Evaluating the marginal risk management benefits of the supplemental coverage option

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Abstract

Purpose – The purpose of this paper is to evaluate the risk management benefits provided by the supplemental coverage option (SCO) insurance plan which was created in the 2014 Farm Bill. Specifically, the marginal expected utility benefits are compared with the potential additional subsidy cost introduced by the new program for a stylized example of a corn producer.

Design/methodology/approach – The paper uses a stylized simulation model examines the preferred insurance program choice for a typical Midwestern corn farmer. The expected utility of the farmer is calculated under their preferred insurance program choice both with and without the availability of the SCO program, and compared to the case where crop insurance is not available. Scenarios are examined for a range of farmer risk aversion levels, different levels of correlation between farm-level and county-level corn yields, and case with and without insurance premium subsidies.

Findings – The SCO program is found to enter into the preferred insurance program choice for risk averse farmers. As risk aversion increases, farmers are estimated to prefer higher coverage levels for individual products along with SCO coverage. While the availability of existing crop insurance programs are shown to substantially increase the expected utility of farmers, the marginal impact of adding SCO to the crop insurance program is relatively small. Furthermore, the additional expected benefits generated by SCO are shown to include both risk management and expected return components. With subsidies removed, the estimated marginal benefits provided by SCO are reduced significantly.

Practical implications – The findings of this paper can help inform the policy debate for future farm bills as agricultural support programs continue to evolve. The results in this paper can also be used to help explain farm-level decision making related to crop insurance program choices.

Originality/value – This paper contributes to the literature by documenting a new, federally supported risk management programs made available to farmers in the 2014 Farm Bill and evaluates the marginal benefits the SCO program offers US crop producers.

Keywords Risk management, Crop insurance, Farm Bill, Farm subsidies

Paper type Research paper

The 2014 Farm Bill created a number of modifications to commodity programs which require producers to choose among price- and revenue-based programs. The Farm Bill also created a new crop insurance program – the supplemental coverage option (SCO) – which provides supplemental coverage for a portion of the producer's individual crop insurance coverage plan deductible. SCO coverage is linked to the producer's individual plan of insurance and losses are triggered by yield or revenue losses at the county level. Furthermore, eligibility to purchase SCO is tied to the producer's commodity program choice. Specifically, SCO is not available for base acreage enrolled in the Agriculture Risk Coverage (ARC) program at the county or individual farm levels[1].

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All of these changes taken together have created a rich set of programs that are available for producers in forming a risk management portfolio for their farm businesses. This choice set includes existing crop insurance programs (various types of insurance with various coverage level options), price- and revenue-based commodity program options, the new supplemental insurance coverage, as well as private-market instruments to manage price risk (i.e. forward contracts or futures, and options).

While expanding the program choice set creates additional options and flexibility for producers, it also creates a highly complex decision-making scenario requiring a significant amount of knowledge regarding the details and mechanics of the individual programs and other risk management tools. Furthermore, despite the projected savings relative to current farm programs, by expanding the set of programs available for producers the potential for overlap and inefficiencies is also increased from the perspective of government outlays.

Therefore, passage of the 2014 Farm Bill raises the following questions. First, does SCO enter into a producer's optimal risk management portfolio or impact their individual crop insurance plan and coverage level choices? Second, does SCO provide significant and economically meaningful opportunities for marginal risk management gains given the large set of already existing insurance programs? Finally, what are the marginal or additional subsidy costs associated with the SCO program and can they be justified by the additional risk management benefits created for producers? While the 2014 Farm Bill has passed, answering these questions provides information useful in evaluating continued changes for the next farm bill. Also, answering these questions will aid farmers in making risk management choices given current programs.

We address these questions in an optimization framework which considers the joint distribution of insurance (futures prices), marketing year average prices, and farm- and county-level crop yields. Various objective function measures based on the farm's gross revenue distribution are examined to determine whether a representative corn producer should choose to incorporate SCO into their insurance portfolio, and the marginal gains that are achieved in terms of expected returns and risk reduction. The simulation model compares the expected utility of the corn farmer's gross revenue distribution with the various combinations of insurance plans which are available. These insurance program choices are then ranked by the level of expected utility achieved under each option. The net effects on expected revenue, risk reduction, and total premiums subsidy costs are summarized and compared with the base case where SCO is not available.

This paper focusses on the results from a stylized farm-level example of corn production in the Midwest. We consider a number of different subsidy and yield correlation scenarios, and show that the optimal mix of risk management tools is impacted by farm-level characteristics such as the level of correlation assumed between farm- and county-level yields.

The highlights of our findings are as follows. First, SCO enters the optimal crop insurance choice for most risk averse producers. This is true because of the subsidies, but also because it does offer additional coverage on top of existing individual plans, even at the highest individual coverage level available of 85 percent. Second, the additional benefits created by SCO are relatively small compared with those provided by existing insurance program options. Furthermore, a significant portion of those benefits come from the positive effect on expected revenues due to premium subsidies rather than from the effect of risk reduction. Finally, the additional subsidy costs associated with making SCO available can be quite large relative to the expected utility benefits the program provides producers.

The SCO

The SCO is an optional insurance program that can be used to supplement the coverage associated with a COMBO product[2]. Conceptually, SCO is designed to provide coverage for a portion of the farmer's deductible on their individual plan of insurance. SCO mimics the type of coverage provided by the underlying plan: if SCO is coupled with a yield protection (YP) policy, SCO provides supplemental county YP; if SCO is coupled with a revenue plan – revenue protection (RP) or revenue protection with the harvest price exclusion (RPHPE) – SCO provides supplemental county revenue protection.

Indemnity payments for SCO are triggered at the county-level, and the program provides a fixed trigger level of 86 percent. Thus, actual county yields/revenues must be below 86 percent of expected yield/revenue at the county level. Expected yields are based on the same county trend yields used in the existing area insurance programs (i.e. Area Risk Protection Insurance (ARPI), or what was previously referred to as the GRP and GRIP programs). SCO uses the same base/expected and harvest/actual prices as other insurance plans (i.e. planting and harvest futures contracts). SCO provides a limited amount of coverage, or a coverage band. The size of this band is determined by the coverage level of the underlying plan of insurance. For example, if SCO is coupled with an 80 percent RP plan it would provide supplemental revenue coverage for county revenue losses ranging from 80 to 86 percent of expected county revenue. Since losses are triggered at the county level, either all producers carrying SCO in a county will receive a payment (county losses are triggered), or no producers in the county will receive a payment (county losses are not triggered). Furthermore, producers could receive a payment without experiencing losses at the farm level, and farm-level losses could occur without the triggering of an SCO payment.

The size of the SCO indemnity received by any individual farmer is determined by their individual insurance liability. The size of the loss at the county level translates to a percentage payment factor which is then multiplied by the maximum payment the individual farmer could receive. If losses are triggered at the county level, the SCO payment factor is:

$$\text{SCO payment factor} = \frac{\left[86\% - \frac{\text{actual county revenue/yield}}{\text{expected county revenue/yield}}\right]}{86\% - \text{individual coverage level}} \quad (1)$$

The maximum payment an individual farmer can receive is given by:

$$\text{Max SCO payment} = (86\% - \text{individual coverage level}) \times \text{expected crop value}, \quad (2)$$

where the expected crop value is the product of the insurance price and the farmer's APH yield.

Premiums for SCO are subsidized at a flat rate of 65 percent regardless of the producer's underlying plan. This subsidy rate exceeds that of existing area plans and for individual coverage levels at the higher end of the available range. More information about SCO is available from the Risk Management Agency (RMA, 2014), in Paulson and Coppess (2014), and in the Agricultural Act (2014).

Optimization model

Our research questions are addressed using a stylized optimization model. Farm and county crop yields, and crop prices are modeled as stochastic variables within a simulation framework. Specifically, 10,000 random draws are taken from the marginal

yield and price distributions. Yields are assumed to follow a Weibull distribution[3], while prices are assumed to be lognormal. Rank correlations are imposed among the yield and price distributions using the method outlined in Iman and Conover (1982). Finally, a fixed basis is assumed between the futures price and farm price[4]. The simulation approach follows that used in the simulation model underlying the iFarm Premium Calculator and Payment Evaluator (Schnitkey *et al.*, 2016).

Using the correlated price and yield draws, distributions of insurance program indemnities are calculated for individual yield and revenue plans, area plans, and SCO coupled with the individual plans[5]. The full ranges of individual coverage levels (ranging from 50 to 85 percent in 5 percent increments) and area coverage levels (ranging from 70 to 90 percent in 5 percent increments) are considered. The maximum risk protection factor of 1.2 is assumed for area coverage. SCO indemnity distributions are created for each possible underlying individual plan and coverage level. Fair premiums for each policy and coverage level are calculated from the indemnity distributions and subsidy rates are applied. Subsidy rates used are the current rates applied for area coverage and individual coverage using enterprise units by coverage level.

The expected utility of revenue is then calculated for each insurance program choice, covering all available combinations of possible coverage level choices for individual coverage, with and without SCO, and area coverage. For the results presented here, we use the constant relative risk aversion (CRRA) utility function and use a range of risk aversion levels. Specifically, we consider relative risk aversion coefficient values ranging from 0 to 12. Note that these risk aversion coefficients represent risk premium levels ranging from 5.5 percent (CRRA = 2) to more than 50 percent (CRRA = 12). Revenue is defined net of insurance program payments and equals crop revenues (product of farm price and farm yield) plus any net insurance payments (indemnities less farmer-paid premium). The insurance program choices are then ranked based on the expected level of utility achieved under each program option.

Table I summarizes the parameter values used in the baseline case, which is modeled after a typical farm producing corn in Central Illinois[6], and Table II provides the subsidy rates by coverage level used for the individual and area plans of insurance. Note that the subsidy rate for SCO is fixed at 65 percent. Additional parameter scenarios are also examined. These include cases without premium subsidies, and where there is zero correlation between farm and county yields. Removing the effect of premium subsidies allows for the separation of risk reduction and expected profit motivations for insurance choice, while the scenario with independent farm and county yields is meant to reflect regions where yield basis risk is high, meaning the county average does not provide an appropriate representation of the individual farm within that county.

Parameter	Baseline value
Expected farm yield	183 bu/acre
Farm yield standard deviation	38 bu/acre
Expected county yield	183 bu/acre
County yield standard deviation	31 bu/acre
Expected futures price	$3.86/bu
Price volatility	17%
Farm price basis	($0.30)
Price-yield correlation	−0.50
Farm-county yield correlation	0.75

Table I.
Simulation model baseline parameter values

Coverage level (%)	Individual plans (YP, RP, RPHPE) (%)	Area plan (ARPI) (%)
50	80	na
55	80	na
60	80	na
65	80	na
70	80	59
75	77	55
80	68	55
85	53	49
90	na	44

Notes: SCO is only available with individual plan coverage and has a flat subsidy rate of 65 percent. The maximum risk protection factor of 1.2 is used for ARPI payments

Table II. Summary of crop insurance program subsidy rates

Additionally, we consider a case where the maximum coverage level available for individual insurance plans is 75 percent. There are a number of counties where the maximum level of coverage available for the individual revenue and yield plans does not reach 85 percent. For example, based on the RMA's (2015) Summary of Business statistics, approximately 15 percent (13.5 percent) of counties offering YP, RP, or RPHPE coverage for corn (soybeans) provide coverage levels up to just 75 percent. For wheat, the percentage of counties with a maximum available coverage level of 75 percent increases to over 44 percent. Since the coverage band associated with SCO increases as the coverage level of the underlying individual plan of insurance declines, the potential additional value provided by the SCO program in these types of areas will be greater. The results for the baseline case and additional scenarios are summarized in the next section.

Results

Table III reports the top five insurance program rankings at various risk aversion levels for the baseline case, which includes premium subsidies and high correlation between farm and county yields. For risk neutral farmers, the area insurance plan at the 85 and 90 percent coverage levels are the most preferred choices. Area coverage at 90 percent provides the greatest impact on expected revenues, generating the largest expected net insurance payment for the representative corn farmer presented here.

Rank	Risk neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
1	90% ARP	80% RP, SCO	80% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO
2	85% ARP	85% RP, SCO	85% RP, SCO	80% RP, SCO	85% RP	85% RP	85% RPHPE, SCO
3	80% RP, SCO	75% RP, SCO	85% RP	85% RP	80% RP, SCO	85% RPHPE, SCO	85% RP
4	75% RP, SCO	90% ARP	75% RP, SCO	85% RPHPE, SCO	85% RPHPE, SCO	80% RP, SCO	85% RPHPE
5	70% RP, SCO	85% RP	85% RPHPE, SCO	85% RPHPE	85% RPHPE	85% RPHPE	80% RP, SCO

Note: Percentages represent the change in expected utility when optimal insurance plan choice is made relative to expected utility without crop insurance

Table III. Insurance choice rankings for a representative corn farmer-premium subsidies and farm-county yield correlation

For risk averse farmers, combinations of individual revenue coverage plus SCO are the top ranked insurance choices. At the lower end of the risk aversion range, the farmer chooses 80 percent RP with SCO. Choosing this level of individual coverage maximizes the overall subsidy effect, since moving to 85 percent would push the subsidy rate for the individual plan from 68 percent down to 53 percent, below the 65 percent subsidy rate for SCO. Note that, without SCO, farmers at the low end of the risk aversion range would prefer a higher coverage level on either the area plan (90 percent ARP when CRRA = 2) or individual revenue insurance (85 percent RP when CRRA = 4). This illustrates the potential "buy-down" effect, where a farmer might choose to reduce individual coverage and add the SCO coverage option to maximize their net insurance payment.

As risk aversion increases, farmers prefer the highest available individual coverage combined with SCO coverage. This illustrates the preference for farm-level coverage, relative to area-based coverage, even when the subsidy rate for the individual plan is lower.

Table IV reports changes in expected utility relative to the case where crop insurance is not available. The first row measures the percentage increase in expected utility when SCO coverage is added to the available insurance plans (labeled "With SCO"), while the second row measures the percentage increase in expected utility due to the availability of only existing individual and area plans (labeled "Without SCO"). As an example, for a farmer with a coefficient of relative risk aversion equal to 4 (CRRA = 4), the preferred insurance choice without SCO is 85 percent RP. This is listed as the third ranked choice overall in Table III, but the first choice which does not include SCO.

The overall expected utility gains from crop insurance are relatively large, ranging from a 4.37 percent improvement for a risk neutral farmer to a nearly 100 percent improvement in expected utility at the highest end of the risk aversion range. While the addition of SCO does provide further additional expected utility gains, they are relatively small as shown in the third row of Table IV. For the risk neutral case, adding SCO to the menu of available insurance plans does not increase expected utility to the farmer since the 90 percent area plan is the preferred program choice even when SCO is available. For higher levels of risk aversion there are very small additional gains in expected utility. At most, a farmer with a relative risk aversion coefficient of 4 is estimated to realize an additional 1.60 percentage point gain in expected utility due to SCO being made available, relative to the scenario where no crop insurance is available.

Note that the results summarized in Tables III and IV are based on current subsidy rates, so insurance choices and rankings include both expected revenue effects from the subsidies along with the risk reduction effect of the policy or policy combination used. Tables V and VI report insurance program rankings for the model when all subsidy rates are set to 0. In this case, the risk neutral farmer is indifferent between buying any

Table IV.
Percentages represent the change in expected utility when optimal insurance plan choice is made relative to expected utility without crop insurance

	Risk neutral (%)	CRRA = 2 (%)	CRRA = 4 (%)	CRRA = 6 (%)	CRRA = 8 (%)	CRRA = 10 (%)	CRRA = 12 (%)
With SCO	4.37	5.49	24.20	54.64	84.66	97.41	99.70
Without SCO	4.37	5.30	22.60	53.34	84.39	97.30	99.67
Difference	0.00	0.19	1.60	1.30	0.27	0.11	0.03

of the actuarially fair insurance products and not carrying insurance, while risk averse farmers still realize risk reduction benefits from insurance coverage. Again, across the range of risk aversion levels considered, farmers tend to prefer the individual revenue plans at the maximum coverage level available plus SCO. This is not surprising given that the insurance programs in this case are actuarially fair.

The results in Table V indicate a shift in preference from the RP product to the RPHPE product when subsidies are removed. However, the differences in expected utility across the top insurance program choices listed in the table are quite small. Our explanation for this shift is that the additional cost of the harvest price component of the RP plan, relative to the RPHPE plan, is greater than the value of the additional risk protection that it provides. Comparing the results in Table VI to those in Table IV, the increase in expected utility provided by crop insurance programs are smaller than those in the case when the insurance programs are subsidized. In the absence of subsidies, risk averse farmers still realize relatively large expected utility gains from insurance in general (i.e. without the SCO option), but the addition of SCO provides a smaller additional increase in expected utility compared to the scenario which included premium subsidies in Tables III and IV. This suggests that only a portion of the additional benefits provided by the introduction of SCO are related to improved risk management, while the remaining benefits can be attributed to the additional subsidy received.

To examine the effect of the level of correlation between farm and county yields, Tables VII-X examine cases where farm and county yields are independent. Since SCO is triggered by county losses, the extent to which county and farm yields are correlated should be positively related to the risk reduction benefits created by SCO. Thus, one should expect the value of, and preference for, the SCO option to be lower in areas

Rank	Risk neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
1	na	85% RPHPE, SCO	85% RPHPE, SCO	85% RPHPE, SCO	85% RPHPE, SCO	85% RPHPE, SCO	85% RPHPE, SCO
2	na	85% RPHPE, SCO	85% RPHPE	85% RPHPE	85% RPHPE	85% RPHPE	85% RPHPE
3	na	85% RPHPE	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO
4	na	85% RP	85% RP	85% RP	85% RP	85% RP	85% RP
5	na	80% RPHPE, SCO	80% RPHPE, SCO	80% RPHPE, SCO	80% RPHPE, SCO	80% RPHPE, SCO	80% RPHPE, SCO

Note: Percentages represent the change in expected utility when optimal insurance plan choice is made relative to expected utility without crop insurance

Table V. Insurance choice rankings for a representative corn farmer – no subsidies and farm-county yield correlation

	Risk neutral (%)	CRRA = 2 (%)	CRRA = 4 (%)	CRRA = 6 (%)	CRRA = 8 (%)	CRRA = 10 (%)	CRRA = 12 (%)
With SCO	0.00	2.66	19.22	50.11	80.23	95.02	99.07
Without SCO	0.00	2.62	18.92	49.68	79.97	94.91	99.04
Difference	0.00	0.04	0.30	0.43	0.26	0.11	0.03

Table VI. Percentages represent the change in expected utility when optimal insurance plan choice is made relative to expected utility without crop insurance

where farm and county yields are not highly correlated. Tables VII and VIII summarize the program rankings and marginal expected utility gains, respectively, when farm and county yields are independent but insurance programs are subsidized. Here, risk neutral farmers continue to prefer 90 percent area coverage.

As risk aversion increases, farmer preferences shift quickly toward individual plans at high coverage levels, and continue to prefer including SCO with underlying individual plan. As expected, the additional or marginal expected utility gains from SCO are smaller than those reported in Table IV when farm and county yields were correlated. This illustrates the reduction in value of SCO, from a risk reduction standpoint, as yield basis risk in a county increases.

Tables IX and X report results when there are no crop insurance subsidies, and farm and county yields are independent. Again, since the premiums are actuarially fair, risk neutral producers are indifferent across insurance program choices while risk averse farmers tend to prefer high coverage levels on individual plans plus SCO. Similar to the scenarios with correlated farm and county yields, the additional utility benefits of SCO decline when subsidies are removed as in the baseline case, and are also lower compared to the scenario where farm and county yields are correlated and subsidies are removed (Tables V and VI). Again, this illustrates the reduction in the pure risk management value of SCO when yield basis risk for an individual farmer in a county is increased.

Finally, Table XI reports the expected utility gains when SCO is made available in areas where the maximum coverage level for individual insurance plans is 75 percent.

Table VII.
Insurance choice rankings for a representative corn farmer-premium subsidies and independent yields

Rank	Risk neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
1	90% ARP	80% RP, SCO	80% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO
2	90% ARPHPE	75%, RP, SCO	85% RP, SCO	80% RP, SCO	85% RP	85% RP	85% RPHPE, SCO
3	85% ARP	85%, RP, SCO	85% RP	85% RP	80% RP, SCO	85% RPHPE, SCO	85% RP
4	75% RP, SCO	85%, RP	75% RP, SCO	85% RPHPE, SCO	85% RPHPE, SCO	80% RP, SCO	85% RPHPE
5	70% RP, SCO	70%, RP, SCO	85% RPHPE, SCO	85% RPHPE	85% RPHPE	85% RPHPE	80% RP, SCO

Note: Percentages represent the change in expected utility when optimal insurance plan choice is made relative to expected utility without crop insurance

Table VIII.
Percentages represent the change in expected utility when optimal insurance plan choice is made relative to expected utility without crop insurance

	Risk neutral (%)	CRRA = 2 (%)	CRRA = 4 (%)	CRRA = 6 (%)	CRRA = 8 (%)	CRRA = 10 (%)	CRRA = 12 (%)
With SCO	4.79	5.35	23.50	54.00	84.70	97.39	99.68
Without SCO	4.79	5.30	22.60	53.34	84.39	97.30	99.67
Difference	0.00	0.05	0.90	0.67	0.31	0.09	0.01

Again, we include this scenario to illustrate how the value of SCO might change for farmers in areas where the maximum level of coverage is lower than what is available in other areas. In this case, the preferred insurance choice for risk averse farmers is 75 percent RP when SCO is not available, and shifts to 75 percent RP with SCO when it is made available. Here, the additional utility gains of SCO are larger, since the SCO band of coverage when added to a 75 percent coverage level is larger than when coupled with an 85 percent individual coverage level. Additional increases in expected utility range from less than 1 percent at the lowest and highest ends of the risk aversion range to more than 5 percent at more moderate levels of risk aversion. As in the previous scenarios which include premium subsidies, these additional percentage point increases in expected utility include both, a subsidy or

Table IX. Insurance choice rankings for a representative corn farmer – no subsidies and independent yields

Rank	Risk neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
1	na	85% RPHPE, SCO	85% RPHPE, SCO	85% RPHPE, SCO	85% RPHPE, SCO	85% RPHPE, SCO	85% RPHPE, SCO
2	na	85% RPW	85% RPHPE	85% RPHPE	85% RPHPE	85% RPHPE	85% RPHPE
3	na	85% RPHPE, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO
4	na	85% RP	85% RP	85% RP	85% RP	85% RP	85% RP
5	na	80% RP, SCO	80% RPHPE, SCO	80% RPHPE, SCO	80% RPHPE, SCO	80% RPHPE, SCO	80% RPHPE, SCO

Note: Percentages represent the change in expected utility when optimal insurance plan choice is made relative to expected utility without crop insurance

Table X. Percentages represent the change in expected utility when optimal insurance plan choice is made relative to expected utility without crop insurance

	Risk neutral (%)	CRRA = 2 (%)	CRRA = 4 (%)	CRRA = 6 (%)	CRRA = 8 (%)	CRRA = 10 (%)	CRRA = 12 (%)
With SCO	0.00	2.64	19.12	49.95	80.08	94.99	99.06
Without SCO	0.00	2.62	18.92	49.68	79.97	94.91	99.04
Difference	0.00	0.02	0.20	0.27	0.11	0.08	0.02

Table XI. Percentages represent the change in expected utility when optimal insurance plan choice is made relative to expected utility without crop insurance

	Risk neutral (%)	CRRA = 2 (%)	CRRA = 4 (%)	CRRA = 6 (%)	CRRA = 8 (%)	CRRA = 10 (%)	CRRA = 12 (%)
With SCO	4.91	3.74	20.28	51.03	83.59	97.17	99.65
Without SCO	1.71	3.22	17.08	45.59	79.75	96.01	99.43
Difference	3.20	0.52	3.20	5.44	3.84	1.16	0.22

expected revenue effect, as well as a risk reduction effect by adding SCO to the individual plan. Similar to the cases examined without subsidies and yield correlation when 85 percent coverage is available, the additional expected utility gains of SCO decline when 75 percent coverage is the maximum available but subsidies are removed and farm to county yield correlation is reduced.

Additional subsidy costs of SCO

The additional benefits realized by producers with the introduction of SCO will come at a cost to taxpayers via subsidized premiums. Figures 1 and 2 provide estimates of the additional subsidy costs that may be associated with SCO when coupled with various types of individual coverage. Figure 1 provides our model's estimates of the additional subsidy cost associated with adding SCO coverage to individual plans at the 75, 80, and 85 percent coverage levels. For a producer who currently carries 75 percent YP, adding SCO coverage will require an additional $1.72/acre in premium subsidies. In contrast, adding SCO to an RP policy with a 75 percent coverage level would imply additional subsidy costs of more than $11.00/acre[7]. As the coverage level of the individual plan increases, the cost of the SCO coverage and the associated subsidy declines. Adding SCO to an 85 percent YP would require just $0.22/acre in additional subsidy, while adding SCO to an 85 percent RP policy would require an additional $1.47/acre in premium subsidies.

Figure 2 provides estimates of additional subsidy costs associated with SCO compared with three different alternative policies: RP at the 75, 80, and 85 percent coverage levels. These comparison policies were chosen because the RP program is one of the most popular among farmers in the Midwest, where farmers also prefer higher coverage levels (Schnitkey and Sherrick, 2014). Note that the baseline policy, or current insurance choice of the farmer, may limit the alternative SCO combinations considered to those which involve reducing or holding constant the coverage level on their individual plan of insurance. For example, for a farmer currently choosing RP at 75 percent, combinations of SCO with an individual plan at coverage above 75 percent are not illustrated in the figure.

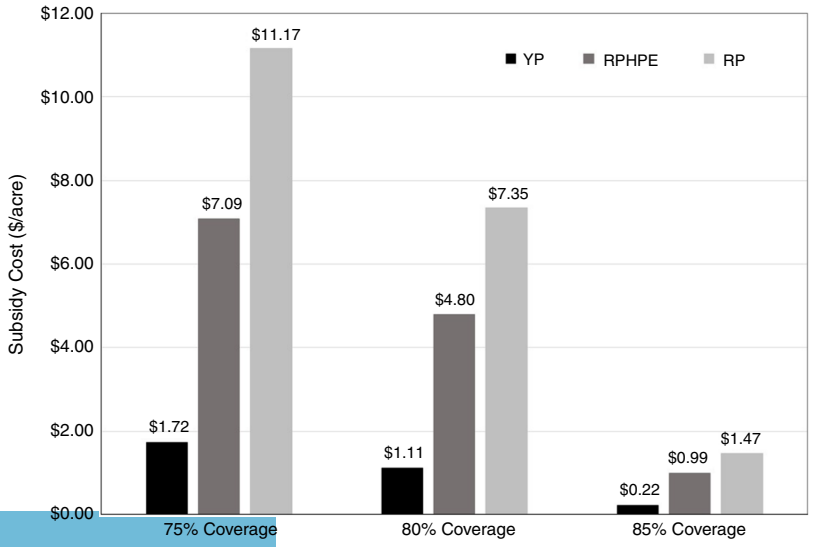

Figure 1.
Additional subsidy cost of SCO when added to an underlying individual plan for a representative corn farm

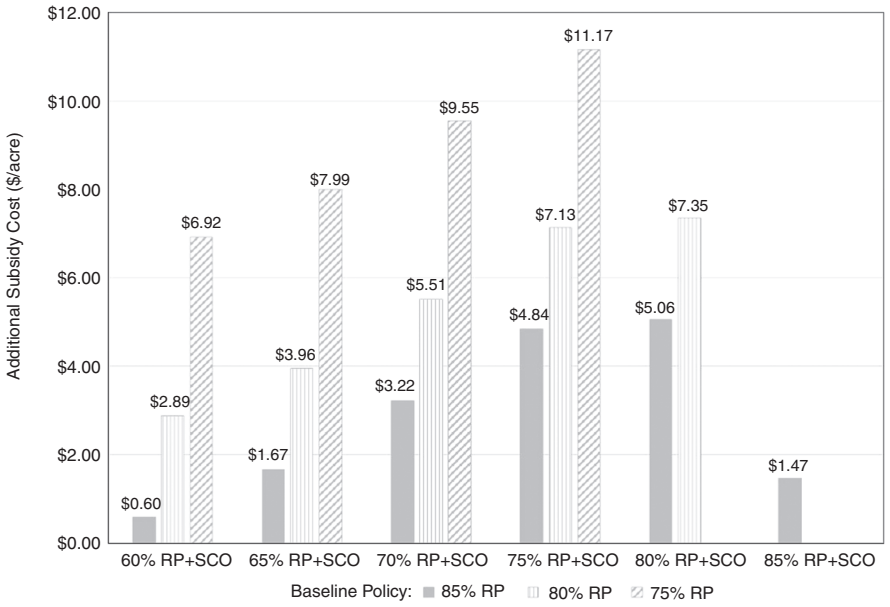

Figure 2. Additional subsidy cost of SCO and an individual plan compared to a baseline insurance plan for a representative corn farm

Moving from an 85 percent RP policy to a 65 percent RP policy with SCO is estimated to increase subsidy costs by $1.67/acre. Moving from an 85 percent RP policy to an 80 percent RP policy with SCO would increase subsidy costs by about $5/acre. Note that both of these examples involve buying-down individual coverage and supplementing back up to 86 percent coverage with SCO, albeit via a county-based trigger. Furthermore, the latter case, moving from 80 to 85 percent RP with SCO, is the result which was illustrated for the representative corn farmer with a moderate risk aversion level (CRRA = 4) in Tables III and IV.

The coverage band and liability associated with the SCO policy increases as the coverage level on the individual policy declines. Therefore, the subsidy cost of the SCO portion will also increase as individual coverage is reduced. However, the subsidy cost associated with the underlying individual plan will also decline with its coverage level. The largest estimate of additional subsidy costs pictured in Figure 2 involve moving from an underlying RP plan to a 75 percent RP policy with SCO. Additional subsidy costs associated with this change in coverage range from nearly $7/acre when originally buying 60 percent RP to more than $11/acre when originally buying 75 percent RP. Note that the 80 percent coverage level (and below) is where the subsidy rate begins to exceed the 65 percent subsidy rate on SCO. Thus, producers who attempt to maximize expected revenues by seeking the greatest amount of premium subsidy will tend to reduce individual coverage to 80 percent or lower, and purchase SCO to supplement that individual coverage.

The estimates in Figures 1 and 2 show that with the introduction of SCO, additional subsidy costs associated with an individual producer could exceed $11/acre depending on how the individual farmer's insurance choices are impacted. To put these estimates in perspective, the subsidy amounts for 75, 80, and 85 percent RP policies implied in our model are $8.68, $13.15, and $16.63/acre, respectively. Thus, the introduction of SCO could increase subsidy costs by more than 100 percent if the producer is currently

purchasing 75 percent RP, and chooses to add SCO coverage. These should be compared with the estimates of additional expected utility benefits which, at most, slightly exceeded 5 percent in the scenarios examined in this analysis.

Discussion and conclusions

Using a simple simulation framework, we model a farmer's insurance program choice to evaluate the risk management benefits of introducing the SCO to the menu of available insurance products. To focus on the impact of SCO on expected utility, we limit our analysis to a single crop, providing results for a representative corn farmer with expected yield and yield variability levels typically observed in Central Illinois. While this is a highly stylized case, we did examine a range of other parameter values for different crop yield and yield variability levels which yielded qualitatively similar results. We do, however, acknowledge that the interpretation of our results could change with alternative modeling techniques such as those which consider alternative distributional assumptions, multiple crops, multiple crop years, or even different approaches to yield distributions and modeling the correlation structure of yields and prices. We leave these as potential useful extensions to our analysis.

With these caveats in mind, our findings suggest that farmers may realize additional benefits by adding SCO to their underlying individual insurance coverage. These benefits will include both subsidy (expected revenue) and risk reduction effects. Since the subsidy rate on SCO of 65 percent is higher than the subsidy rates on existing individual plans toward the higher end of the available range of coverage levels, farmers should be able to increase expected revenues by adding SCO coverage. In some cases, this could encourage farmers to buy-down or reduce their individual coverage levels slightly to maximize subsidy or expected revenue benefits, especially for less risk averse farmers.

However, the additional utility gains offered by the introduction of SCO seem relatively small. When 85 percent individual coverage is available, we find a less than 1 percent additional increase in expected utility when SCO is made available across all levels of risk aversion. Furthermore, when crop insurance subsidies are removed the gains in expected utility are further reduced, showing that the risk reduction benefits are an even smaller portion of the modest overall gains in expected utility. We do find that expected utility gains may exceed 5 percent compared to those achieved by existing insurance programs if a risk averse farmer is located in an area where the maximum coverage level available on individual plans is just 75 percent. In this case, SCO does create an opportunity to increase insurance coverage even if it is based on a county-level loss trigger.

Using RMA's (2015) Summary of Business data, actual uptake of SCO seems to support the results illustrated in this analysis. Liability associated with the SCO portion of coverage was less than 0.1 percent of total liability associated with YP, RP, and RPHPE policies for corn and soybeans. On a total policy basis, SCO was used with 5-6 percent of total RP and RPHPE policies for corn and soybeans. For wheat, where maximum available coverage levels are much lower in a larger percentage of counties, SCO represents 0.9 percent of total liability and was combined with more than 13 percent of the RP and RPHPE policies for wheat. However, the relatively low uptake of SCO for corn and soybeans can also be explained by the majority of base acreage of those crops being enrolled in the ARC commodity program and thus ineligible for SCO. Base acreages of wheat was split fairly evenly among the ARC and PLC programs, making a higher percentage wheat acreage eligible for SCO. More evidence of this can be seen on rice acreage, where virtually all base was enrolled in PLC, as SCO represents over

5.5 percent of the liability and more than 34.5 percent of the RP and RPHPE policies for rice in 2015. Further analysis of the various factors behind actual use of SCO is needed.

Finally, we also examine the potential increase in subsidy costs that may be associated with the introduction of SCO. The size of additional subsidy costs in our model varies from less than $1/acre to more than $11/acre depending on the impact that SCO has on the individual farmer's insurance plan choices. In relative terms these represent the potential for a more than 100 percent increase in crop insurance premiums going to any individual farmer. Again, the potential cost increases seem large relative to the estimated utility gains which were, at most, just over 5 percent more than what is already achieved given existing insurance programs and subsidy levels.

Notes

1. We ignore the linkages between commodity program choice and SCO eligibility in this analysis because our objective was to isolate the additional risk management benefits offered by SCO given the individual plans of insurance already available to farmers. This does not suggest that the linkage between commodity program choice and SCO eligibility was not an important factor in the decision-making process.
2. For our purposes, COMBO products refer to the individual insurance plans which can be coupled with SCO coverage. These include yield protection (YP), revenue protection (RP), and revenue protection with the harvest price exclusion (RPHPE).
3. A number of studies in the literature on fitting parametric distributions to crop yields for insurance applications have examined the Weibull distribution and justified its use for insurance applications, particularly for corn and soybean yields in Illinois (Sherrick *et al.*, 2004, 2014; Lu *et al.*, 2008).
4. The fixed basis is applied to the futures price in the model to determine the price received by the farmer for the physical crop produced. Basis does not impact the value of insurance program payments.
5. In practice, SCO is not available to be coupled with an underlying area plan. Thus, SCO can only be combined with the individual plans of insurance – YP, RP, and RPHPE – in our analysis.
6. A range of crop yields and yield standard deviations for corn, soybeans, and wheat were also examined, all providing qualitatively similar results to the specific case presented in this analysis.
7. Note that this is expected shift in insurance program preference illustrated in the scenario where the max insurance coverage is available across the range of risk aversion levels considered (Table XI), moving from 75 percent RP to 75 percent RP with SCO.

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Further reading

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