the coverage level selected by the producer at 5 percentage point increments up to 30 percent. The actuarially-fair premium is subsidized at 80 percent according to S. 3240.

Model and Data

Our model simulates random yields, prices, and revenues at farm and county levels for corn, soybeans, wheat, cotton and rice. The model accounts for correlations among the random variables by using empirical sampling techniques. The model draws on continuous historical data series at the county level. It includes counties with 80 - 90 percent of the 2011 planted acres of corn, soybeans and rice and about 60 percent of the 2011 planted acres of cotton and wheat (Table 1).

To measure yield variability at the county level we estimate a linear time trend for each yield data series (annual yields reported by USDA's National Agricultural Statistics Service (NASS) for 1974 – 2011) and calculate residuals, differences between actual yield in a particular year and the trend yield. The trend estimate is used to predict an expected yield for the county, about which yields are simulated.

To measure yield variability at the farm level, we use estimated county yield variability in conjunction with premium rate data supplied by USDA's Risk Management Agency. Specifically, we use the 2012 base county premium rates for yield coverage for each crop, adjusted to exclude portions of the premium rates that cover prevented planting, replanting and crop quality. The adjusted premium rates are used to calibrate an additive farm yield variability term for each county and crop.

We model farm yield variability by estimating the following relationship between systemic and idiosyncratic yield variability (Miranda 1991):

(7) $$\tilde{y}_{ft} = \mu_f + \beta(\tilde{y}_{ct} - \mu_c) + \varepsilon_{ft} \quad \forall\ f \in c$$

where $\tilde{y}_{ft}$ is the realization of the random yield on farm *f* in year *t*, $\tilde{y}_{ct}$ is the realization of the random yield in county *c* in year *t*, $\mu_f = E(\tilde{y}_{ft}), \mu_c = E(\tilde{y}_{ct})$ and ε_t is a normally distributed error term with $E(\varepsilon_{ft}) = 0$ and $Var(\varepsilon_{ft}) = \sigma^2$.

The coefficient β measures the responsiveness of deviations in farm yield relative to the expected value to deviations in county yield relative to the expected value. We initially assume that $\beta = 1$ for the representative farm so that the mean yield for the farm equals the acreage weighted average of all βs in the county. The error term ε_{ft} represents idiosyncratic effects on farm yield deviations relative to the expected values that are orthogonal to county yield deviations relative to the expected value. A grid search was conducted for values of σ (the standard deviation of ε_{ft}) that in a simulation replicate the 65 percent coverage crop yield insurance premium rates.

Price variability is estimated from futures market contract price data and NASS national price data for the same years as the yield data. Percentage changes in prices are calculated and adjusted to account for recent increases in price volatility, measured from options on futures contracts.

The price data are placed in a matrix [**P**] with *T* rows of annual prices. Yield data for each of the crops are placed in a matrix [**Y**] that contains deviations relative to their expected values. The yield matrix has *T* rows representing *T* years of historical yields. Revenue simulations are generated from 1,000 random draws from this matrix. For every location, a row (yield and price deviations for the same historical year) is simultaneously drawn randomly from yield matrix [**Y**] and price matrix [**P**] to maintain the empirical correlations between prices and yields and between yields in different counties. The idiosyncratic portion of farm yield is independently drawn (5 draws) for each representative farm for each of the 1,000 draws.

Results

Simulation results of the average[4] certainty equivalent for representative farms are presented in Table 2 for four scenarios:

(1) individual-level crop revenue insurance only,[5]

(2) individual-level crop revenue insurance and a county-level revenue program similar to ARC,

(3) individual-level crop revenue insurance and county-level supplemental revenue insurance similar to SCO and

(4) for cotton only individual-level crop revenue insurance and county-level additional income insurance similar to STAX.

Note that the certainty equivalent for a risk-averse producer reflects gains in mean returns as well as risk reduction. Thus, choices that increase subsidy would, for example, increase producer welfare. Similarly, in the case where two options result in the same mean return but

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[4] The average is calculated as the mean of the highest certainty equivalent for a representative farm, generated by simulations at the optimal coverage level for individual-level revenue insurance.
[5] All farms are assumed to have purchased enterprise unit coverage at the individual level.

one results in less risk, then the less risky option would be preferred. While the values of the certainty equivalents in Table 2 vary by crop, on average, scenario (1) has the lowest certainty equivalents and scenario (3)—individual crop insurance plus supplemental county insurance similar to SCO—results in the highest certainty equivalents for all crops except cotton, which has the highest average certainty equivalent for scenario (4). In many respects, that scenario (1) is dominated is to be expected. Since scenarios (2)-(4) include additional subsidized risk protection these programs are likely to increase producer welfare through both subsidy and risk reduction. Comparisons of scenarios (2)-(4) are more interesting. Scenario (2) involves a fully-subsidized county-triggered design while scenarios (3) and (4) involve highly-subsidized county-triggered insurance designs. A key difference is the range of the shallow loss covered, 10 percent for scenario (2) and wider for scenarios (3) and (4). Also, scenario (2) has a co-payment while scenarios (3) and (4) require a premium. The different coverage levels and the co-payment factors cause the producer to absorb a portion of the loss when a loss occurs, but an insurance premium, in contrast with a co-payment, is paid in loss and non-loss years. Although the two scenarios that include supplemental or additional insurance, scenarios (3) and (4), have the highest certainty equivalents their increases relative to the county-level revenue program, scenario (2), are relatively modest in percentage terms. Also, as others have noted, the moving average of prices incorporated in the area revenue program in scenario (2) provide could provide better price protection over multiple years, while the supplemental insurance coverage provides within-year price protection similar to that of the current insurance program (Paulson 2012).

Underlying these summaries of certainty equivalents for the scenarios are optimal coverage levels of individual-level crop revenue insurance, which are determined from revenue simulations for representative farms (one per crop per county). The coverage level that would produce the highest certainty equivalent for a moderately risk-averse producer is considered optimal. Examining the changes in the optimal individual-level coverage as the various area-based revenue programs and insurance are used indicates the potential impact of the area programs on the demand for individual crop insurance. As a base case, the distribution of the optimal coverage levels for the individual crop insurance alone is present in Table 3. For example, for corn 75 percent coverage is optimal for 47.2 percent of the locations, while 85 percent coverage is optimal for 41.8 percent of locations, and 80 percent coverage is optimal for 11 percent of the locations simulated. Corn, in fact, is the only crop for which an optimal coverage level does not occur for a majority of locations. For soybeans and wheat 75 percent coverage is optimal for a majority of locations, 52.7 percent and 79.5 percent, respectively. For cotton and rice, 85 percent coverage is optimal in a majority of locations. For both crops, 85 percent coverage is optimal in a large majority of rice locations (89 and 81 percent, respectively). No coverage level below 75 percent is optimal for any of the crops in any of the locations, based on certainty equivalent criterion.

Table 4 presents the effects on the optimal level of crop revenue insurance coverage when the producer also participates in the county-level revenue program, scenario (2). Across all crops, this county-level program has a modest effect on the optimal coverage. When the county-level revenue program is combined with individual-level crop revenue insurance, representative farms for corn, for example, where 80 percent coverage for crop insurance was optimal, relative small shares of farms, switch to 75 or 85 percent, with the majority dropping their coverage level to 75 percent.

Table 5 shows the effect of the supplemental insurance coverage, scenario (3) on optimal coverage levels. The supplemental insurance coverage scenario causes much larger effects on the optimal coverage level for individual-level crop insurance than the county-level average revenue program. Most notable is the effect on coverage selection for cotton where 89 percent of locations had an optimal coverage level of 85 percent in the revenue insurance only, scenario (1), falls to zero and 50 percent coverage—the lowest level of coverage available—becomes optimal in 87.5 percent of locations when participating in the supplemental insurance coverage option, scenario (3). The impacts are similarly large for rice. When only the current individual-level crop revenue insurance coverage is available, scenario (1), 85 percent coverage is found in our simulations to be optimal in over 80 percent of locations. However, when producers in these locations participate in the supplemental insurance coverage option, 85 percent coverage is no longer optimal in any locations and the share of rice counties with 75 percent coverage optimal increases from six to 100 percent. Changes in optimal coverage levels for corn and soybeans follow similar but slightly less dramatic patterns. For both crops 75 percent coverage is optimal in essentially all locations when the supplemental insurance coverage is used. In fact, with the exception of cotton, 75 percent coverage becomes optimal in essentially all locations for all crops. Thus, supplemental insurance coverage could affect the choice of optimal coverage levels, particularly at higher levels of coverage.

Table 6 presents the distribution of optimal coverage levels when the area-based additional income insurance similar to STAX is used for cotton. Note that 85 percent is still optimal in 78 percent of the locations. This is quite different from the optimal coverage distribution for cotton under the supplemental insurance coverage in scenario (3).

Figures 1 – 4 illustrate the particular locations where the changes in individual-level optimal insurance coverage are most likely to occur. For corn and soybeans, the individual-level coverage level would drop to 75 percent for most representative farms in the Corn Belt when the county-level supplemental coverage is used. These switches in coverage levels at the farm-level suggest that the farm-level revenue is strongly correlated with the county-level revenue because of relatively strong correlation between farm and county yields. For wheat, few representative farms decrease their farm-level insurance coverage, suggesting that their revenue is not as strongly correlated with county revenue. For rice, which has relatively little yield variability, farm-level coverages decrease because revenue variability is driven largely by price variability, which is the same at the farm and county levels. Thus, county-level revenue insurance is a relatively good substitute for farm-level revenue.

Conclusions

The 2012 farm bill debate has focused a great deal on capturing federal budgetary savings ($23 billion over 10 years in S. 3234) by eliminating the Direct Payment, ACRE and price-based Counter-Cyclical Payment programs, while individual-level crop insurance has been largely unchanged. The new programs that have emerged have been proposed to cover shallow loss not covered by the current crop insurance program. These proposed programs represent different visions of area-based shallow loss revenue coverage: (1) a revenue program delivered at no charge to producers by USDA's Farm Service Agency, called ARC, and (2) two similar forms of supplemental or additional crop insurance subsidized by USDA and delivered by private insurance companies and agents, called SCO and STAX. Both approaches to shallow loss coverage use county-level triggers in order to avoid potential moral hazard problems that could arise if producers insured at very high coverage levels of individual-level insurance.[6]

[6] The ARC proposal in S. 3240 includes a farm-level revenue program option (not modeled in this paper) that, in contrast to individual-level revenue insurance, has a co-payment factor that requires the producer to pay a large share of any loss beyond the deductible. This could prevent moral hazard.

Based on certainty equivalent analysis, the area triggered insurance designs have some potential for causing producers to reduce individual coverage levels for crop insurance. This could have several implications. First, USDA's Risk Management Agency, which administers the federal crop insurance program, might be pressured to make the area-based coverage available even in areas where county and even crop reporting district data is sparse. Recent reductions in the counties where USDA's National Agricultural Statistics Service (NASS) reports county yields could make the implementation of these area-based programs more difficult.

Second, changes in producers' coverage choices offered by these proposed programs may have significant effects on government costs as well as returns to the companies that deliver crop insurance through changes in amount of insurance coverage sold, called liability, and in subsidies that are based on insurance premium amounts. This would likely be the greatest for corn and soybeans, which account for large shares of crop insurance liability and subsidies and have relatively large proportion of their current actual revenue insurance coverage at high coverage levels (Tables 7 and 8). Our research suggests that drops in individual-level coverage levels could be most common in counties that have accounted for a large volume of federal crop insurance business and underwriting gains.

Area revenue risk and thus premium rates are generally lower for area-level products than those of individual-level insurance. The area programs as proposed in 2012 would be highly subsidized, in many instances more highly subsidized than individual-level basic and optional unit (sub-divisions of a farm's acreage for a crop) coverage. However, area proposals are never subsidized more than individual enterprise unit individual coverage, which has become increasingly popular. Thus, the relative subsidy levels of individual crop insurance and the proposed shallow loss area programs will be a key to the behavior of producers and government costs. These factors are particularly crucial since the marginal differences in the certainty equivalents among options are often relatively small on a percentage basis.

Our results suggest that many producers would be willing to accept area triggered programs in lieu of individual coverage at higher coverage levels. This result is based on objective data where no biases occur in the producer's perception of the risk they face. In general, area-triggered crop insurance has not historically captured a large share of the crop insurance market even when research suggests it should compete well against individual coverage. Actual behavior may deviate from that suggested here because of subjective perceptions of area revenue designs. In particular, we suspect that producers fear that less than perfect correlation between farm and county revenue might result in area programs not triggering in amounts matching their farms' losses. Thus, our results could be an upper bound on the amount of coverage level reductions that might occur, given that producers have historically demonstrated an aversion to the basis risk in area-based coverage.

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Table 1. Planted acres and counties included in simulation data set.

Crop	Actual	Simulation Data Set		
	Planted Acres	Planted Acres	Acres Covered by Simulation Data Set	Counties
	1,000 Acres	*1,000 Acres*	*Percent*	*Number*
Corn	86,001	76,992	90	1,107
Cotton	14.428	9,061	63	145
Rice	2,689	2,151	80	48
Soybeans	75,046	60,578	81	940
Wheat	54,409	31,276	58	733

Actual planted acres are NASS estimates for 2011. Corn is an estimate by authors of acres planted to grain.

Table 2. Average certainty equivalents by combinations of individual-level crop revenue insurance and county-level revenue coverage, four scenarios, by crop

Crop	**(1)**	**(2)**		**(3)**		**(4)**	
	Crop Revenue Insurance Only	**Crop Revenue Insurance and County-level Revenue Program (similar to ARC)**		**Crop Revenue Insurance and County-level Supplemental Revenue Insurance (similar to SCO)**		**Crop Revenue Insurance and County-level Additional Income Insurance (similar to STAX)**	
	Certainty Equivalent	**Certainty Equivalent**	**Increase in CE from Crop Insurance Only CE**	**Certainty Equivalent**	**Increase in CE from Crop Insurance Only CE**	**Certainty Equivalent**	**Increase in CE from Crop Insurance Only CE**
	Dollars	*Dollars*	*Percent*	*Dollars*	*Percent*	*Dollars*	*Percent*
Corn	712,450	734,626	3.1	748,035	5.0	---	---
Cotton	636,051	652,699	2.6	665,119	4.6	670,948	5.4
Soybeans	538,665	550,300	2.2	557,321	3.5	---	---
Rice	884,299	913,364	3.2	931,160	5.3	---	---
Wheat	346,958	355,720	2.5	362,415	4.5	---	---

Based on simulations. Calculated using the individual-level crop revenue insurance coverage level with highest of certainty equivalent.

Table 3. Distribution of representative farms (one per county per crop) by optimal individual-level crop revenue insurance coverage level, individual-level crop revenue insurance only (scenario 1)

Crop	**Coverage Level (Percent of Expected Revenue)**		
	75	**80**	**85**
	Percent		
Corn	47.2	11.0	41.8
Cotton	8.2	2.3	89.0
Soybeans	52.4	8.7	38.8
Rice	6.3	12.5	81.3
Wheat	79.5	7.5	13.0

Based on simulations. Rows sum to 100.

Table 4. Distribution of representative farms (one per county per crop) by optimal individual-level crop revenue insurance coverage level, individual-level crop revenue insurance and county-level revenue program (scenario 2)

Crop	**Coverage Level (Percent of Expected Revenue)**		
	75	**80**	**85**
	Percent		
Corn	53.3	0.0	46.7
Cotton	10.3	0.0	89.7
Soybeans	57.8	0.0	42.2
Rice	16.7	0.0	83.3
Wheat	85.0	0.0	15.0

Based on simulations. Rows sum to 100. County-level revenue program covers fixed range of expected revenue.

Table 5. Distribution of representative farms (one per county per crop) by optimal individual-level crop revenue insurance coverage level, individual-level crop revenue insurance and county-level supplemental insurance program (scenario 3)

Crop	**Coverage Level (Percent of Expected Revenue)**		
	50	**60**	**75**
	Percent		
Corn	0.1	0.0	99.9
Cotton	87.5	2.8	9.7
Soybeans	0	0	100
Rice	0	0	100
Wheat	1.1	0	98.9

Based on simulations. Rows sum to 100. County-level supplemental insurance program covers range of expected revenue that depends on individual insurance coverage level.

Table 6. Distribution of representative farms (one per county per crop) by optimal individual-level crop revenue insurance coverage level, individual-level crop revenue insurance and county-level additional income insurance program, cotton only (scenario 4)

Crop	**Coverage Level (Percent of Expected Revenue)**		
	75	**80**	**85**
	Percent		
Cotton	11.1	11.1	77.8

Based on simulations. Rows sum to 100. County-level additional insurance program covers range of expected revenue that depends on individual insurance coverage level.

Table 7. Federal crop insurance liability for individual-level crop revenue insurance by crop, 2012

Crop	Liability		
	Total	**75 Percent Coverage Level and Above**	**80 Percent Coverage Level and Above**
	$ Million	*Percent of Total*	
Corn	47,248	75.9	32.4
Cotton	3,772	31.6	7.4
Rice	452	45.4	7.7
Soybeans	22,601	73.6	39.4
Wheat	9,096	49.1	18.7

Source: Tabulations of RMA Summary of Business data.

Individual-level crop revenue insurance (Revenue Protection) accounted in 2012 for nearly 90 percent of the total liability for corn, soybeans and wheat, nearly 80 percent of the liability for cotton and about 40 percent of the liability for rice.

Table 8. Federal crop insurance premium subsidy for individual-level crop revenue insurance by crop, 2012

Crop	**Premium Subsidy**		
	Total	**75 Percent Coverage Level and Above**	**80 Percent Coverage Level and Above**
	$ Million	*Percent of Total*	
Corn	2,461	72.7	36.8
Cotton	472	28.3	4.7
Rice	20	52.1	8.8
Soybeans	1,337	71.6	33.0
Wheat	990	43.4	11.3

Source: Tabulations of RMA Summary of Business data.

Individual-level crop revenue insurance (Revenue Protection) accounted in 2012 for about 90 percent of the total premium subsidy for corn, soybeans and wheat, about 85 percent of the premium subsidy for cotton and about 50 percent of the premium subsidy for rice.

Figure 1. Change in individual-level crop revenue insurance with county-level supplemental coverage insurance (scenario 3) by county, corn.

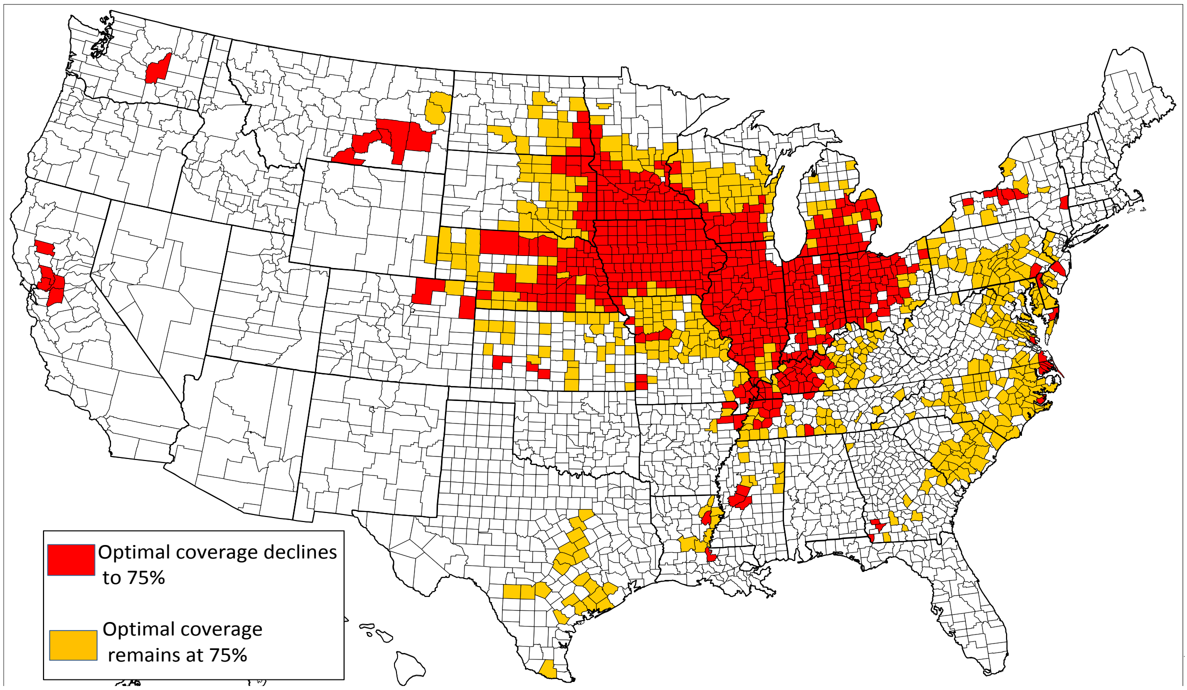

Figure 2. Change in individual-level crop revenue insurance with county-level supplemental coverage insurance (scenario 3) by county, soybeans.

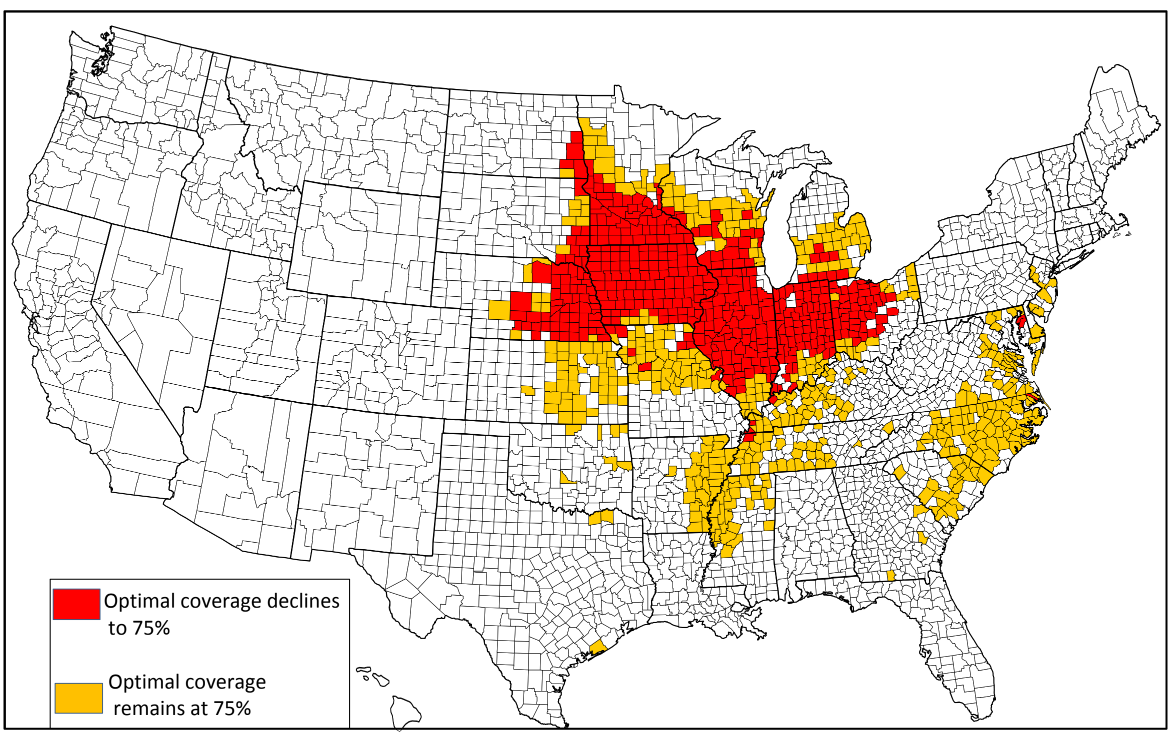

Figure 3. Change in individual-level crop revenue insurance with county-level supplemental coverage insurance (scenario 3) by county, wheat.

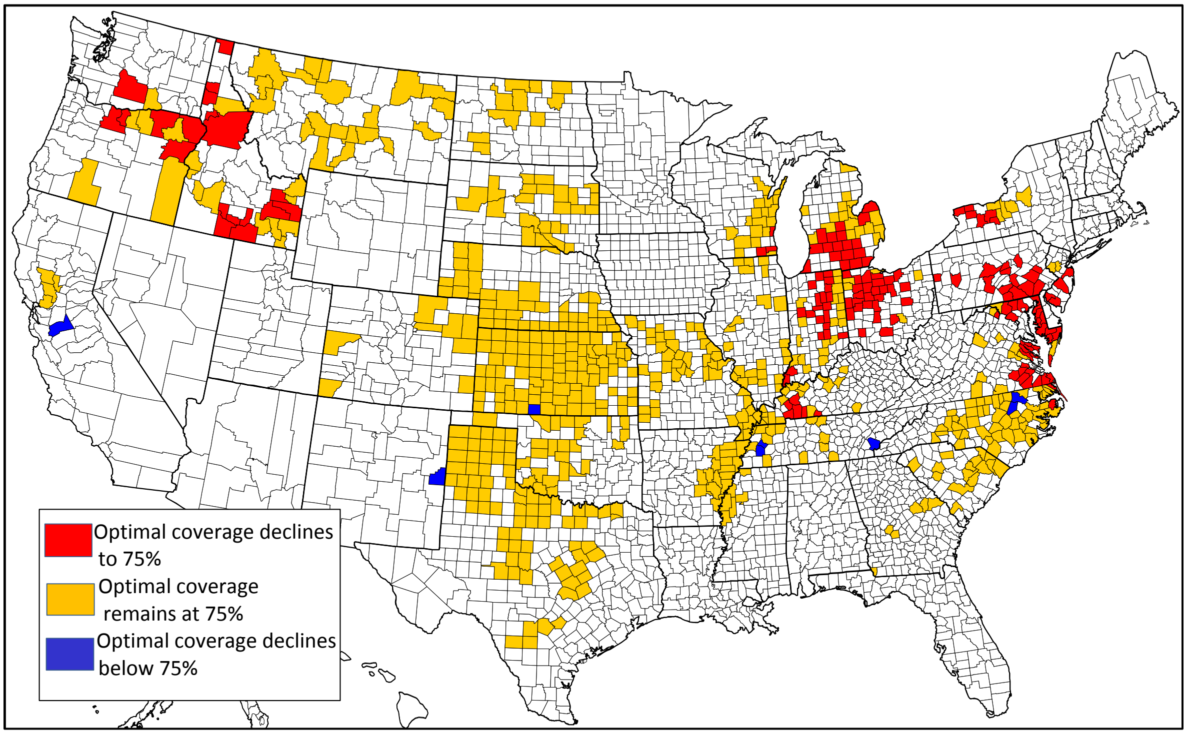

Figure 4. Change in individual-level crop revenue insurance with county-level supplemental coverage insurance (scenario 3) by county, rice.