Evaluating the Marginal Risk Management Benefits of the Supplemental Coverage Option

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The 2014 Farm Bill has 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.

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. 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 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 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 focuses on the results from a stylized farm-level example of corn production in the Midwest. Future work will expand upon these findings, but the results are not expected to

change from a qualitative perspective. We do 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.

Our initial results indicate a number of other general results. 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 coverage level available of 85%. 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 programs provides producers.

The Supplemental Coverage Option

The Supplemental Coverage Option is an optional insurance program that can be used to supplement the coverage associated with a COMBO product. 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 yield protection; if SCO is coupled with a revenue plan – revenue protection (RP) or revenue protection with the harvest price exclusion (RP-HPE) – SCO provides supplemental revenue protection.

Indemnity payments for SCO are triggered at the county level, and the program provides a fixed coverage level of 86%. Thus, actual county yields/revenues must be below 86% 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. 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% RP plan it would provide supplemental revenue coverage for county revenue losses ranging from 86% to 80% 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:

$$\textbf{SCO County Payment Factor} = \frac{\left[86\% - \frac{\textbf{Actual}\ \text{County Revenue\Yield}}{\textbf{Expected}\ \text{County Revenue\Yield}}\right]}{86\% - \text{Individual Coverage Level}}$$

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

Max SCO Payment = $\left(86\% - \text{Coverage Level}\right)$ x Expected Crop Value,

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

Premiums for SCO are subsidized at a flat rate of 65% 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 of 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, 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.

Using the correlated price and yield draws, distributions of insurance program indemnities are calculated for individual yield and revenue plans, area plans, and SCO. The full ranges of individual coverage levels (ranging from 50% to 85% in 5% increments) and area coverage (ranging from 70% to 90% in 5% increments) is 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. 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 options are then ranked based on the expected level of utility achieved under each.

Table 1 summarizes the parameter values used in the baseline case, which is modeled after a typical farm producing corn in central Illinois, and table 2 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%. Additional parameter scenarios are also examined. These include cases without premium subsidies, and where there is zero correlation between farm and county yields. Additionally, we consider a case where the maximum coverage level available for individual insurance plans is 75% and no area coverage is available. The results for the baseline case and additional scenarios are summarized in the next section.

Results

Table 3a 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. At low risk aversion levels, the area insurance plan at the maximum coverage level is the

most preferred choice. Combinations of individual revenue coverage plus SCO also enter the top of the rankings. At low levels of risk aversion, or for risk-neutral farmers, insurance choice will be driven by a subsidy effect. Area coverage at 90% provides the greatest impacted on expected revenues due to the high rates of subsidization and net expected payments. As risk aversion increases, farmers are predicted to prefer the individual revenue protection at 85% plus SCO. This combination offers the most individual insurance coverage available plus supplemental coverage triggered at the county by adding SCO. Note also, however, that 85% RP is still preferred to SCO combined with individual plans at coverage levels below 80%.

Table 3b reports changes in expected utility relative to the case where crop insurance is not available. The first row is when SCO coverage is also available, while the second row measures the percentage increase in expected utility due to the availability of existing individual and area plans. The expected utility gains are significant, and increasing with the level of risk aversion in general. The addition of SCO does provide additional expected utility gains, but they are relatively small as shown in the third row of table 3b. At the lower end of the range of risk aversion levels considered, adding SCO to the menu of available insurance plans does not increase expected utility to the farmer since the 90% area plan is the preferred program choice. For larger level of risk aversion there are very small additional gains in expected utility. At most, the farmer realizes an additional 1% gain in expected utility due to SCO being made available.

Note that the results summarized in tables 3a and 3b are based on current subsidy rates, so insurance choices and rankings include both expected revenue effects from the subsidies along with a risk reduction effect of the policy used. Tables 4a and 4b report insurance program rankings for the model when all subsidy rates are set to zero. In this case, the risk-neutral farmer is indifferent between buying any of the actuarially fair insurance program or not carrying

insurance while risk averse farmers still realize risk reduction benefits from insurance coverage. 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 marginal gains in expected utility for the case with no premium subsidies are reported in table 4b. The increase in expected utility when SCO is introduced are smaller than those in the case when the insurance programs are subsidized. Here, risk averse farmers still realize large expected utility gains from insurance in general, but the addition of SCO provides less than a 1% additional increase in expected utility compared with existing individual and area coverage options.

Tables 5 and 6 examine cases where farm-level yields are not correlated with county yields. Since SCO is triggered by county losses, the extent to which county and farm yields are correlated should be related to the risk reduction benefits created by SCO. Tables 5a and 5b 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 still prefer the 90% area coverage due to the subsidy effect. However, risk-averse farmers now rank individual coverage above area options, and also prefer to include SCO with individual coverage at a given coverage level. Across risk aversion levels, the maximum coverage level for RP of 85% is preferred along with SCO. The additional utility gains from SCO are even smaller than in the baseline case with yield correlation. While the subsidy effect on expected revenues still leads risk averse farmers to add SCO to their underlying individual plan, the expected utility gains from a risk management perspective are very small.

Tables 6a and 6b report results when there are no crop insurance subsidies, and yields are uncorrelated. Again, since the premiums are actuarially fair, risk-neutral producers are

indifferent across insurance program choices while risk-averse farmers are predicted to prefer high coverage levels on individual plans plus SCO. The additional utility benefits of SCO decline when subsidies are removed as in the baseline case, and are also lower (less than 1%) compared to the scenario where farm and county yields are correlated. Here there is not expected revenue benefit from premium subsidies, and the risk management benefit of SCO is reduced since it is triggered by county losses which are now less correlated with losses at the farm level.

Finally, table 7 reports the expected utility gains when SCO is made available in areas where the maximum coverage level for individual insurance plans is 75%. In this case, the preferred insurance choice for risk-averse farmers is 75% RP when SCO is not available, and shifts to 75% RP with SCO when it is made available. Here, the additional utility gains of SCO are larger, since the additional band of coverage when added to a 75% coverage level is larger than when coupled with an 85% individual coverage level. Additional increases in expected utility range from around 2% at low levels of risk aversion to nearly 10% at more moderate level so risk aversion. These percentage increases in expected utility include both a subsidy or expected revenue effect, as well as a risk reduction effect by adding SCO to the individual plan. Similar to the cases examined without subsidies an yield correlation when 85% coverage is available, the additional expected utility gains of SCO decline when 75% 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 subsidy 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% coverage levels. For a producer who currently carries 75% YP, adding SCO coverage will require an additional $1.00 per acre in premium subsidies. In contrast, adding SCO to an RP policy with a 75% coverage level would imply additional subsidy costs of more than $12.00 per acre. 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% YP would require just $0.17/acre in additional subsidy, while adding SCO to an 85% RP policy would require an additional $1.76/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% 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). Moving from an 85% RP policy to a 65% RP policy with SCO is estimated to increase subsidy costs by $1.30/acre. Moving from an 85% RP policy to an 80% RP policy with SCO would increase subsidy costs by about $5/acre. Note that both of these examples involve the producer reducing individual coverage (often referred to as "buying down") and supplementing back up to an 86% coverage with SCO, albeit via a county-based trigger. The largest estimate of additional subsidy costs involve moving from an underlying RP plan to a 75% RP policy with SCO. Additional subsidy costs associated with this change in coverage range from over $4/acre when originally buying 85% RP to more than $12/acre when originally buying 75% RP. Note that the 75% coverage level (and below) is where the subsidy rate begins to exceed the 65% 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 75% or 80% 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 $12/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% RP policies from our model are $8.68, $13.15, and $16.63 per acre, respectively. Thus, the introduction of SCO could increase subsidy costs by more than 100% if the producer is currently purchasing 75% RP, and chooses to add SCO coverage. These should be compared with the estimates of additional expected utility benefits which, at most, approached 10% 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 Supplemental Coverage Option (SCO) to the menu of available insurance products. Our findings suggest that farmers will be interested in adding SCO to their underlying individual insurance coverage. This desire will be driven by both subsidy (expected revenue) and risk reduction effects. Since the subsidy rate on SCO of 65% is higher than the subsidy rates on existing individual plans towards 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 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% individual coverage is available, we find a less than 1% 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 roughly cut in half, 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 approach 10% compared to those achieved by existing insurance programs if the farmer is located in an area where the maximum coverage level available on individual plans is just 75%. In this case, SCO does create an opportunity to increase insurance coverage even if it based on a county-level loss trigger.

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 per acre to more than $12 per 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% increase in crop insurance premiums going to any individual farmer. The potential cost increases seem large relative to the estimated utility gains which were, at most, 10% more than what is already achieved given existing insurance programs and subsidy levels.

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Tables and Figures

Table 1. Simulation Model Baseline Parameter Values

Parameter	Baseline Value
Expected Farm Yield	180 bu/acre
Farm Yield Standard Deviation	29 bu/acre
Expected County Yield	180 bu/acre
County Yield Standard Deviation	25 bu/acre
Expected Futures Price	$4.62/bu
Price Volatility	19%
Farm Price Basis	($0.30)
Price-yield correlation	-0.50
Farm-county yield correlation	0.75

Table 2. Summary of Crop Insurance Program Subsidy Rates

Coverage Level	Individual Plans (YP, RP, RP-HPE)	Area Plan (ARPI)
50%	80%	n/a
55%	80%	n/a
60%	80%	n/a
65%	80%	n/a
70%	80%	59%
75%	77%	59%
80%	68%	55%
85%	53%	55%
90%	n/a	51%

Note: SCO is only available with Individual Plan coverage and has a flat subsidy rate of 65%.
The maximum risk protection factor of 1.2 is used for ARPI payments

Table 3a. Insurance Choice Rankings - Premium Subsidies and Farm-County Yield Correlation

Rank	Risk Neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
1	90% ARP	90% ARP	90% ARP	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO
2	85% ARP	90% ARPw	80% RP, SCO	80% RP, SCO	80% RP, SCO	85% RPw, SCO	85% RPw, SCO
3	90% ARPw	80% RP, SCO	85% RP, SCO	85% RP	85% RPw, SCO	80% RP, SCO	85% RP
4	80% RP, SCO	75% RP, SCO	90% ARPw	85% RPw, SCO	85% RP	85% RP	80% RP, SCO
5	75% RP, SCO	85% RP, SCO	85% RP	80% RPw, SCO	85% RPw	85% RPw	85% RPw

Table 3b. Percentage Change in Expected Utility When Crop Insurance is Available

	Risk Neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
With SCO	4.37%	5.43%	20.68%	45.08%	73.34%	92.24%	98.56%
Without SCO	4.37%	5.43%	20.68%	44.00%	72.52%	91.90%	98.47%
Difference	0.00%	0.00%	0.00%	1.08%	0.82%	0.34%	0.08%

Table 4a. Insurance Choice Rankings - No Subsidies and Farm-County Yield Correlation

Rank	Risk Neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
1	N/A	85% RPw, SCO	85% RPw, SCO	85% RPw, SCO	85% RPw, SCO	85% RPw, SCO	85% RPw, SCO
2	N/A	85% RPw	85% RPw	85% RPw	85% RPw	85% RPw	85% RPw
3	N/A	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO
4	N/A	85% RP	85% RP	85% RP	85% RP	85% RP	85% RP
5	N/A	80% RPw, SCO	80% RPw, SCO	80% RPw, SCO	80% RPw, SCO	80% RPw, SCO	80% RPw, SCO

Table 4b. Percentage Change in Expected Utility When Crop Insurance is Available

	Risk Neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
With SCO	0.00%	1.93%	13.44%	35.63%	62.79%	84.28%	95.09%
Without SCO	0.00%	1.85%	13.07%	34.98%	62.12%	83.86%	94.90%
Difference	0.000%	0.071%	0.369%	0.656%	0.667%	0.423%	0.181%

Table 5a. Insurance Choice Rankings, Baseline Case - Premium Subsidies and Independent Yields

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

Table 5b. Percentage Change in Expected Utility When Crop Insurance is Available

	Risk Neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
With SCO	4.35%	5.96%	28.87%	60.78%	86.36%	97.11%	99.56%
Without SCO	4.35%	5.73%	28.28%	60.19%	86.04%	97.02%	99.55%
Difference	0.000%	0.230%	0.584%	0.593%	0.313%	0.091%	0.018%

Table 6a. Insurance Choice Rankings, Baseline Case - No Subsidies and Independent Yields

Rank	Risk Neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
1	N/A	85% RPw, SCO	85% RPw, SCO	85% RPw, SCO	85% RPw, SCO	85% RPw, SCO	85% RPw, SCO
2	N/A	85% RPw	85% RPw	85% RPw	85% RPw	85% RPw	85% RPw
3	N/A	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO	85% RP, SCO
4	N/A	85% RP	85% RP	85% RP	85% RP	85% RP	85% RP
5	N/A	80% RPw, SCO	80% RPw, SCO	80% RPw, SCO	80% RPw, SCO	80% RPw, SCO	80% RPw, SCO

Table 6b. Percentage Change in Expected Utility When Crop Insurance is Available

	Risk Neutral	CRRA = 2	CRRA = 4	CRRA = 6	CRRA = 8	CRRA = 10	CRRA = 12
With SCO	0.00%	3.24%	22.44%	55.34%	84.24%	96.62%	99.47%
Without SCO	0.00%	3.21%	22.22%	55.06%	84.07%	96.56%	99.46%
Difference	0.000%	0.029%	0.217%	0.286%	0.171%	0.053%	0.011%

Table 7. Percentage Change in Expected Utility When Crop Insurance is Available, Max Individual Coverage Level of 75%

	Risk Neutral	**CRRA = 2**	**CRRA = 4**	**CRRA = 6**	**CRRA = 8**	**CRRA = 10**	**CRRA = 12**
With SCO	2.77%	4.36%	19.15%	42.74%	70.86%	90.95%	98.17%
Without SCO	1.13%	2.31%	12.41%	32.91%	62.55%	87.14%	97.13%
Difference	1.64%	2.05%	6.74%	9.83%	8.31%	3.81%	1.05%

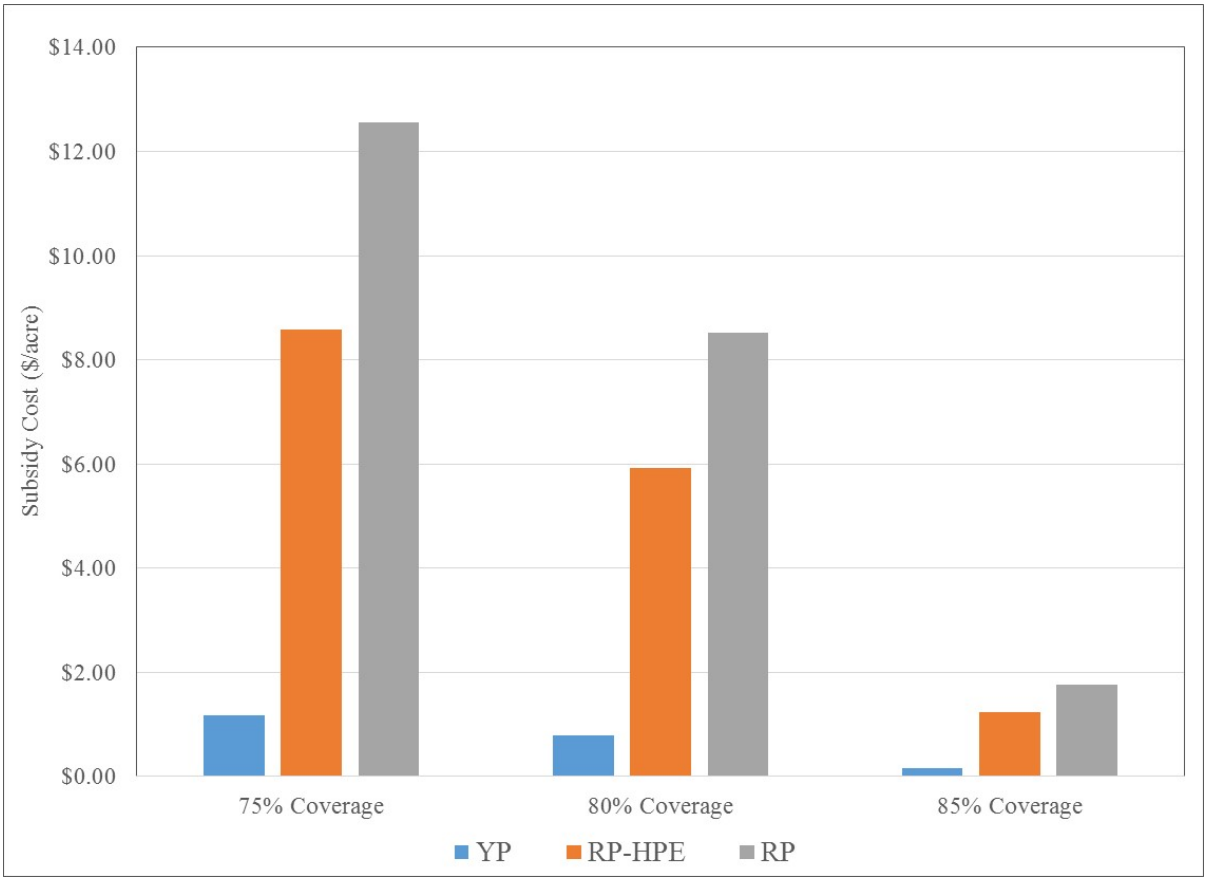

Figure 1. Additional Subsidy Cost of SCO When Added to an Underlying Individual Plan

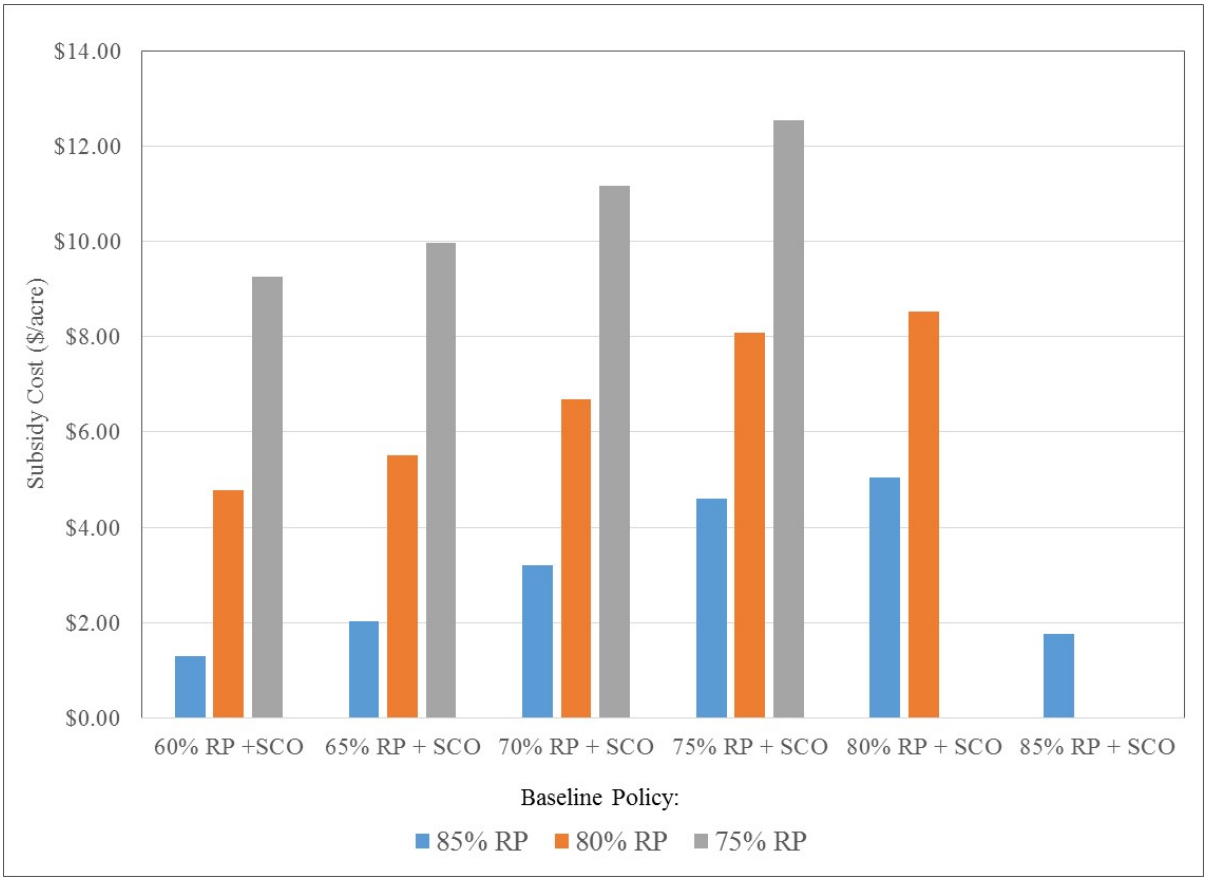

Figure 2. Additional Subsidy Cost of SCO and an Individual Plan Compared to a Baseline Insurance Plan