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January 2016

The 2014 Farm Act Agriculture Risk Coverage, Price Loss Coverage, and Supplemental Coverage Option Programs' Effects on Crop Revenue

Erik J. O’Donoghue, Ashley E. Hungerford, Joseph C. Cooper, Thomas Worth, and Mark Ash

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Abstract

The 2014 Farm Act provides eligible U.S. farmers with new commodity supports in the Agriculture Risk Coverage (ARC), the Price Loss Coverage (PLC), and the Supplemental Coverage Option (SCO) programs. These programs help producers with revenue losses generally not covered by traditional crop insurance policies. Interactions, both among these programs and between these programs and the Federal Crop Insurance (FCI) program, determine the nature and magnitude of support available to producers. This report provides an analysis of these programs with a focus on how various combinations of the programs impact producer revenue and its variability, producer well-being, and expected program costs. The report finds that these programs' effectiveness are influenced by historical prices, expected prices, and FCI coverage rates. High historic crop prices combined with low expected prices since the enactment of the 2014 Farm Act led to higher enrollment of producers in the ARC program in 2015 relative to that in the SCO program.

Keywords: 2014 Farm Act, Agriculture Risk Coverage, crop insurance, crop revenue, Supplemental Coverage Option

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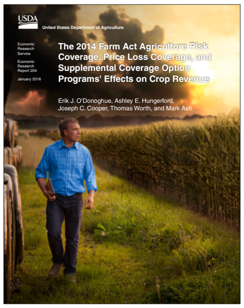

Find the full report at *www.ers.usda.gov/publications/err-economic-research-report/err204*

The 2014 Farm Act Agriculture Risk Coverage, Price Loss Coverage, and Supplemental Coverage Option Programs' Effects on Crop Revenue

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What Is the Issue?

The structure of U.S. agricultural commodity support changed significantly under the 2014 Farm Act. The new programs—in particular, Price Loss Coverage (PLC), Supplemental Coverage Option (SCO), and Agriculture Risk Coverage (ARC)—have linkages with each other and with the pre-existing Federal Crop Insurance (FCI) program. (In this report, the term "ARC" refers to the most popular version of ARC (ARC-County), which is an area-based, rather than individual-based, commodity program.) While PLC builds on the old Countercyclical Payment program, SCO and ARC are known as "shallow loss" programs, covering losses typically not covered by the "deep loss" FCI program. Understanding these new programs and how the available combinations of programs can affect crop revenue provides information on agricultural producers' enrollment decisions, the programs' impact on producers' risk and revenues, and expected program costs.

What Did the Study Find?

Interactions, both among these programs and the Federal Crop Insurance (FCI) program are complex. The mandatory decision producers had to make to elect either the Agriculture Risk Coverage or Price Loss Coverage programs will last for the duration of the Farm Act and has implications for how they can use crop insurance. For example, if a producer elects ARC, the producer cannot use SCO, a crop insurance policy. If the producer instead elects PLC, the producer can enroll in SCO, which then takes on the traits of the (required) underlying policy it supplements—which can have implications for the type and coverage level of the underlying crop insurance policy that a producer chooses to enroll in.

At first glance, the two major "shallow loss" programs for field crops, ARC and SCO, appear similar. However, like the benefits from the Direct and Countercyclical Program that was repealed with the 2014 Farm Act, ARC payments are not influenced by current production. In contrast, the size of the SCO payments are linked to the expected crop production of the farm for the current year.

Moreover, the ARC program has a "memory" for prices—it relies on historic prices to calculate the potential benefits for the producer. In contrast, the SCO guarantee depends on the higher

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

of the expected prices at planting time (also known as the futures price) or the realized harvest time price. Therefore, while ARC provides benefits that depend on past outcomes, which helps to smooth payments over time, SCO provides intra-year benefits, comparing expected returns at planting time with the actual returns realized at harvest time.

Assuming the futures prices are "close" to the eventual realized prices, these expected prices also matter for the benefits a producer receives from these programs. ERS research results suggest that in an environment with lower expected prices, the Agriculture Risk Coverage program helps to minimize the largest potential losses the most (in other words, ARC helps to increase the lower bound of expected revenues more than SCO would in an environment with low expected prices). In an environment with higher expected prices, the reverse is true and the Supplemental Coverage Option policy helps to minimize a producer's largest potential losses the most.

When producers had to make their decision to elect either ARC or PLC, historic commodity prices had been high while expected commodity prices for the upcoming crop year were low. Likely due to the differences in how the Agriculture Risk Coverage and Supplemental Coverage Option programs work with respect to both high historic prices and low expected commodity prices, producers overwhelmingly elected ARC instead of the Price Loss Coverage program (and hence over SCO). According to USDA's Farm Service Agency, producers elected ARC for 91 percent of corn base acres and 96 percent of soybean base acres. While almost all corn and soybean producers elected ARC, more than one in three wheat base acres were covered with PLC—and hence were eligible for enrollment in the SCO program. Compared to ARC, SCO appears to provide higher benefits for winter wheat, providing slightly higher average revenues while generating similar potential low-end losses as the ARC program, which could help explain why a significant portion of wheat producers made different choices than corn and soybean producers.

How Was the Study Conducted?

The analysis translates 2014 Farm Act terms into quantitative functions. Because no data exist for these programs—since they have only recently been enacted into law—ERS researchers used a model to simulate revenue outcomes for a representative (typical) producer for each county that produced corn, soybeans, and wheat. This model was used to generate distributions of simulated crop prices and yields, centered on their expected values at planting time in 2014.

For each crop, nonparametric county-level yield distributions are generated for each county for which USDA's National Agricultural Statistics Service (NASS) has reported data each year from 1975 through 2013. This amounted to 1,001 counties for corn, 889 counties for soybeans, and 510 counties for wheat. The price distribution is also generated non-parametrically, based on planting time and harvest time futures prices over the same period.

The analysis maintains the historical correlations of yields across all counties and between the county yields and prices using an empirical approach that helps describe the historic relationships between the two variables. The yield distribution for a typical (representative) farmer in each county is generated by inflating the county-level yield variability based on farm yield information implicit in actual crop insurance premium rates for each county.

The model makes 10,000 draws from each county and farm yield distribution as well as from the price distribution. Payments, net revenue, and total revenue (net revenue plus the payments) are then calculated for each of the 10,000 price and yield pairs to generate distributions for each of these variables, providing researchers with the data used in the analysis.

The 2014 Farm Act Agriculture Risk Coverage, Price Loss Coverage, and Supplemental Coverage Option Programs' Effects on Crop Revenue

Introduction

Crop revenue is subject to both price risk and yield risk. Price risk is a systemic risk in the sense that it is correlated among farmers (e.g., Miranda and Glauber, 1997; Cooper, 2009; USDA/ERS, 2014a). Since price is determined by domestic production, stocks, and trade, as well as demand factors, no one farmer controls price. Therefore, all farmers receive the same price for the same commodity (after adjusting for arbitrage), making price strongly correlated across farmers. Yield risk has both systemic and idiosyncratic components (Miranda, 1991). The main source of systemic risk in yields is weather. Droughts, in particular, have proven to be a major cause of systemic losses, such as the 2012 drought in the Corn Belt (USDA/RMA, 2014d). By definition, idiosyncratic risk is uncorrelated across farmers and has a variety of causes. Furthermore, prices and yields can be correlated at the farm level and can vary across farms while producer financial-risk profiles differ, which can affect producers' willingness to take on price and yield risk. The 2014 Farm Act enacted various programs to help producers reduce the risks they face.

The 2014 Farm Act includes several new farm programs such as the Price Loss Coverage (PLC), the Agriculture Risk Coverage (ARC), and the Supplemental Coverage Option (SCO). The first two, PLC and ARC, replace the repealed Direct Payments (DPs), Counter-cyclical Payments (CCPs), and Average Crop Revenue Election (ACRE) programs found in the commodities title (Title I) of the 2008 Farm Act. ARC and PLC are administered by the U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA). The SCO policy is a new entrant into the crop insurance title (Title XI), managed by USDA's Risk Management Agency (RMA).

This report focuses on three of the new programs—ARC, PLC, and SCO. ARC and SCO are colloquially known as "shallow loss" programs because they address the smaller revenue losses typically not covered under traditional Federal crop insurance policies (policies that cover the "deep losses" potentially felt by producers). Each of these programs affects agricultural risk exposure, but does so in different ways. Moreover, these new programs interact with each other. For example, producers can elect to enroll in ARC or PLC, but not both. If the producer elects ARC, that producer is no longer eligible to enroll in SCO. Further eligibility constraints and interactions exist. However, the empirical differences between the revenue support provided by SCO and ARC remain unexplored.

This study provides a novel graphical approach to provide the intuition behind the mechanics of how payments differ among these programs. In addition, we use a new advanced statistical approach to empirically examine the impacts of these programs on crop revenue, with particular emphasis on the extent to which they can reduce the farmer's downside revenue risk. This empirical analysis examines the impacts of these programs on crop revenue both as standalone programs (even when not available as such) as well as in conjunction with traditional Federal crop insurance. The analysis summarizes the empirical results across all counties for which USDA reports yields and for several individual representative farms from low-, medium-, and high-risk areas of production that allow us to explore differences in the potential ranges of impacts given historic distributions of prices and yields and recent planting time prices and expected yields. The analysis covers the major field crops corn, soybeans, and winter wheat. The results have implications for other eligible crops as well.

2014 Farm Act Programs

Several major new programs were introduced in the 2014 Farm Act. After a brief overview of the new programs, we illustrate how they operate, using a county-level example of soybeans.[1]

- ARC provides either individual- or area-based revenue protection without requiring a premium. Payments are paid out to either 85 percent (in the case of area-based) or 65 percent (in the individual-based selection) of base acres. The ARC guarantee is based on an Olympic average (average of the last 5 years, dropping the highest and lowest values) of market-year average prices and yields. Payments begin when realized revenues fall below 86 percent of expected revenues and cover up to 10 percent of the benchmark (expected) revenue.

- SCO provides area-based revenue protection as part of the crop insurance program. Producers pay a premium subsidized at the 65-percent level. The SCO guarantee is based on futures prices and expected yields. SCO supplements the underlying policy in place. SCO payments begin when realized revenues fall below 86 percent of expected revenues and cover up to the level of insurance selected by the producer for the underlying policy.

- PLC provides a price floor for producers, helping mitigate downside price risk.

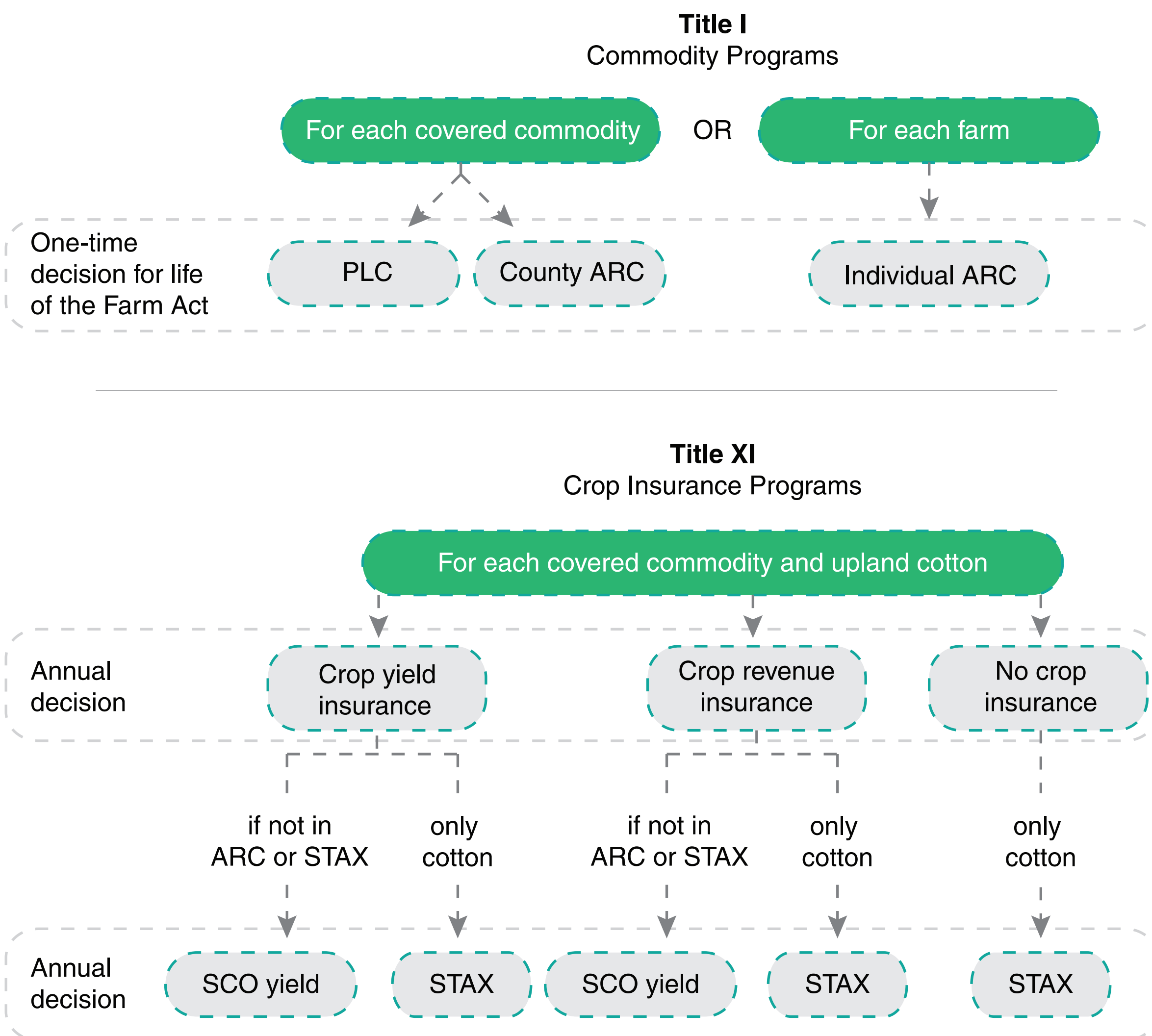
To minimize overlap between these new programs, growers cannot simultaneously elect ARC and PLC for the same crop on the same farm, nor can a producer elect ARC and enroll in SCO for the same crop and farm. However, electing PLC and enrolling in SCO is allowed. Furthermore, once the election for either ARC or PLC is made, the producer is committed to this choice for the duration of the Farm Act (see box, “Producers’ Choices”).

The payments producers receive depend on prices, yields, and the combination of programs enrolled in. The mechanics behind the various programs is explored, followed by a statistical analysis, to provide a basis for understanding how the payment mechanisms work. The basic payment mechanisms are the same across all covered crops. For the sake of brevity, the numerical discussion in this section focuses on just soybeans. For the numerical illustrations, an average soybean producer from Linn County, IA, is used, assuming that this soybean producer has yields identical to those of the county (since the programs are county-based programs).

Based on actual yields and prices, the expected yield for a typical soybean producer in Linn County, IA, in 2014 is 50 bushels per acre (bu/acre), the Olympic-average yield is also 50 bu/acre, the 5-year Olympic-average price is $12.27 per bushel, and a base insurance price—the average of the daily February (planting month) prices of the November (futures harvest month) Chicago Board of Trade (CBOT) soybean futures contract—is $11.36 per bushel (USDA/RMA, 2014a; USDA/RMA, 2014f).

[1]The Stacked Income Protection Plan (STAX) is also new in the 2014 Farm Act, but because it is exclusively for upland cotton producers, we do not cover it in this report.

Producers' Choices



PLC = Price Loss Coverage, which provides benefits to producers with base acres of wheat, feed grains, rice, oilseeds, peanuts, and pulses (covered commodities) on a commodity-by-commodity basis when market prices drop below the reference price.
ARC = Agriculture Risk Coverage, which provides benefits to producers of covered commodities at either the county or individual level. The most popular election, county-based ARC, operates on a commodity-by-commodity basis and provides support when county crop revenue drops below 86 percent of the county benchmark revenue. In the individual ARC case, payments are issued when the actual individual crop revenues, summed across all covered commodities on the farm, are less than the ARC individual guarantee.
SCO = Supplemental Coverage Option, which offers producers additional area-based insurance coverage in combination with coverage by traditional crop insurance policies, also beginning with the 2015 crop year.
STAX = Stacked Income Protection Plan, which provides revenue insurance policies to producers of upland cotton beginning with the 2015 crop and operates as either a stand-alone policy or in conjunction with an underlying crop insurance policy.
Source: USDA, Economic Research Service.

Agriculture Risk Coverage (ARC)

The ARC program is a revenue-based program in which producers do not need to pay a premium to participate (USDA/FSA, 2014). Similar to the Direct and Countercyclical Program that was repealed in the 2014 Farm Act, the benefits producers receive from the ARC program do not depend on current production outcomes. While producers can enroll in either individual- or county-level coverage, FSA election statistics show that very few participants elected individual-level coverage. Therefore, hereafter in this report, the term "ARC" will refer to "ARC-County," the heavily favored area-based version of ARC.[2] Producers electing ARC can enroll on a crop-by-crop basis, and the payments they receive are based on 85 percent of their farm's base (historic) acres.

The ARC payment calculation centers around the benchmark revenue, a revenue guarantee based on the expected per-acre county revenue. This revenue guarantee can change from year to year because historic national prices and county yields are used to generate the benchmark revenue (USDA/FSA, 2015). For the Linn County, IA, soybean example, the benchmark revenue comes to $613.50 per acre.

The ARC program provides support when area revenue drops below 86 percent of the expected (benchmark) revenue. This support is called the ARC guarantee. The program provides support up to 10 percent of the benchmark (or $61.35 per acre) and is only provided for 85 percent of historic (base) acres. So the maximum level of support for Linn County, IA, comes to roughly $52 per base acre. The per-acre county-ARC payment can be expressed as:

Agriculture Risk Coverage-County (ARC-CO) Per-Acre Payment

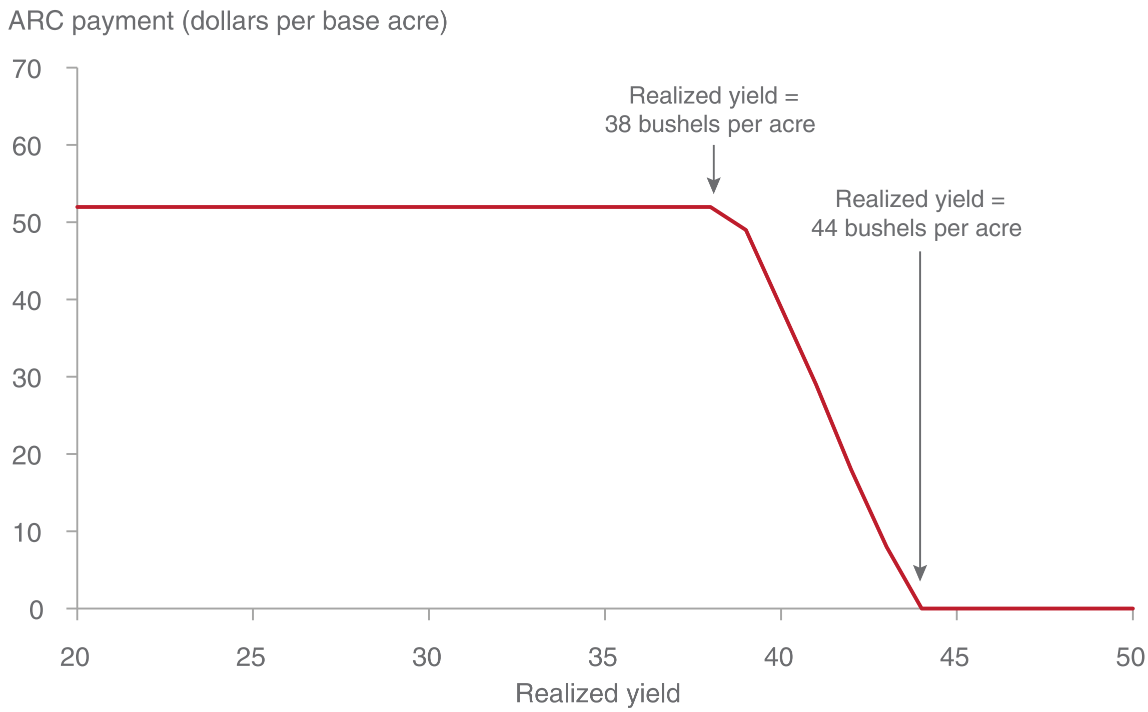
ARC guarantee = 0.86*benchmark revenue
Diff = ARC guarantee – realized revenue
Max = 10 percent of benchmark revenue

if Diff ≤ 0	**if Diff > 0 and**	
	if Diff ≤ Max	**if Diff > Max**
then	then	then
Payment = 0	Payment = Diff*0.85	Payment = Max*0.85

Figure 1 shows how ARC payment rates vary for a realized price of $12 per bushel. The maximum level of support ($52 per base acre) is provided up until the realized yield of 38 bushels per acre. After that, support drops until it hits zero at a realized yield of 44 bushels per acre. Given the 86-percent coverage rate and the maximum payment being 10 percent of benchmark revenue, ARC effectively covers (at the area level) realized revenue losses between 76 and 86 percent of the benchmark revenue.

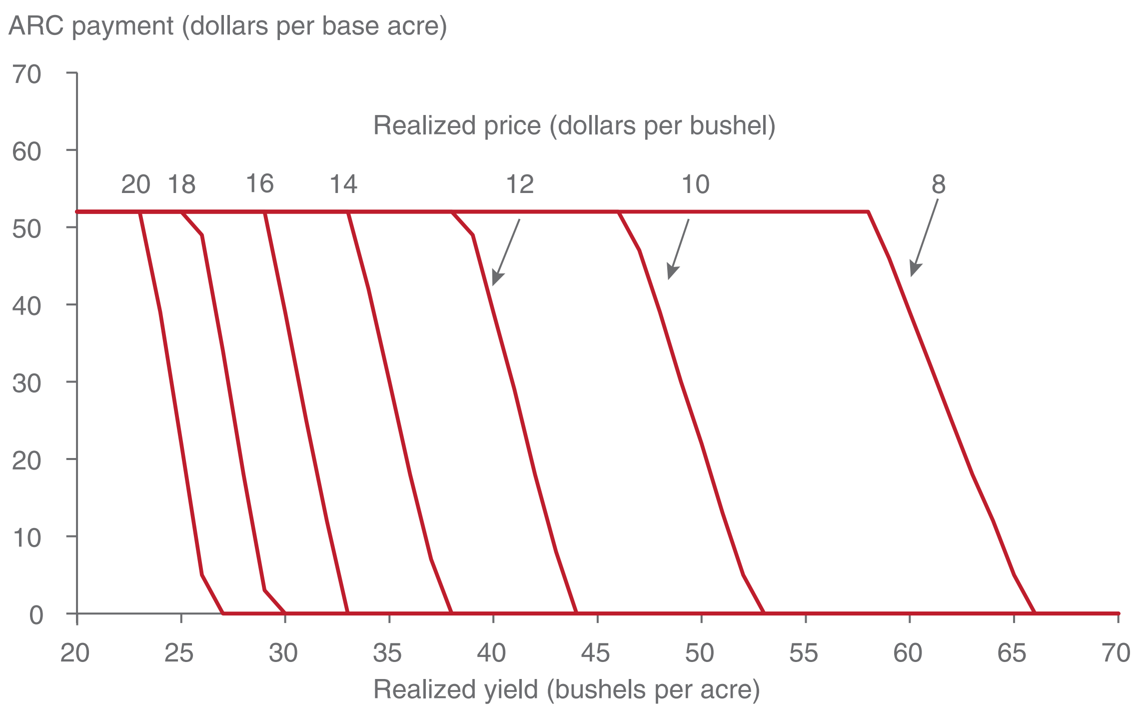
[2]Ninety-six percent of soybean, 91 percent of corn, and 66 percent of wheat farmers elected county-level ARC. For more information concerning program election results, see USDA's Farm Service Agency (FSA) website, http://www.fsa.usda.gov/programs-and-services/arcplc_program/. For more information on the specifics of the ARC program, including details of the individual-level ARC program, see the specific link on the USDA/FSA website, http://www.fsa.usda.gov/Internet/FSA_File/base_acre_reallocate_arc_plc.pdf/.

Figure 1
ARC payment rates vary by realized yield for a realized price of $12 per bushel



ARC = Agriculture Risk Coverage program.
Source: USDA, Economic Research Service.

Figure 2
ARC payment rates vary as realized prices vary



ARC = Agriculture Risk Coverage program.
Source: USDA, Economic Research Service.

Different realized prices generate different payment schedules (fig. 2). Note that for a given expected yield and price, the highest level of support does not change (since it remains constant at 10 percent of the fixed benchmark). As realized prices drop, the maximum level of support is provided for a wider range of yields and vice versa.

Supplemental Coverage Option (SCO)

While ARC is a commodity program, the SCO program works as a crop insurance policy, relying on the underlying individual-level policy to determine the characteristics of support (USDA/RMA, 2014d; USDA/RMA, 2014b). Enrollment requires the farmer to pay a premium, and the SCO policy takes the basic traits of the underlying policy selected by the producer—being either yield or revenue based—and extends it (generally) as a county-based program. For example, if a producer who enrolled in a crop insurance yield protection plan also enrolled in SCO, the producer would receive additional yield protection coverage at the county level. If the producer had a revenue protection policy instead, the SCO would provide additional county-level revenue protection coverage (USDA/RMA, 2014d).

For this report, we assume a revenue-based underlying individual insurance policy with upward price protection (revenue protection, or RP) at a coverage level of 75 percent (the most common policy purchased by producers). With an underlying RP policy, the SCO expected area revenue consists of the higher of the base insurance price and the harvest time price multiplied by the expected yield.[3] With the base insurance price (the 2014 futures price) of $11.36 per bushel and a harvest price below the base insurance price, this comes to an expected per-acre revenue of almost $570. As with the ARC program, area losses between 100 and 86 percent of expected revenue are not covered.

The amount of coverage offered by SCO depends on the coverage level selected for the underlying insurance policy—SCO covers, at the area level, from 86 percent of expected county revenues down to the level of coverage of the underlying insurance policy. For example, if a producer took out an RP policy with a coverage level of 80 percent and supplemented with an SCO policy, the SCO policy would cover—at the area level—from 86 percent of expected revenues down to 80 percent. Losses below 80 percent would then be covered by the individual-level RP policy. If, instead, the producer purchased an RP policy with 70-percent coverage supplemented with SCO, the SCO policy would cover from 86 percent down to 70 percent of expected revenues, again at the area level.

Formally, the SCO payment per acre can be expressed as:

SCO/acre =

$$min\left[max\left\{\frac{\left(0.86-\frac{Final\ Area\ Rev}{E\left(Area\ Rev\right)}\right)}{\left(0.86-Cov.level\right)},0\right\},1\right]*E\left(Farm\ Rev\ per\ acre\right)*\left(0.86-Cov.level\right)-Premium\ per\ acre,$$

where *Rev* denotes "revenue", *E*(.) denotes the expected value of the variable inside the parentheses, and *Cov.* denotes "coverage." The formula in the inner curly brackets is the "revenue payment

[3]The same expected yield is used here as in the ARC example (50 bu/acre). However, it is possible that the expected area yields for SCO and ARC may differ since FSA and RMA use different methodologies to calculate them.

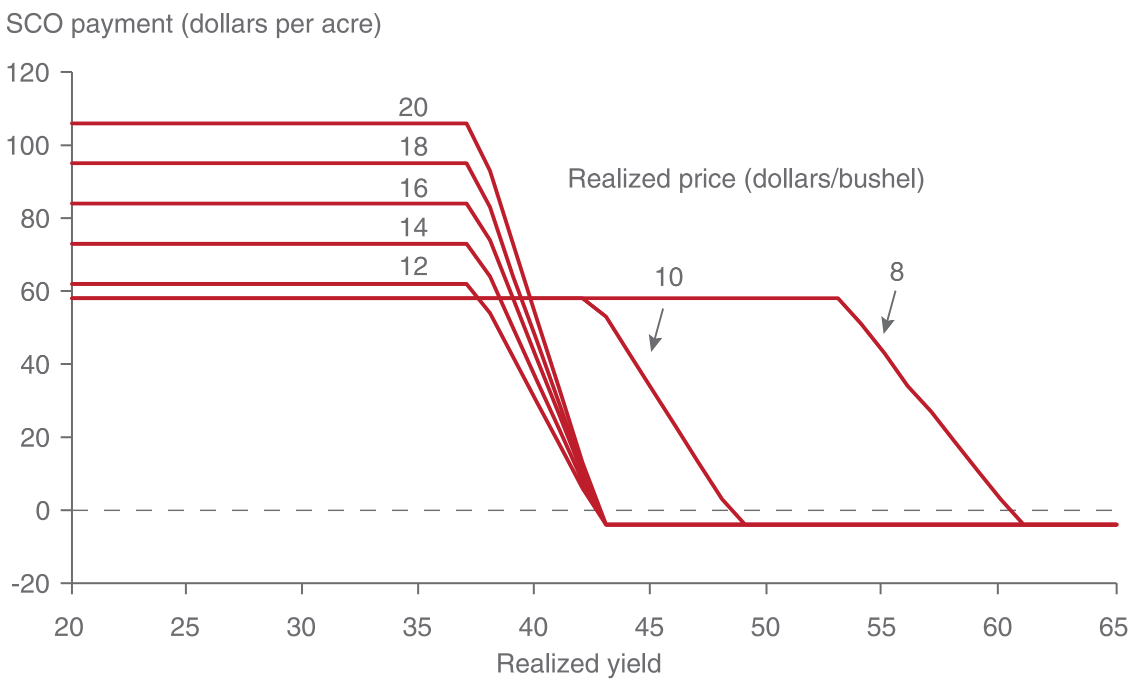
factor," and to the right of the square brackets, *E*(*Farm Rev per acre*) * (0.86 - *Cov.level*) is the "supplemental protection," to use the RMA terminology.

Similar to ARC payment rates, SCO payment rates vary by the realized price. However, the upward price protection embodied in the underlying RP policy causes the relationship between realized prices, yields, and support rates to differ from those of ARC (fig. 3). The payments in figure 3 are net of the farmer-paid SCO premium, derived from the simulation model. (The model is discussed in more detail later).[4] For simplicity, the figures (but not the simulation analysis in the next section) assume that the expected yield is the same at the farm and area level.

For realized prices below the base insurance price (here $8/bu and $10/bu), the SCO payment rates look very similar to those of the ARC program. They both have a maximum level of payment (in our example, $58 per planted acre) that spans over a wide range of realized yields, which widens as the prices drop. The net payment to the producer is negative (in this case, the policy costs $4 per acre) when yields and/or prices are sufficiently high enough that they do not trigger SCO benefits since the producer must pay a premium to obtain SCO coverage.

Because the SCO program takes on the traits of the underlying crop insurance policy (in our example, RP), this means that producers are also insured against a loss of revenue due to price

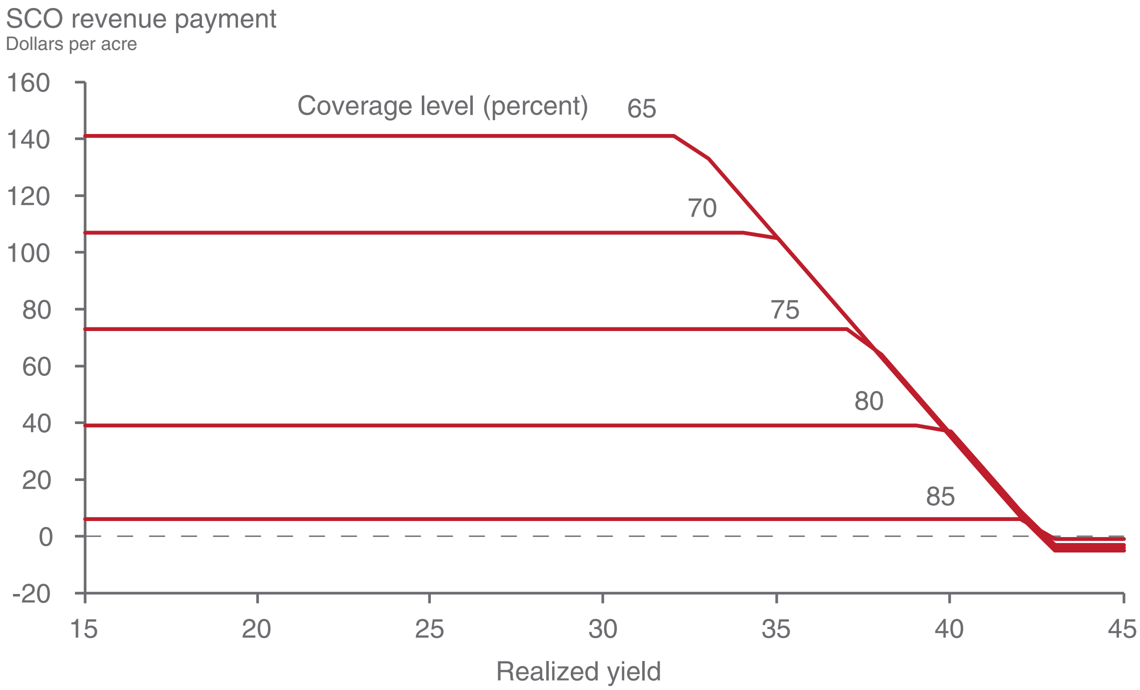
Figure 3
SCO payment rates vary by realized crop price (coverage level on underlying policy = 75 percent)



SCO = Supplemental Coverage Option.
Source: USDA, Economic Research Service.

[4]We use a simulation model to price the SCO policy. By generating 10,000 draws of revenues, we can apply the SCO program to these draws to estimate payments made to a representative producer for each draw. Averaging over these estimated payments then provides us with an actuarially fair price for the policy, which we use to calculate net returns to the producer in the current section. For more information on the model, see box, "The Empirical Approach," p. 14.

Figure 4
SCO payment rates: the coverage level of the underlying individual policy matters



SCO = Supplemental Coverage Option.
Source: USDA, Economic Research Service.

increases. As the realized price exceeds the futures price at the time of planting (in our example, $11.36 per bushel), the SCO payment calculations incorporate the harvest price instead of the futures price. This generates the step-like function seen in figure 3.

As noted earlier, unlike ARC, SCO payment rates vary based on the coverage level of the individual underlying revenue policy (fig. 4). For example, with a realized soybean price of $14 per bushel and 65 percent coverage on the underlying policy, a realized yield of 32 bushels per acre would establish the maximum payment rate of $141 per acre. If the individual had an underlying policy with 85-percent coverage, he or she, too, would receive the maximum payment rate, but it would only amount to $6 per acre. Because the producer pays for the SCO policy, for a given price, when yields are high enough that program payments go to zero, the producer will have a different negative return depending on the coverage level chosen.

Price Loss Coverage

PLC is similar to the recently repealed CCPs, with current reference prices increased from the CCP target prices of the previous Farm Act. The PLC program generates a price floor. Generally, if a program crop's national average market price falls below the statutorily determined reference price for that crop, the producer receives a payment, as expressed here:

PLC/acre =

0.85
* (*Reference price — max[Annual National average market price, Marketing Assistance loan rate*])
* *payment yield*.

As mentioned earlier, if a producer elects ARC, he or she may not enroll that same acreage in the PLC program (or in the SCO program for that matter). However, if the producer elects to participate in PLC, it is likely that he or she will consider annually purchasing SCO. If the producer does not elect either ARC or PLC, the producer automatically defaults to PLC coverage starting in the 2015 crop year.

ARC versus SCO

ARC and SCO use different benchmark revenues, so the payment levels and ranges of coverage can differ, sometimes dramatically, due to the upside-price protection embodied in SCO when RP is chosen as the underlying policy. Given current conditions and expectations and a 75-percent coverage level on the underlying RP policy, SCO's per-acre payment rates are higher than ARC rates when realized prices are high and realized yields are low, while ARC provides support over a wider range of realized yields. For example, at a realized price of $8 per bushel, ARC will make payments for realized yields up to and including 65 bushels per acre. SCO only provides support for yields up to and including 59 bushels per acre (fig. 5). However, if prices drop far enough, producers begin to receive payments from the PLC program as well, boosting the support they receive. Since the PLC program generates a price floor, if the price falls far enough, producers would receive payments irrespective of the level of yields attained (top-left chart in figure 5).

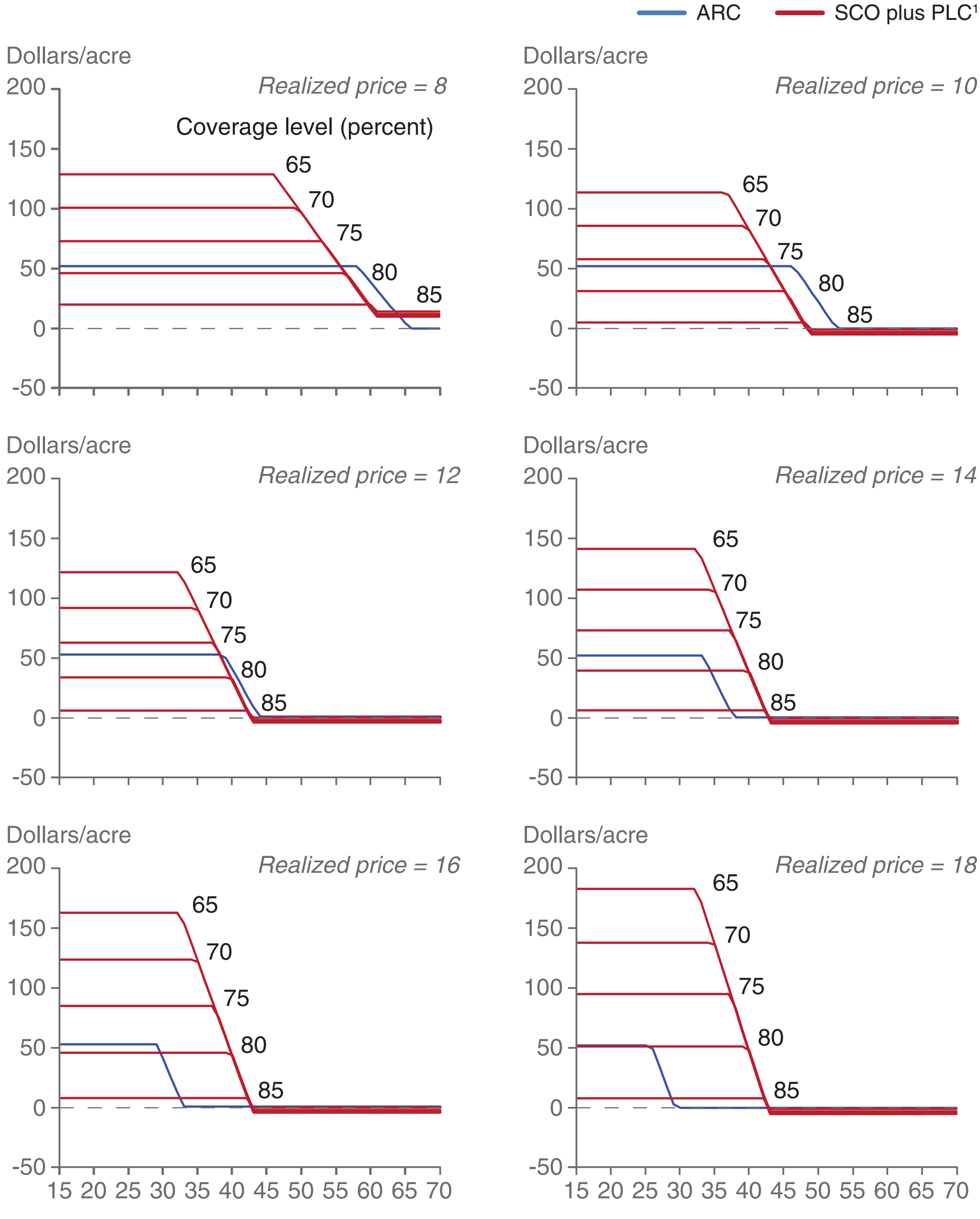
For higher prices, however, SCO provides higher levels of support over a wider range of yields. In an extreme example, if the harvest price were to hit $20 per bushel, SCO would deliver support up to a maximum of $95 per acre and through yields of 42 bushels per acre, while the ARC maximum level of support remains at $52 per acre and ARC only delivers support for yields up to 26 bushels per acre. Under 2014 price and yield conditions at planting time, the ARC program payment rates provide support "as if" it were an SCO payment rate, with a coverage level between 75 and 80 percent.

Note, however, that different initial conditions (if, for example, prices and/or yields went on a multiyear decline) could alter the payment outcome. Figure 6 explores this possibility using two scenarios, the first assuming that historical prices were three-quarters of those reported here ($9.20 vs. $12.27) and the second assuming that historical prices were 1.25 times the current prices ($15.34 vs. $12.27). Changing historical prices has no bearing on the SCO program—note that the SCO charts in figure 6 do not change with the change in historical prices.

Because the benchmark used to determine ARC support levels uses historic prices, ARC does not provide as much support in the lower historic price scenario as in the higher historic price scenario, all else being equal. The difference in ARC program support can be substantial given different historic prices. For example, with historic Olympic-average prices near $9 per bushel and a realized price of $8 per bushel, the ARC program provides support up through realized yields of 48 bushels per acre, while if historic Olympic-average prices were near $15 per bushel, the ARC program provides support up through realized yields of over 80 bushels per acre (fig. 6).

All else being equal, a support program with a slower adjusting revenue guarantee has a greater probability of providing payments when prices are on a falling trend across seasons, but a smaller probability of providing payments when prices are increasing across seasons. Given the recent relatively high commodity prices prior to 2014, it is not a surprise that the USDA, FSA data show that the ARC program appears to be relatively attractive to farmers.

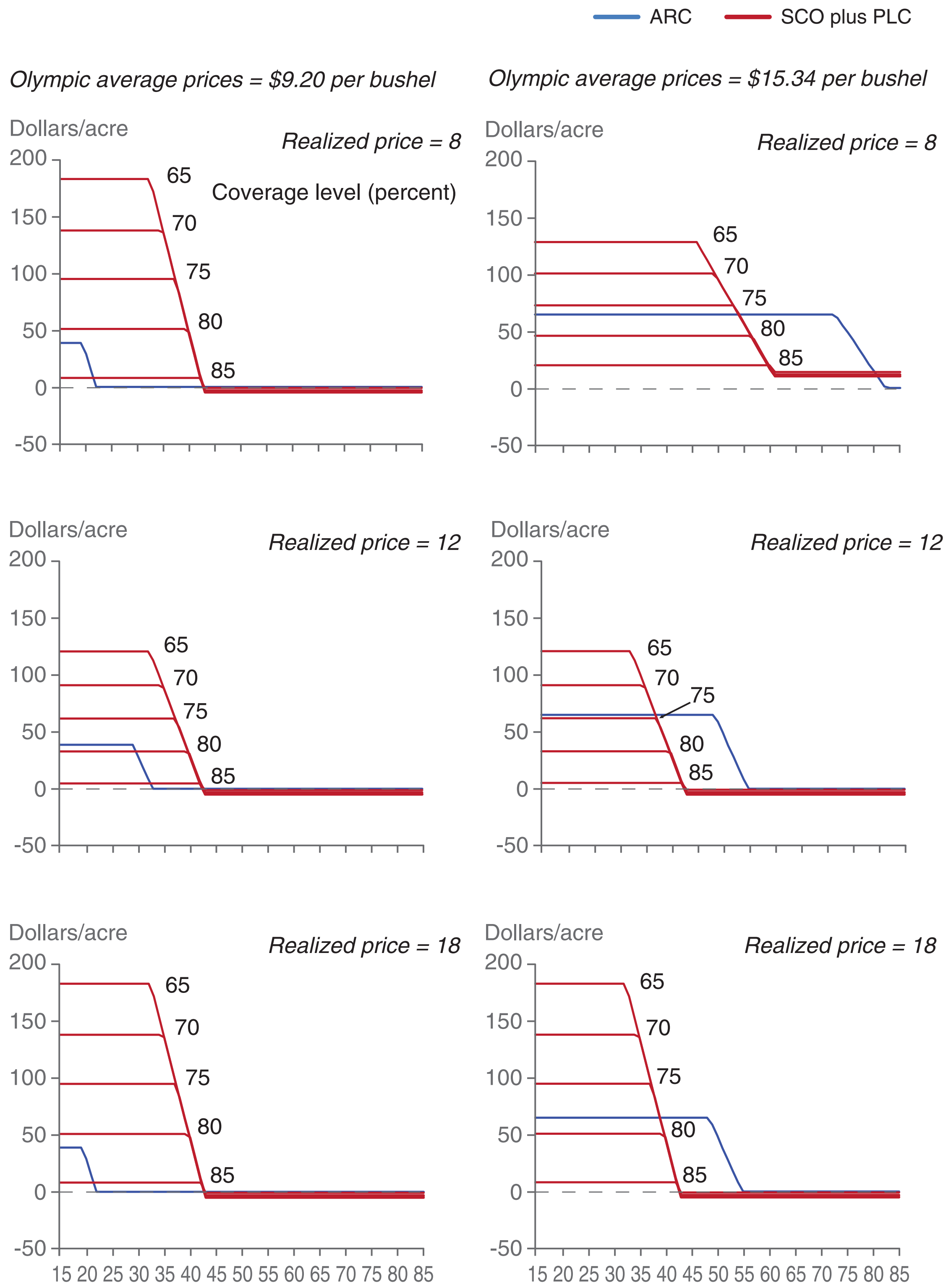
Figure 5
Comparing ARC to SCO plus PLC[1] payment rates (assuming price and yield expectations for 2014)



[1]To calculate the PLC payment, we assume a program payment yield for soybeans equal to 90 percent of the production weighted national yield from 2008 to 2012, which in this case equals 38 bushels per acre. Note that for an individual producer, the program payment yield would be calculated at the farm level. Also note that in the examples shown here, PLC payments only accrue in the top-left chart where the realized price of $8 per bushel falls below the trigger reference price of $8.40 per bushel.
ARC = Agriculture Risk Coverage program; PLC = Price Loss Coverage program; SCO = Supplemental Coverage Option.
Source: USDA, Economic Research Service.

Figure 6

Historical prices affect ARC support, but do not alter SCO support



ARC = Agriculture Risk Coverage program; PLC = Price Loss Coverage program.
Source: USDA, Economic Research Service.

Producer Returns Under Alternative Program Choices

The previous chapter assumed that realized prices and yields were deterministic in nature, that is, they did not include the reality of uncertain future price and yield outcomes. The deterministic approach facilitates the examination of the mechanics of the SCO and ARC programs, exploring the relationship between prices, yields, insurance coverage rates, and payments. This chapter performs a forward-looking analysis by assuming that prices and yields follow stochastic processes, permitting us to examine the distribution of payments and revenue with and without payments that eligible producers are likely to face. Based on an estimated distribution of prices and yields, the expected value (mean) of revenue and payments can be calculated, as can other characteristics of their distributions, such as those related to variability. Since farmers are likely to be risk averse (e.g., Serra et al., 2006), we examine the impacts the program payments would have on measures of revenue variability and expected revenues and also explore how changes to these programs would affect producer revenues. In addition, not all counties have the same correlations between prices and yields, allowing us to explore where the ARC and the SCO programs cause the greatest risk reduction.

The relationship between price and national average yield is generally negative, although the strength of the correlation depends on the crop. The historical correlations for corn, soybeans, and winter wheat are -0.59, -0.50, and -0.32, respectively, based on data from 1975 through 2013. At the national level, low yields often result in high prices and vice versa, creating a “hedging” effect. However, for those counties and States that do not reflect the national yield, this hedging effect may not exist. To see this effect or lack thereof, appendix figures 1-3 are maps that show the correlations between simulated yields of each county’s representative farm and the simulated prices. We suspect the greatest benefit of these revenue programs may exist in those counties that do not historically follow the national average simply because these counties do not have the built-in price-yield hedge that the counties that do tend to follow the national average enjoy. For example, counties producing corn outside the Corn Belt would likely see greater risk reduction than counties inside the Corn Belt.

We use a statistical model to generate distributions of simulated prices and yields that are centered around their expected values at planting time in 2014 (see box, “The Empirical Approach”). County-level yield distributions are generated for each of the 1,001 counties for which USDA, NASS has reported corn data, 889 counties for which NASS has reported soybean data, and 510 counties for which NASS has reported winter wheat data from 1975 through 2013. As a result, not all counties with production are included; 84 percent of 2013 total U.S. corn production, 82 percent of total soybean production, and 56 percent of total winter wheat production are represented in the analysis.

The analysis maintains the historical correlations of yields across counties and between county yields and prices. The yield distribution for a typical farmer in each county is generated by inflating the county-level yield variability based on farm yield information implicit in actual crop insurance-premium rates for each county. The model makes 10,000 draws from each county and farm yield distribution as well as from the price distribution. Payments, crop revenue, and total revenue (crop revenue plus the payments) are calculated for each of the 10,000 price and yield pairs. Producer-paid premiums for SCO and the underlying insurance policy are also calculated from this price-yield data and are subtracted from the payments in order to obtain a “net payment” to the producer. Total revenue then equals the crop revenue plus the net payments. We summarize the results by presenting

The Empirical Approach

The approach to the stochastic simulation used in this report is described in detail in Cooper and Delbecq (2014a; 2014b), which in turn is an update of Cooper (2010). A county-based simulation model is used, one that was developed to generate stochastic price and yield outcomes that are correlated across space and time. Using historic prices and yields as the basis from which to generate nonparametric kernel distributions of these variables, each run of the model consists of 10,000 price and yield draws. These draws form the distribution of price and yield outcomes used to generate expected price and yield outcomes for every county in the United States growing soybeans for which USDA's National Agricultural Statistics Service (NASS) reports county-level yields from 1975 through 2013 (USDA, NASS).

Since prices and yields are correlated, as are yields across counties, these historic correlations need to be accounted for in the simulated price and yields data. For this analysis, the historic relationships between prices and yields and between county yields are assumed to follow a multivariate Gaussian distribution and are imposed via a copula approach. Under this approach, the historic relationships between the variables are defined by the correlation matrix and a degrees of freedom parameter, which are allowed to vary by ERS Farm Resource Region (Heimlich, 2000).

County-level yields are the lowest aggregation of yield data available from the USDA that has the same time series as the State and national data. However, farm-level yield tends to exhibit higher variability than county-level yield. As per Coble and Dismukes (2008), the additional variability at the farm level for each county is inferred from Federal crop insurance premiums, and the variability of the simulated county-level data is increased by this amount. The result is a yield distribution for a representative farmer in each county.

The generated 2014 farm yields and harvest time and season average prices are then used as inputs into the various programs offered (ARC, SCO, etc.) to examine potential payment and revenue outcomes for representative producers within these counties. For the national-level average payments, depending on the support program, the revenue and payment outcomes are weighted by the number of base acres or planted acres in the county.

their expected values and their confidence intervals, the latter being one way to express variability.[5] The results include the costs associated with the various programs, which are the farmer-paid premiums for SCO and the underlying crop insurance policy.[6] With the analysis, we explore the benefits to having: PLC; standalone SCO (i.e., no underlying insurance policy; SCO without an underlying insurance policy is not possible in practice, but we want to allow the direct comparison of the SCO and ARC payments); county-level ARC revenue protection (RP) with a 75-percent coverage

[5]The confidence intervals presented here do not assume any particular distribution of the underlying data (that is, the empirical confidence intervals are nonparametric). While we present the coefficient of variation of total gross revenue in the tables as it is a common statistic, the lower bound of the confidence interval is more informative of downside risk. Using the lower bound value to compare riskiness across programs is similar in concept to the value- at-risk (VAR) approach used in financial risk management.

[6]The net payments are calculated by generating the total premium and using the appropriate premium subsidy rates to calculate the portion the producer pays (the farmer-paid premium). This farmer-paid premium is then subtracted from the total premium to obtain the amount of benefits the producer receives from the program/policy.

rate; RP with a 75-percent coverage rate plus SCO and PLC; and RP with a 75-percent coverage rate plus county-level ARC.[7] Although traditional crop insurance is not required to obtain ARC, we examine the effect of the combination of ARC and traditional crop insurance on crop revenue for two reasons: first, as with other major field crops, the bulk of soybean, corn, and wheat acreage in the United States is insured; and second, doing so provides a comparison to returns under SCO and traditional insurance.

Table 1 shows the average of the revenue and payment simulations across representative producers in each county producing either corn, soybeans, or winter wheat. The results show the national weighted average of what a typical U.S. producer would expect to generate in revenues from 1 acre planted to corn, soybeans, or winter wheat under the different support scenarios. For the payments coming from ARC or PLC, the averages reported in the table are generated by weighting the results for each producer by the total commodity base acres in the producer's county. For payments that do not involve ARC or PLC, the weights are total planted commodity acres in the county. If a producer did not enroll in any programs, but simply planted the acres to the crop, the producer would expect to earn a per-acre revenue of $664 for corn, $498 for soybeans, or $261 for winter wheat. For simplicity, following corn only, based on 10,000 simulations, 95 percent of the time the revenue fell within the interval of ($232 to $1,157) suggesting that with a 95-percent probability, the farmer could expect to receive no less than $232 per acre (in bad years) or no more than $1,157 (in a good year) from simply the gross revenue and no program payments—based on price and yield realizations—of the crop. Of course, this does not rule out the possibility of complete disaster wiping out the crop entirely (for a revenue of $0), or a revenue that exceeds $1,157 per acre, but the model suggests that such extreme outcomes are likely to happen less than 5 percent of the time.[8]

If a producer enrolled only in the PLC program, the average total revenue would increase to $675 per corn acre with a 95-percent probability of the total revenue for a given year falling within the range of $242 and $1,164. PLC limits losses due to drops in prices, reflected in an increase in the lower bound of the 95-percent confidence interval of $3 per acre (from $239 to $242 per acre).[9]

While a producer cannot enroll only in SCO (he or she must have an underlying insurance policy to be eligible to enroll in the SCO program), we include the possibility of only enrolling in SCO to enable a direct comparison with the ARC program as well as exploring the benefits accruing directly from the SCO program itself. Simulation results suggest that under the 2014 price scenarios used here, a producer with SCO coverage would expect an average total revenue of $677, which includes a cost (of roughly $13) for enrolling in the program. With a 95-percent probability, the producer could expect a revenue between $281 and $1,154 for each corn acre planted. Note that the upper end of the revenues is slightly lower due to the producer's cost of enrolling in the program. Raising the lower end of revenue, however, is the likely reason a producer interested in risk management would enroll in the program—to limit downside risk and the associated losses. As a result of enrolling in SCO

[7]We choose the 75-percent coverage level because it is currently one of the most commonly selected coverage levels. Note that these new programs may induce producers to change their coverage level choices, but for sake of the report, we use the 75-percent level and explore in a couple instances how changes to this level may affect outcomes.

[8]Note that the 95-percent percent upper bounds with RP and RP plus SCO are lower than the bounds without program support (the "unenrolled" column) or with ARC only because the RP and SCO calculations include the farmer-paid premiums for these products.

[9]Recall that the PLC and ARC program payments are weighted by base acres, not planted acres, resulting in the higher base levels of gross revenue.

Table 1

Per-acre payments and revenues for producers in all U.S. corn-, soybean-, and winter wheat-producing counties (2014 expected prices and yields)

Farmers' program enrollment	Average (net) payment ($/acre)	Average total revenue ($/acre)	95-percent confidence interval of revenue ($/acre)	Coefficient of variation of total revenue/acre[1]
		Corn		
Not enrolled-planted[2]	--	664	[232, 1157]	0.36
Not enrolled-base[2]	--	671	[239, 1164]	0.36
PLC only[2]	4	675	[242, 1164]	0.35
SCO only[3]	13	677	[281, 1154]	0.34
ARC only[2]	28	699	[296, 1167]	0.32
RP (75 percent)	23	687	[494, 1138]	0.27
RP + SCO + PLC[2]	39	710	[501, 1143][4]	0.25
RP + ARC[2]	50	721	[517, 1148][4]	0.24
		Soybeans		
Not enrolled-planted[2]	--	498	[151,910]	0.40
Not enrolled-base[2]	--	507	[166, 911]	0.38
PLC only[2]	0.17	507	[167, 911]	0.38
SCO only[3]	9	507	[177, 909]	0.38
ARC only[2]	13	520	[195, 912]	0.36
RP (75 percent)	19	517	[359, 894]	0.30
RP + SCO + PLC[2]	26	533	[362, 895][4]	0.28
RP + ARC[2]	31	538[a]	[367, 897][4]	0.27
		Winter wheat		
Not enrolled-planted [2]	--	261	[32, 556]	0.55
Not enrolled-base[2]	--	276	[31, 589]	0.54
PLC only[2]	2	278	[33, 589]	0.54
SCO only[3]	7	268	[50, 555]	0.52
ARC only[2]	4	280	[43, 590]	0.52
RP (75 percent)	16	278	[180, 543]	0.40
RP + SCO + PLC[2]	26	302	[187, 574][4]	0.36
RP + ARC[2]	21	297	[190, 575][4]	0.38

ARC = Agriculture Risk Coverage program; PLC = Price Loss Coverage program; RP = Revenue Protection; SCO = Supplemental Coverage Option. [1]"Coefficient of variation of revenue" is the standard deviation of revenue divided by average revenue, and is a standardized measure to allow comparability of variability across programs. [2]With ARC and PLC, the results across counties are weighted by base acres ("base" in the first column), while SCO and RP are weighted by planted acres ("planted). Also, note that the confidence interval is nonparametric (i.e., does not assume any particular distribution), and as such, and may not be symmetric around the average. [3]"SCO only" presumes a 75-percent coverage rate on the RP policy. [4] While these are likely close to the "true" interval, caveats must be made due to their construction. They are the result of averaging across counties while weighting by base acres, which can cause funny outcomes. Adding ARC (or SCO plus PLC) to RP will not cause the lower end of the distribution to change for any individual county (see fig. 11 for details). It will shift many producers to higher levels of revenues, indicated by the increase in the average total revenue, and will lower the CV of revenue, and can reduce downside risk as measured by other measures, such as semi-variance (used in the finance industry), but will not shift the lower end of the distribution because these are area-based policies/programs and as a result, will not provide benefits for everyone suffering losses. There will be enough who do not correlate perfectly with the county outcomes such that the lower bound of the 95-percent confidence interval will, in almost all cases, remain unchanged. With respect to the upper bound, it is also not clear how RP+SCO+PLC can have a higher upper bound than RP alone given SCO also has a premium associated with it, which should lower that upper bound.

Source: USDA, Economic Research Service.

only (again, a choice not actually available), the lower end of the 95-percent confidence interval now lies at $281 per acre—$49 higher than with not enrolling in any programs at all.

If a producer enrolled only in ARC, the program provides a slightly higher expected per-acre net payment (ARC has no enrollment fees; the ARC payment is based on base acres, not planted acres) of $699 per acre to the producer, but appears to limit downside risk in this scenario (under current historic prices and yields) slightly more than the SCO (plus PLC) program, with an associated lower end of the 95-percent confidence interval of $296, an increase of $15 per acre over the lower bound found with the SCO-only election.

If the producer decided to enroll in the Federal Crop Insurance (FCI) program with a revenue policy and 75-percent coverage, the RP policy would net the farmer an average of $23 per acre. This would increase the average total revenue to $687 for each corn acre planted. The producer has a positive net average benefit from the RP policy, as the Government is paying a portion of the premium.[10] With a 95-percent probability, a producer could expect a revenue falling between $494 and $1,138. The lower end of the 95-percent confidence interval now lies more than $260 per acre higher than the lower bound of the associated interval for the no-insurance outcome and roughly $200 above the lower bound of either the SCO- or ARC-only outcomes. This is why SCO and ARC are colloquially referred to as "shallow loss" programs. They are not designed to cover the deeper losses that the RP program does cover.

When SCO (plus PLC) and ARC are separately combined with an underlying RP policy with 75-percent coverage, the resulting expected level of revenue and range of likely revenue outcomes are close for the 2014 planting-time price scenario, suggesting that the two county-based programs work similarly under the 2014 scenario of historic and expected yields and prices. Overall, when looking across all counties, under the 2014 scenario, ARC appears to generate higher mean levels of revenue, and the lower end of the 95-percent confidence intervals appear greater as well for all three crops.

Underlying Revenue Protection Coverage Levels

The results presented above for the RP, the RP plus SCO plus PLC, and the RP plus ARC options all assumed that the producer would select an underlying RP policy with 75-percent coverage (the most common choice currently selected by producers). However, the introduction of SCO (plus PLC) and ARC may cause producers to change their coverage election of the underlying insurance policy. In other words, rather than these shallow-loss programs acting as complements to the FCI program, they may act as substitutes. To explore this possibility, we examine the corn revenue distributions for corn for RP coverage selections of 65 and 55 percent, respectively, to compare them to the benchmark election of 75 percent that represents the coverage level most commonly elected before the advent of these programs (table 2).

The underlying coverage level of RP affects the payouts of the various combinations of programs selected by the producers. While the average revenue per acre does increase over the various coverage levels selected, the lower bound of the confidence interval changes more substantially. For example, with a 75-percent underlying RP policy, having SCO and PLC as well generates a revenue

[10]For the sake of internal consistency across gross revenue, ARC, SCO, and RP calculations, the actuarially fair (e.g., Arrow, 1963) SCO and RP insurance premiums are set to the expected value of the indemnities across the 10,000 price-yield outcomes. The producer-paid premium excludes the Government-paid portion (i.e., the premium subsidy).

distribution with a mean of $710 per acre; with a 55-percent underlying RP policy and the same combination of programs, the mean drops to $705 per acre, a relatively minor drop. However, the lower bound of the confidence interval decreases from just over $500 to $415 per acre, signifying that if a loss occurs, it has a greater probability of being a larger loss with the lower underlying coverage level. Recall that even though SCO will cover losses down to the level of the underlying policy, and will do so at the same rate regardless of the coverage level selected for the underlying policy, the SCO is an area-based policy, so the degree of protection afforded to the producer relies heavily on how correlated an individual producer's returns are to those of the county where the farm is located. Therefore, these results may differ by county. In addition, the upper bound of the 95-percent confidence interval changes when moving to the lower RP coverage level, increasing from $1,143 to $1,156 per acre, reflecting the additional out-of-pocket costs (of the premium) the producer faces when enrolling in the RP and SCO policies.

Exploring corn, for the lower coverage levels, ARC versus SCO and PLC provides roughly the same decrease in risk as measured by the coefficient of variation (CV).[11] At 75-percent coverage, however, ARC appears to provide slightly more protection against risk. At an aggregate level, examining across all counties, the 75-percent RP coverage coupled with ARC provides the highest level of risk protection for a corn producer. This pattern holds for soybeans as well, while for winter wheat, the 75-percent RP coverage coupled with SCO provides the highest level of risk protection. This result helps explain why wheat producers were more likely to elect PLC than ARC, according to the FSA election results. Note, however, that these results are likely to be sensitive to the base year chosen for the scenario.

[11]The coefficient of variation (CV) is calculated by dividing the standard deviation by the mean of the variable, relating a measure of variability to the population's average level of the variable. The larger the estimated CV, the higher the variance relative to the mean, which denotes a higher level of riskiness.

Table 2

Changing the underlying coverage level of RP plan can alter revenue distributions[1]

Farmers' program enrollment	Average (net) payment ($/acre)	Average total revenue ($/acre)[2]	95-percent confidence interval of revenue ($/acre)[3]	Coefficient of variation of total revenue/acre[4]
Not enrolled-planted	--	664	[232, 1157]	0.36
Not enrolled-base	--	671	[239, 1164]	0.36
55-percent RP coverage				
RP (55 percent)	9	674	[372, 1152]	0.32
RP + SCO + PLC	34	705	[415, 1156]	0.28
RP + ARC	37	708	[427, 1162]	0.28
65-percent RP coverage				
RP (65 percent)	15	679	[434, 1146]	0.30
RP + SCO + PLC	37	708	[452, 1151]	0.26
RP + ARC	42	713	[474, 1157]	0.26
75-percent RP coverage				
RP (75 percent)	23	687	[494, 1138]	0.27
RP + SCO + PLC	39	710	[501, 1143]	0.25
RP + ARC	50	721	[517, 1148]	0.24

ARC = Agriculture Risk Coverage program; PLC = Price Loss Coverage program; RP = Revenue Protection; SCO = Supplemental Coverage Option.

[1]Results across a representative producer in each U.S. corn-producing county, given 2014 expected prices and yields.

[2]With ARC and PLC, the results across counties are weighted by base acres, while SCO and RP are weighted by planted acres.

[3]Note that the confidence interval is nonparametric (i.e., does not assume any particular distribution), and as such, may not be symmetric around the average.

[4]"Coefficient of variation of revenue" is the standard deviation of revenue divided by average revenue, and is a standardized measure to allow comparability of variability across programs.

Source: USDA, Economic Research Service.

Different Levels of Revenue Risk Produce Varying Results

To explore the idea of whether results vary for different levels of revenue risk being faced by producers (and if so, how), three specific counties are examined where producers face various levels of risk producing soybeans—Linn County, IA; Stearns County, MN; and Prentiss County, MS. First, we calculated the CV for every county growing soybeans in the United States. All soybean counties fell between a low of 0.25 and a high of 0.82, where the lower the CV, the lower revenue risk the producer faces. Linn County, IA, is typically a low-risk production area, with a CV of 0.28. Stearns County, MN, represents a medium-risk county with a CV of 0.55, while Prentiss County, MS, is a high-risk county for soybean production with a CV of 0.76 (see the figure 7 map for where these counties are located). Figure 8 graphically represents the expected (average) revenue—denoted by the dot—and the range of revenue a soybean producer could expect to fall within 95 percent of the time—denoted by the whiskers—associated with the various programs the producers could enroll in (the data for figure 8 resides in appendix table 8 as well). We also include "all counties," the acreage-weighted average results across all U.S. counties for which USDA, NASS has reported soybean production over 1975-2013, as a comparison to obtain a sense of the overall average effect of enrolling in the various programs.

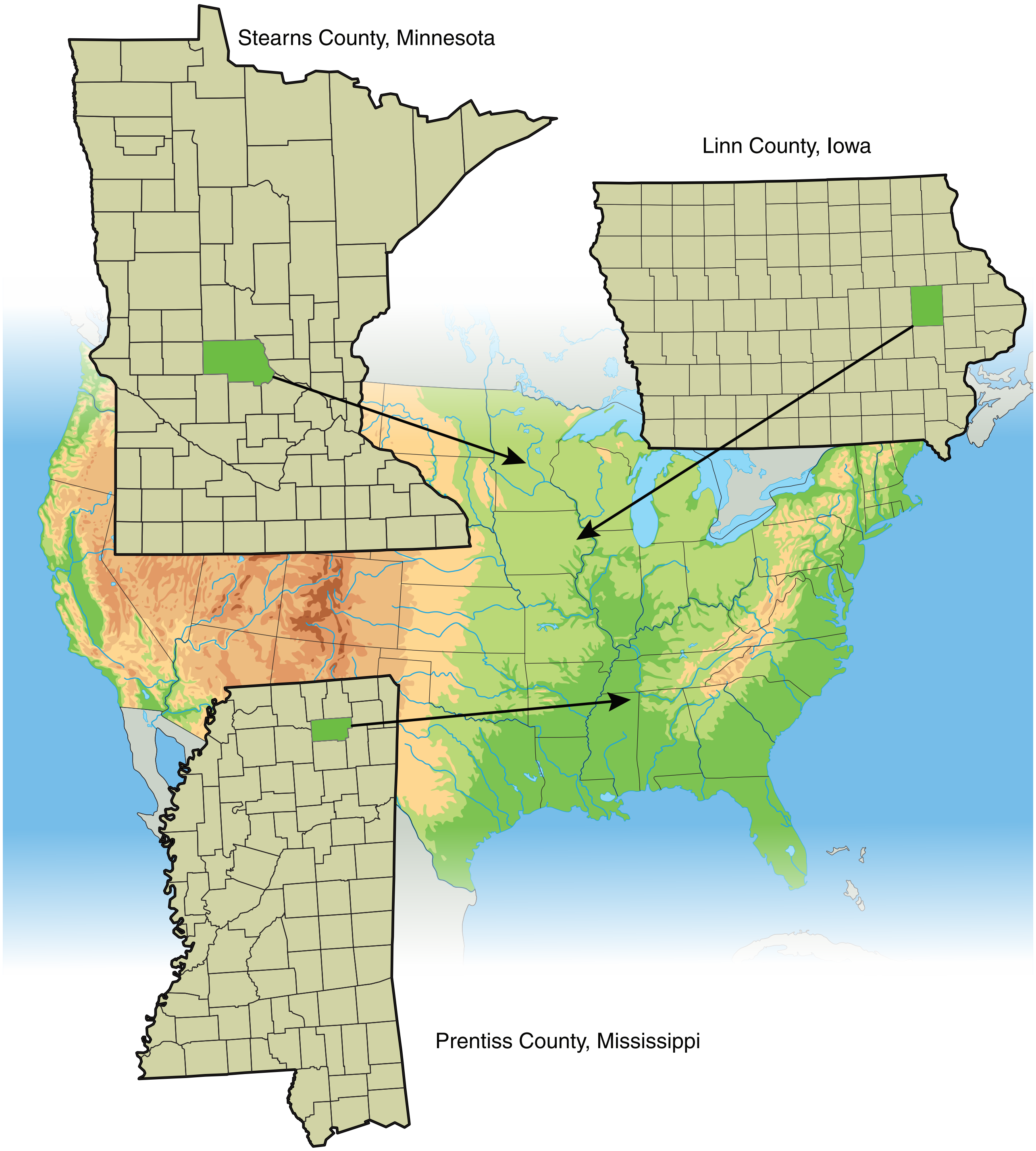
Overall, across all counties included in the simulation model at planting time in 2014, a soybean producer could expect to receive roughly $500 per acre. If not enrolled in any Federal programs, the expected revenue would lie somewhere between roughly $150 and $910 per acre 95 percent of the time. Enrolling in the support programs reduces the lower end of the distribution—in effect, shortening the lower whisker in the figure. However, overall averages often mask underlying variation. A typical soybean producer in Stearns County, MN, expects a lower revenue, on average, than a typical soybean producer in Linn County, IA (by roughly $100 per acre). Furthermore, a producer in Stearns County, MN, is more likely to lose a substantial amount, if not the producer's entire expected revenue, compared with a typical producer in Linn County, IA. This suggests that Stearns County is a riskier place to grow soybeans than in Linn County, and the relatively larger benefit from enrolling in the various safety net programs is evident by the degree to which the lower "whiskers" are shortened—implying a greater reduction in low-revenue outcomes. Following our expectations given the calculated CVs, results suggest that Prentiss County, MS, is even riskier yet. Producers in both Stearns and Prentiss counties on average expect lower levels of revenue and stand to lose more than a producer in Linn County, IA, and therefore have greater changes in the lower bound of revenue with enrollment, particularly regarding RP.

Note also that in Linn County, IA, producers would face less downside risk if they adopt standalone SCO or ARC.[12] As the risk level increases, however, the benefits from these programs in terms of alleviating downside risk decreases. Producers in a very high-risk county like Prentiss County, MS, do not receive many downside risk reduction benefits from enrolling in either standalone ARC or SCO (if they could indeed enroll in SCO alone). For the riskiest county, the downside risk protection is negligible—the lower bound remains 0 (and even goes negative for standalone SCO—since producers have to pay a premium) despite enrolling in these programs. These differences among counties in the standalone benefits of SCO and ARC are due to small revenue losses being more typical in lower risk Linn County, IA, than in the two more risky counties.

[12] Again, it is not possible to obtain standalone SCO. The point, however, is to compare the SCO with the ARC program in the absence of traditional crop insurance to examine which program provides more downside risk protection when dealing with a riskier environment.

When combining SCO or ARC with RP, the additional downside risk protection—defined as the increase in the lower bound of the 95-percent confidence interval on revenue—disappears, as shown in the figures and in appendix table 8. However, this does not mean that adding SCO or ARC in conjunction with RP does not reduce downside risk. For example, if calculating the semi-variance, a measure of downside risk that attempts to capture the variability of "poor" or undesirable returns (e.g., the variation of returns that are below the average return) used in the finance literature, adding SCO or ARC to RP does decrease such a measure of downside risk.

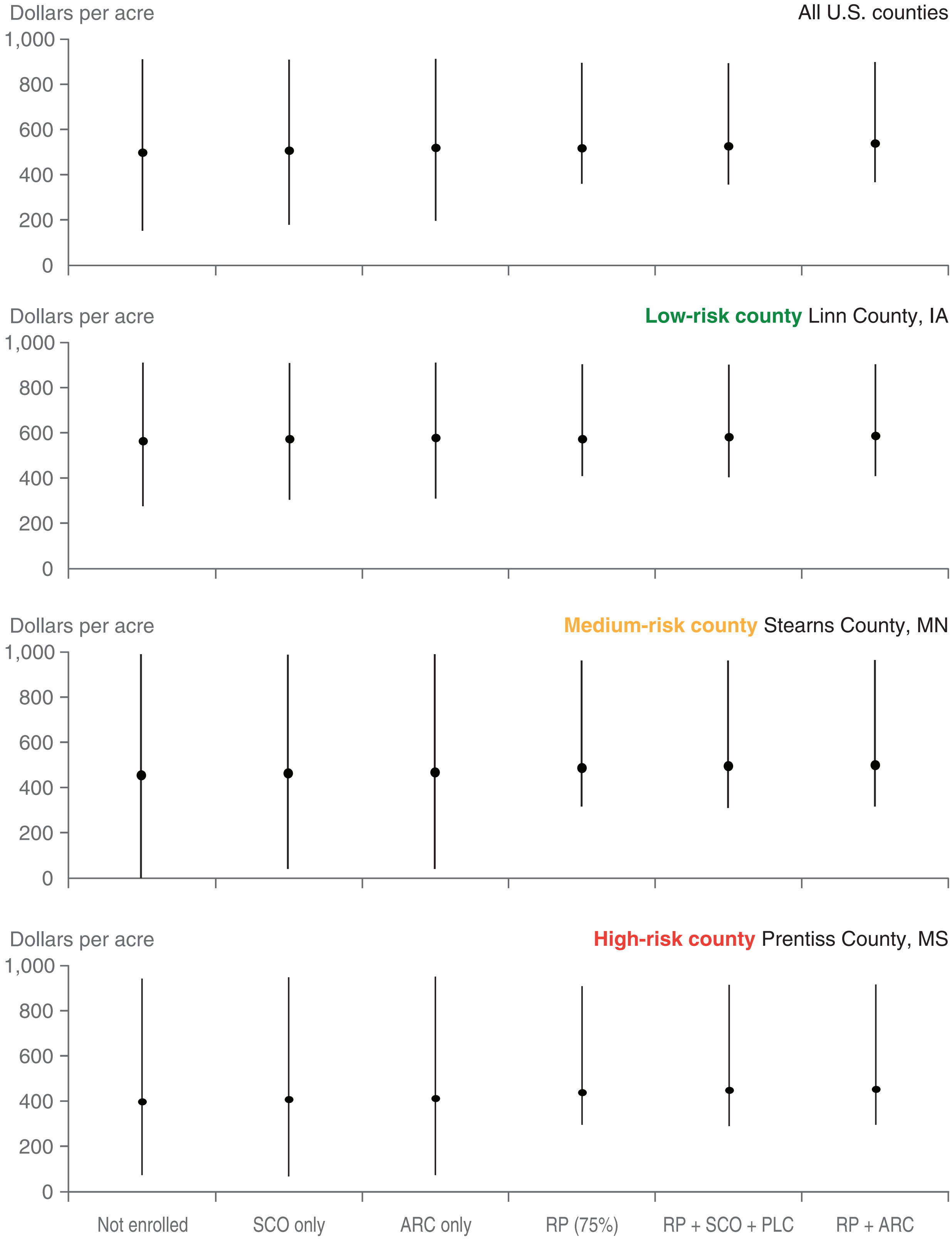
Figure 7
Location of Linn County, IA; Stearns County, MN; and Prentiss County, MS



Source: USDA, Economic Research Service.

Figure 8

Expected soybean revenue outcomes, all U.S. counties and county examples by level of revenue risk



ARC = Agriculture Risk Coverage program; PLC = Price Loss Coverage program; RP = Revenue Protection; SCO = Supplemental Coverage Option.

Source: USDA, Economic Research Service.

What the New Distributions Look Like

Figure 9 allows us to compare the various distributions emerging from the different programs farmers can enroll in for a low-risk county (Linn County, IA) and provides a better idea of how the various programs deal with risk in terms of the revenues and the probability of a producer realizing a revenue in a particular part of the distribution. The X axis shows the range of revenues while the Y axis denotes the density associated with a particular revenue.[13] The chart was made using the revenue data from each of the 10,000 simulations run for a typical producer in this particular county.

The gold curve shows the crop revenue distribution when the producer does not enroll in any programs. The distributions for the crop revenue plus the crop insurance products (RP; RP plus ARC; and RP plus SCO plus PLC) look fairly similar. RP limits downside risk by effectively cutting off the left tail of the revenue distribution (denoted by the dark orange distribution). With a 75-percent coverage choice, the RP policy guarantees at least 75 percent of expected farm revenues (less the farmer-paid RP premium). As a result, a large spike occurs at the 75-percent level of expected revenues, which is the result of all the producers who had losses that brought their revenue below the 75-percent level, which their RP policy then made up for—up to the 75-percent level. To the right, the spike quickly drops and then comes close to following the revenue distribution.[14]

The blue line shows the revenue distribution with RP, SCO, and PLC in place. There is a similar, but much smaller ,spike at the left side of this distribution, due to the fact that in any scenario with RP, revenue cannot be lower than the revenue protection guarantee (less the farmer-paid premium) under RP. The reason that the leftmost spike is lower than in the RP-only case is that a second spike occurs close to the 86-percent level of expected revenues, since this is where SCO begins to make its payments for the smaller losses between the RP coverage rate and 86 percent of expected county revenues (the area under the line sums to 1, meaning an increase in height in one part of the distribution must be offset by a lowering somewhere else in the distribution). Note also that the left "tail" of the blue distribution lies slightly to the left of the dark orange RP-only distribution. This is due to the fact that producers incur a premium in order to purchase SCO and, since SCO is an area-based product, producers could pay for SCO, incur losses, and if those losses do not coincide with losses at the county level, can leave them with no indemnity payments, despite having incurred losses and paid a premium. The "lost premium" is what moves this distribution to the left of the RP-only distribution. Given expected prices, the PLC program is not expected to alter the distribution much.

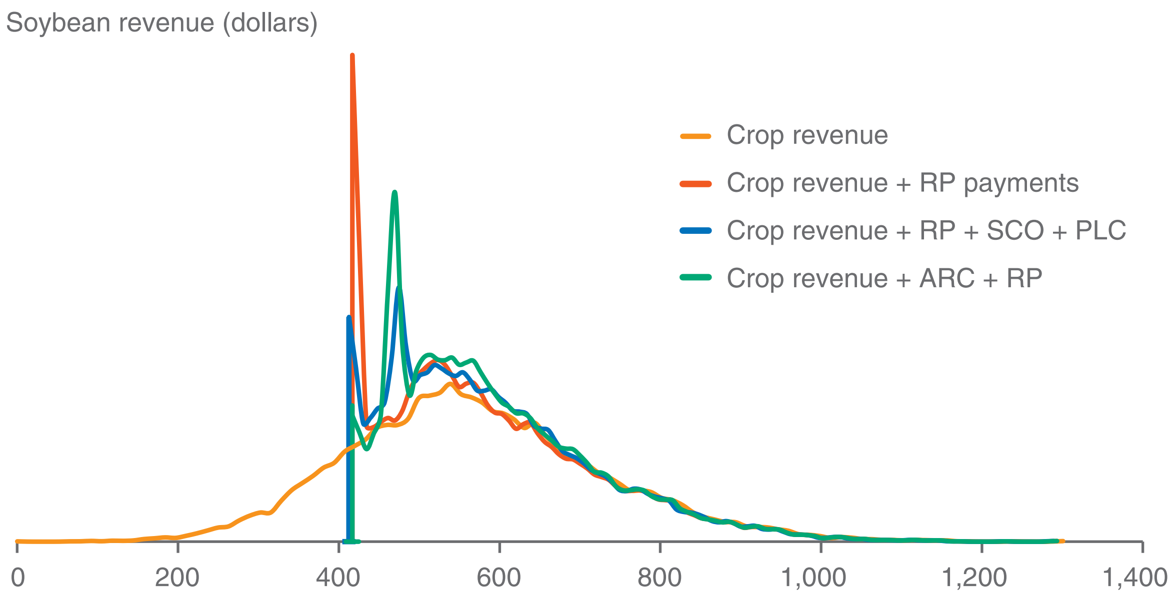
The green line denotes the revenue distribution with RP plus ARC. This has a similar shape to that of the RP plus SCO and PLC curve, although it has a lower first spike and a higher second spike. Because there is no premium associated with the ARC program, the green curve lies to the right of the blue curve and above it as revenues increase. The second spike is higher, suggesting that for soybean producers in Linn County, IA, a low-risk county, the ARC program may provide higher levels of benefits than the SCO program, with a higher likelihood of a producer obtaining a larger revenue (evidenced by the higher second spike to the right and a lower spike to the left at the RP cutoff).

[13]The density is related to frequency of occurrence, with the higher the density, the higher the frequency of the associated revenue occurring. The area under the density function sums to 1, that is, 100 percent of all occurrences are covered under the graph.

[14]The reason that the spike is not a thin vertical line is due the limitations of the sampling of the distribution being finite.

Finally, as expected, all distributions converge as we move to the right along the revenue axis. As producers realize higher levels of revenues, the programs do not tend to pay out indemnities—with the potential exception of the RP policy and associated SCO, which provides some upside price protection given that the base price is the higher of the planting time or harvest price. However, in any scenario, higher yields leading to higher revenues tend not to trigger any payments. As a result, the distributions get too close together to be able to discern any meaningful differences between the four distributions.

Figure 9
Example of impacts of RP and SCO on the distribution of soybean revenue for a low-revenue-risk county
Soybean revenue distributions by program for low-risk county (Linn Cty, IA)



ARC = Agriculture Risk Coverage program; PLC = Price Loss Coverage program; RP = Revenue Protection; SCO = Supplemental Coverage Option.
Source: USDA, Economic Research Service.

New Programs' Risk Coverage Relative to Traditional Crop Insurance

Understanding how the SCO and ARC programs reduce producers' risk above and beyond that already covered by traditional crop insurance remains difficult. Relative to the benefits of traditional crop insurance, how large are the added benefits these programs provide? And do these relative benefits differ for producers facing different levels of risk? In other words, are SCO and ARC more valuable relative to the underlying crop insurance policy for some producers than others?

To explore this concept, we generate measures of the total costs of the SCO and ARC programs relative to the total costs of the underlying traditional RP crop insurance policy. The total costs reflect the amount the Government has to pay to provide the support to the producers as well as the producer's payment; the total captures the level of risk being covered by each type of support. For SCO and RP, we define total costs as the total (farmer- plus Government-paid) premiums for these programs. The total premiums embody the total cost on average of providing these supports. The total cost of ARC is the expected payment, ignoring administrative costs. We then create a ratio of the total costs of either SCO or ARC to the RP policy. If close to 0, this would suggest that the SCO (ARC) program provides little, if any, additional value to the producer in terms of revenue risk covered above and beyond the benefits of the underlying RP crop insurance policy. If close to 1, SCO (ARC) provides value very close to that of the underlying policy. If above 1, the SCO (ARC) program provides value that exceeds that of the underlying policy. We then graph these ratios of relative benefits according to the riskiness of the producer (measured by the CV of revenues).

Figure 10 shows these ratios in graphical form. A clear relationship emerges showing that the ratio tends to be higher when the farmer's revenue risk is lower. As we suspected from comparing the three counties earlier in the report, this graph demonstrates that the shallow-loss programs are relatively more important for low-risk producers than they are for high-risk producers. This makes sense since producers in low-risk areas of the country have a low probability of incurring large losses. The primary losses they face tend to be smaller in nature and the shallow-loss programs help with exactly these types of losses. For these lower risk producers, the shallow-loss programs are almost as important, if not more important, in terms of mitigating the risk they face when compared to the traditional, underlying RP policy. For example, Linn County, IA, a low-risk part of the country, has an SCO-to-RP ratio that exceeds 1, suggesting that producers in Linn County would, on average, obtain benefits from the SCO program greater than those of the underlying RP program (fig. 10a). In higher risk counties, like Prentiss County, MS, the relative benefit is small. Producers in these riskier parts of the country are more worried about the large losses they have to face and the benefits of the shallow-loss programs—SCO and ARC—are relatively small when compared to the benefits received from the traditional underlying RP policy.

Under 2014 conditions, the underlying riskiness of the county (measured by the county's CV of gross revenue) explains more of the variation in the ARC/RP ratio than in the SCO/RP ratio.[15] However,

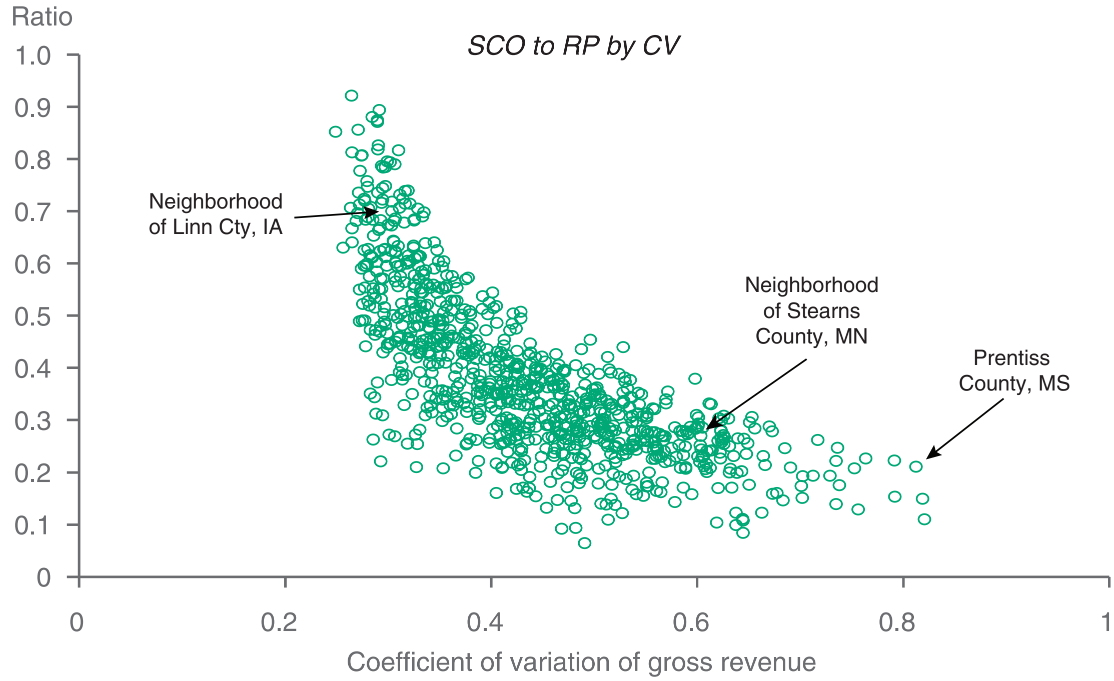
[15]Using simple double-log univariate regressions of the data in figure 8, 59 percent of the variation in the SCO/RP ratio is explained by the CV of gross revenue and 77 percent of the variation in the ARC/RP ratio is explained by the coefficient of variation of gross revenue. Note that the denominator (RP) is increasing in the coverage-rate choice, SCO is decreasing in the RP coverage rate, and ARC payments are invariant to the coverage choice. Hence, the relationship of the SCO/RP ratio to the CV of revenue is likely to have some sensitivity to the RP coverage rate choice, while the ARC/RP ratio is strictly decreasing in the coverage choice.

a 1-percent increase in the CV causes a smaller marginal percentage drop in the ratio for SCO than for ARC, suggesting that SCO maintains a higher level of benefits than does ARC when production becomes more risky. Focusing solely on this metric, SCO generally appears more attractive than ARC to typical producers. This could, in part, be due to the fact that producers receive some upside-price protection with SCO (given the assumption of an underlying RP policy) that is absent with ARC. However, since the two shallow-loss programs operate differently, producers may have preferences over the various properties of the two offered programs that will help dictate their final enrollment choices. And, indeed, election results made available from USDA's Farm Service Agency have shown that producers appear to have overwhelmingly elected ARC over PLC (and hence, SCO).

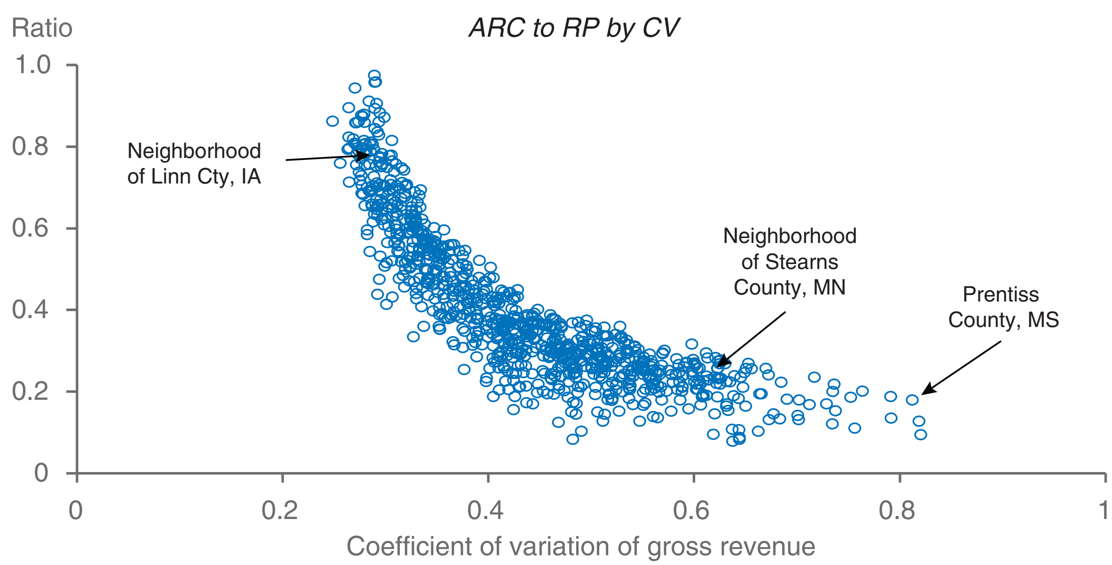
Figure 10

Ratio of shallow loss to insurance support versus the coefficient of variation of gross revenue for all counties (based on 2014 expected prices and yields and RP with 75-percent coverage rate)

(a) Ratio of SCO total premium to RP total premium



(b) Ratio of mean ARC payment to RP total premium



ARC = Agriculture Risk Coverage program; RP = Revenue Protection; SCO = Supplemental Coverage Option.
Coefficient of variation of gross revenue is a measure of risk evaluated by dividing the standard deviation (spread) of gross revenue by its mean (average) value.
Note: Fig. 10 shows a typical producer for each U.S. county for which USDA's National Agricultural Statistics Service reported soybean production from 1975 through 2013.
Source: USDA, Economic Research Service.

The Role of Price Changes in Program Choice

Program benefits can differ based on how prices change over time (table 3). For example, if the average futures price at planting time—our expected price (E[P])—was high relative to the actual 2014 planting time price, then SCO would have a higher probability of providing a greater level of support to producers than ARC. The SCO revenue-guarantee price equals E[P], while the ARC benchmark price is an Olympic average of season-average prices in the prior 5-year function (with the PLC reference price as a floor). This design characteristic means that the SCO revenue guarantee will change more from year to year than the ARC revenue guarantee (Effland et al., 2014). It also means that changing E[P] for a particular crop year does not change the ARC revenue guarantee in a particular crop year, increasing the sensitivity of ARC payments to within-season price changes relative to SCO. In particular, we assume that the distribution of harvest-time prices will be centered around the planting-time prices. While an actual draw from such a distribution may not be close to the planting-time price, when generating 10,000 draws, an average over these draws will place the price in a reasonably close neighborhood to the planting time price. For example, a 5-percent increase in the expected price at planting time means that all simulated prices increase by 5 percent, and a 5-percent decrease would lead to all simulated prices decreasing by 5 percent. So when expected prices are relatively high, ARC will not provide high payouts, while SCO has upside price protection that will generate higher support for producers. Hence, while ARC raises the lower bound of revenue more than does standalone SCO in the low base-price scenario, the downside risk protection of ARC in the high base-price scenario is essentially nonexistent. Risk reduction is notably better with SCO in the high base-price scenario due to the base price being the higher of the base price or the harvest price, based on our assumption of the underlying traditional policy being

Table 3
Sensitivity of mean ARC and net SCO payments—with and without gross revenue—to expected prices (E[P]) being 50 percent and 150 percent of the 2014 expected price (for soybeans, average across all U.S. counties)[1]

ARC			SCO (*assuming underlying 75-percent coverage revenue policy in place*)		
Lower E[P] *$5.68/bu*	E[P] *$11.36/bu*	Higher E[P] *$17.04/bu*	Lower E[P] *$5.68/bu*	E[P] *$11.36/bu*	Higher E[P] *$17.04/bu*
Mean payments per acre					
41 (8 ; 47)	14 (0 ; 47)	1 (0 ; 10)	4 (-2 ; 29)	9 (-5 ; 58)	13 (-7 ; 86)
Gross revenue per acre					
253 (83 ; 455)	507 (166 ; 911)	760 (249 ; 1,366)	249 (76 ; 455)	498 (151 ; 910)	748 (227 ; 1,365)
Gross revenue plus payment per acre					
294 (128 ; 493)	520 (195 ; 912)	761 (253 ; 1,366)	253 (89 ; 454)	507 (177 ; 909)	760 (266 ; 1,363)

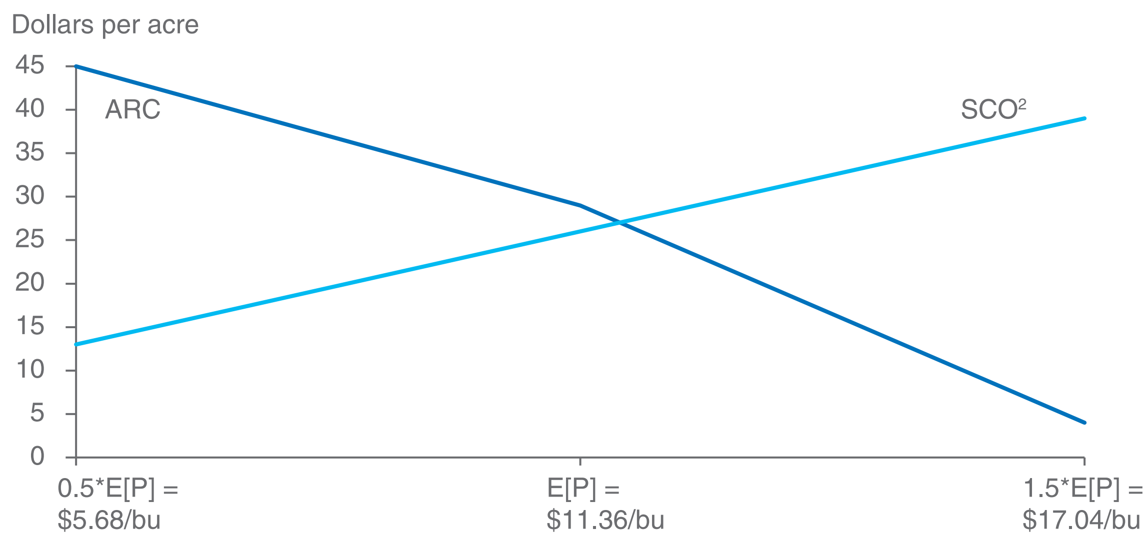
ARC = Agriculture Risk Coverage program; SCO = Supplemental Coverage Option; bu = bushel.
[1]"All U.S. counties" represents the analysis of a representative farmer in all counties for which USDA's National Agricultural Statistics Service has reported soybean yield data each year from 1975 through 2013, which is 889 counties. In the data summaries, the results for each farmer are weighted by the number of planted or base acres in the county. The different weights being used is the reason why the "gross revenue per acre" differs for ARC and SCO.
Source: USDA, Economic Research Service.

RP.Table 3 uses soybeans to show the greater sensitivity of average ARC payments to E[P] that are 50 percent and 150 percent of the 2014 E[P] relative to SCO, in addition to their impacts on revenue (see appendix table 9 for additional results for a low-, medium-, and high-risk county). For example, in the low-price scenario, ARC provides an average of $41 in benefits, while in the high-price scenario, ARC only provides $1 in benefits. With the SCO policy, a low expected price immediately adjusts the guarantee, and SCO ends up only providing $4 in benefits. However, SCO provides roughly three times that amount in a high expected-price scenario due to incorporating an upside price-risk component, assuming RP as the underlying insurance policy.

To better visualize the downside risk protection provided by ARC and SCO, figure 11 graphically compares the change in the lower bound of the 95-percent confidence interval of revenue for different expected price scenarios. For example, the lower bound of the 95-percent confidence interval of gross revenue (no program payments) for the low expected price is $83 per acre under the ARC scenario, which increases to $128 per acre when including program benefits—an increase of $45 per acre. For the high expected price, it is the difference between $249 per acre (the low end of the gross revenue per acre) and $253 per acre (the low end of the gross revenue plus payment per acre), which amounts to $4 per acre. Figure 11 graphically captures these differences in the lower bound of the 95-percent confidence interval between the per-acre gross revenue and the per-acre gross revenue plus program payments (the data can be seen in appendix table 10). This effectively shows how the program affects the lower bound of revenue and how expected prices affect how the programs work. By tracking this change in the lower bound of the confidence interval, we can obtain a good sense of how the programs affect the downside risk the producers face.

Figure 11

Current environment of prices and yields for soybeans, average across all U.S. counties[1]



ARC = Agriculture Risk Coverage program; RP = Revenue Protection; SCO = Supplemental Coverage Option.

[1]Enrolling in ARC limits losses more than enrolling in SCO when expected prices are low. If expected prices are high, the reverse holds (E[P]) = 50 percent, 100 percent, and 150 percent of the 2014 expected price.

[2]"SCO" is the SCO payment less what the farmer paid in SCO indemnity and, although examined as a "stand alone" policy here to compare directly to ARC, acts "as if" a 75-percent coverage Revenue Protection policy is in place.

Note: The $/acre values represent the difference between the lower bound of a 95-percent confidence interval for revenue with the program (ARC or SCO) payment and the lower bound of a 95-percent confidence interval without the payment.

Source: USDA, Economic Research Service.

If expected prices are low—we use half of the current expected prices—the chart shows that if a producer enrolls in the ARC program, the producer will increase his or her downside risk protection and the (95-percent) lower bound of revenues will increase by $45 per acre. If the producer selects SCO instead, his or her lower bound will increase by only $13 per acre. Under this scenario of low expected prices (and current historical prices and yields), ARC appears to provide greater downside-risk protection. However, as the expected price increases, the SCO program begins to provide more downside protection while ARC provides less. When expected prices are 150 percent of current expected prices, SCO increases the lower bound by almost $40 per acre, while ARC increases it by less than $5 per acre. Clearly, the two programs affect downside risk in different ways, and the level of expected prices can play a large role in determining which program provides the highest level of protection.

While the commodity-futures prices at planting time have a tendency to alter the level of payments, the historic prices are also important for determining program benefits for the ARC program. These prices help determine the benchmark and guarantee revenues for the ARC program. Under the simulation scenarios explored so far, the Olympic average of historic prices (over 2009-13) was higher than prices at planting time in 2014, which means that there is both an increased likelihood of ARC providing support and that support is likely to be higher due to a relatively high benchmark revenue. (Of course, the reverse would hold true if historic prices as manifested in the ARC benchmark price were lower than the 2014 planting time price.) Table 4 explores how different historic prices would affect the program payments made through the ARC program (note that the SCO indemnity payments are not affected at all by changes in historic prices—although SCO premiums can be affected to the extent these historic price changes affect loss ratings). We expect that the impacts on ARC payments and the ARC benchmark price will be the opposite of changing the current season price and, in fact, that is what table 4 shows.

ARC payments can change substantially (as shown earlier in figure 6 when using the deterministic framework), depending on the level of historic prices. The current high historic prices, and the fact that prices are declining (and potentially may remain substantially lower than historic prices), may play roles in which program farmers view as most beneficial for them over the next several years. Furthermore, producers may select both SCO and PLC for a particular crop and farm, but rules prevent a producer from selecting both ARC and PLC for a single crop on the same farm. While this is a consideration for producers to keep in mind, prices would have to drop substantially for PLC payments to come into play. For instance, soybean prices would have to drop below $8.40 per bushel for a PLC payment to be made. If the realized price did drop below the PLC reference price of $8.40 per bushel, a producer enrolled in SCO and PLC would then receive further benefits from the PLC program in addition to those of the SCO program (benefits that a grower enrolled in ARC would not receive). Producers will have to work through these issues when weighing the pros and cons of which programs to enroll in.

While prices can alter the level of support, the parameters of the various programs also matter. However, the program parameters will only change when policymakers alter the programs—typically in a Farm Act. The appendix contains an analysis of how the program parameters affect program efficacy in the section called "Looking ahead."

Table 4

Sensitivity of soybean ARC payments to the ARC benchmark price (dollars per bushel)[1]

	ARC payments per acre		
	Low benchmark price	High benchmark price	2014 ARC benchmark price
	75 percent of 2014 benchmark price	125 percent of 2014 benchmark price	
All U.S. counties	1.41 (0 ; 18)	41 (0 ; 58)	14 (0 ; 47)
Low-risk county (Linn Cty, IA)	0.51 (0 ; 2)	46 (0 ; 65)	13 (0 ; 52)
Medium-risk county (Stearns Cty, MN)	1.10 (0 ; 26)	37 (0 ; 53)	14 (0 ; 42)
High-risk county (Prentiss Cty, MS)	3.42 (0 ; 23)	31 (0 ; 39)	15 (0 ; 31)

Note: Numbers in parentheses are lower and upper bounds of a 95-percent confidence interval.
ARC = Agriculture Risk Coverage program.
[1]"All U.S. counties" represents the analysis of a representative farmer in all counties for which USDA's National Agricultural Statistics Service has reported soybean yield data each year from 1975 through 2013, which is 889 counties. In the data summaries for the ARC analysis in this table, the results for each farmer are weighted by the number of soybean base acres in the county.
Source: USDA, Economic Research Service.

Mapping How Support Programs Affect Changes in Risk

The next part of this analysis explores how risk reduction at the county level varies across the United States. Corn, soybeans, and winter wheat have four maps each. The first map depicts the coefficient of variation of gross corn revenue, denoted as $CV_{0.}$ The colors used for the map represent the level of risk as measured by the coefficient of variation. For example, dark blue counties have CV_0s below 0.35 and are the least risky with respect to corn revenue without support payments. The red counties have CV_0s above 0.55 and are the most risky counties with respect to corn revenue without support payments. The next three maps are the change in the coefficient of variation, denoted as ΔCV, for PLC, ARC, and SCO, where ΔCV is the CV of total gross revenue (gross revenue plus the support payment) less CV_0. For these maps, the program parameters (e.g., reference price, maximum coverage rate) are set at the actual values in the 2014 Farm Act. The green color corresponds to those counties where the ΔCV is greater than -0.01 and fall into the lowest risk reduction category. The blue counties have ΔCVs less than -0.03 and fall into the highest risk reduction category. On both the CV_0 and ΔCV maps, white counties indicates counties that we do not have continuous data for 1975 through 2013. As in the earlier section of the report, the simulations assume 2014 expected prices and yields.

In figure 12, a pattern emerges for the CV_0s of corn revenue. Most of the counties in Iowa and Illinois are low risk compared to the rest of the country. Indiana and southern Minnesota also contain a large portion of the corn-growing counties that have low revenue risk. Not surprisingly, these low-risk areas are where the majority of corn is grown in the United States, and the counties comprise the Corn Belt. Generally, as one moves farther away from the Corn Belt, corn revenue becomes more risky. There are high-risk counties for corn revenue throughout much of the United States. Such areas are in Texas, the Carolinas, and the Dakotas.

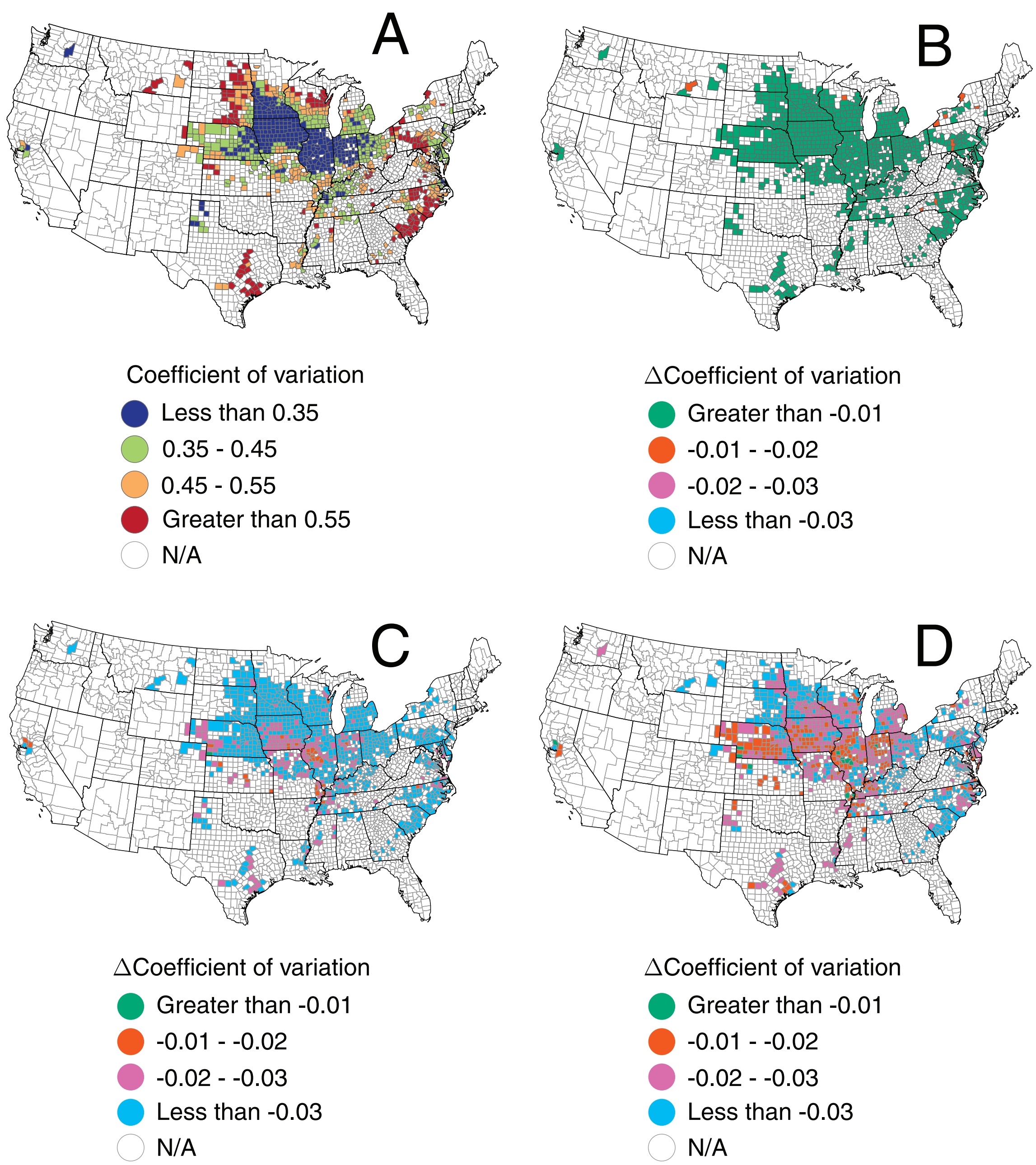
PLC, ARC, and SCO all have unique patterns of risk reduction across the United States. Figure 12b shows the risk reduction for corn under PLC. Throughout the country, with a few exceptions in Montana, Wisconsin, Pennsylvania, and New York, PLC provides very low risk reduction. The low revenue-risk reduction from PLC is not surprising since PLC is designed to reduce price risk, not revenue risk. Figure 12c shows that with corn ARC payments, most counties appear in the highest risk-reduction category and no counties fall in the lowest risk-reduction category. Counties in the middle revenue-risk reduction categories are scattered throughout the United States, with the exception of a cluster of the green and pink counties in southern Iowa and Illinois. This group of counties shows that the risk reduction from ARC payments has a weak negative correlation with CV_0. In other words, low revenue-risk counties may experience lower revenue-risk reduction compared to a high-risk area. Figure 12d demonstrates that many counties experience lower risk reduction from SCO compared to ARC, but the correlation between CV_0 and risk reduction can more easily be seen under SCO.

Figure 13a illustrates soybean revenue risk. The band of dark blue counties from eastern Nebraska through Indiana indicates low revenue risk for soybeans in this region. Emanating outward from these counties, soybean revenue tends to increase in riskiness. Soybean revenue in the Carolinas is at a higher risk compared to the majority of soybean-producing counties. High-risk counties can also be found in Arkansas and Mississippi near the Mississippi River. Figure 13b shows the effect of PLC on soybean revenue risk. For soybean revenue, the risk reduction from PLC is minimal for all counties. Figure 13c and figure 13d illustrate that for soybeans, ARC and SCO tend to reduce more revenue risk compared to PLC, especially in high-risk counties. Like corn, ARC payments for soybean revenue tend to provide higher risk reduction compared to SCO.

Figure 14a illustrates that the production of winter wheat in the simulation is rather dispersed compared to the production of corn and soybeans. No wheat-producing counties fall into the lowest category of revenue risk. Pennsylvania and Michigan have comparatively low revenue risk for winter wheat, while winter wheat revenue in Oklahoma and Texas tends to be higher risk. Although figure 14b shows that the majority of counties experience very low revenue-risk reduction from PLC, some of the high revenue-risk counties in Texas and Oklahoma fall into the second lowest risk-reduction category. ARC and SCO do not present a clear pattern with regard to reducing revenue risk for winter wheat, which is made evident in figure 14c and figure 14d, respectively. Compared to ARC, SCO appears to provide higher risk reduction for winter wheat, contrary to the findings of soybeans and corn. This may help explain why wheat producers elected to cover 42 percent of wheat base acres with PLC, a much higher level than that found on corn or soybean acres (USDA/FSA, 2015).

Figure 12

(A) Risk in corn gross revenue, measured as the coefficient of variation (CV) and changes in risk (ΔCV) for (B) PLC, (C) ARC, and (D) SCO[1] where reference prices and coverage rates are held at the 2014 Farm Act levels



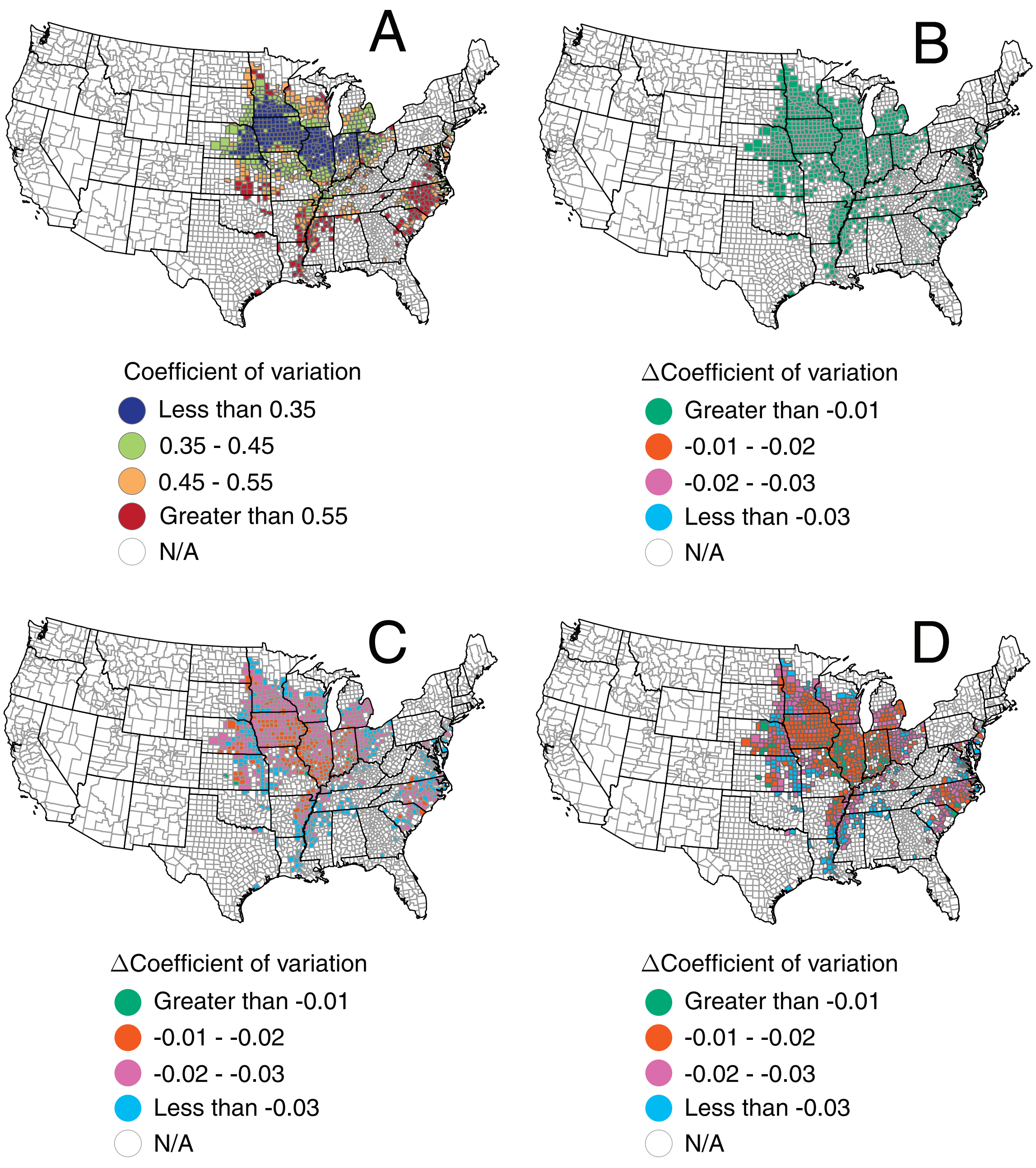
ARC = Agriculture Risk Coverage program; RP = Revenue Protection; SCO = Supplemental Coverage Option.
N/A = data not available.

[1]The SCO calculation insures down to the 75-percent level, as if there were an underlying RP policy with 75-percent coverage. However, we assume there is no RP policy here in order to show the risk reduction impacts of SCO alone, so deeper losses otherwise covered by a 75-percent RP policy are realized by the producer in this scenario. Note that, in reality, SCO cannot be purchased independently of the underlying Federal crop insurance policy.

Source: USDA, Economic Research Service.

Figure 13

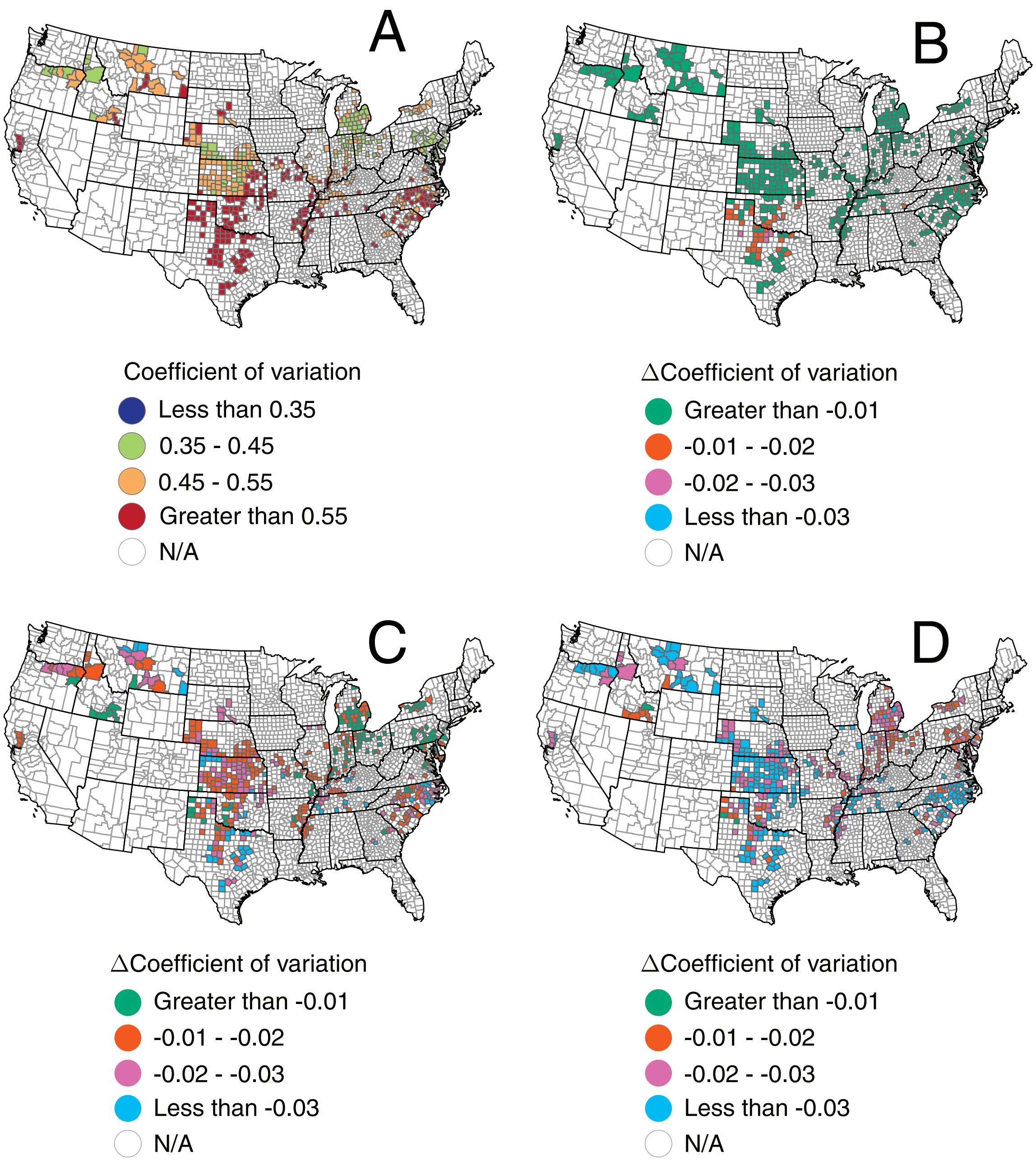
(A) Risk in soybean gross revenue, measured as CV and changes in risk for (B) PLC, (C) ARC, and (D) SCO[1] where reference prices and coverage rates are held at the 2014 Farm Act levels



ARC = Agriculture Risk Coverage program; RP = Revenue Protection; SCO = Supplemental Coverage Option.
N/A = data not available.
[1]The SCO calculation insures down to the 75-percent level, as if there were an underlying RP policy with 75-percent coverage. However, we assume there is no RP policy here in order to show the risk-reduction impacts of SCO alone, so deeper losses otherwise covered by a 75-percent RP policy are realized by the producer in this scenario. Note that, in reality, SCO cannot be purchased independently of the underlying Federal crop insurance policy.
Source: USDA, Economic Research Service.

Figure 14

(A) Risk in winter wheat gross revenue, measured as CV and changes in risk for (B) PLC, (C) ARC, and (D) SCO1 where reference prices and coverage rates are held at the 2014 Farm Act levels



ARC = Agriculture Risk Coverage Program; RP = Revenue Protection; SCO = Supplemental Coverage Option.
N/A = data not available.
[1]The SCO calculation insures down to the 75-percent level, as if there were an underlying RP policy with 75-percent coverage. However, we assume there is no RP policy here in order to show the risk reduction impacts of SCO alone, so deeper losses otherwise covered by a 75-percent RP policy are realized by the producer in this scenario. Note that, in reality, SCO cannot be purchased independently of the underlying Federal crop insurance policy.
Source: USDA, Economic Research Service.

Conclusions

PLC, which acts as a price floor, and SCO and ARC, colloquially known as "shallow-loss" programs, are new programs introduced in the 2014 Farm Act. These programs interact with each other and with the Federal crop insurance (FCI) program, generating a complex set of producer options and potential revenue outcomes. Each program affects agricultural risk exposure but does so in different ways. The underlying mechanics of these new programs and the ways in which the various available combinations of programs can impact crop revenue add to the knowledge base on the programs' impact on producer revenues and expected program costs.

Our analysis shows that mean payment and downside risk-reduction differences between SCO and ARC for soybean producers are quite sensitive to prices at planting time. From the standpoint of planting time in 2014, ARC would have provided a higher mean payment and generally a greater reduction in downside revenue risk than SCO, even if these differences were a relatively small portion of revenue. However, our analysis also shows that ARC payments in any given year are notably more sensitive than SCO payments to planting-time prices that year. Just as the producer's feeling about the future path of prices across the time span of the 2014 Farm Act may determine the choice between PLC and ARC (Effland et al., 2014), the decision between SCO and ARC may be also driven by the perception of future years' prices given that enrollment in ARC precludes enrolling in SCO for that crop. If the producers believe they face significant price risk, enrolling in SCO would also allow them to enroll in PLC, whereas enrolling in ARC would not permit that choice.

It is also possible that factors not directly related to returns per acre may tip the scales in favor of enrolling in either ARC or SCO. For example, an individual is limited to $125,000 in benefits generated from any combination of ARC payments, PLC payments, marketing loan gains, and/or loan deficiency payments (other than for peanuts, which has an additional, separate limit). While smaller farms may not need to worry about this limit, larger farms could run up against the imposed limits. On the other hand, enrolling in SCO requires the producer to pay a premium to enroll, even if the Government premium subsidy is 65 percent. The large number of options and how the programs interact with other programs complicate these decisions—particularly since these elections will last for the duration of the 2014 Farm Act.

Understanding how producers will respond to the new programs and how their decisions will be made will allow policymakers and other stakeholders to assess how the programs affect producer well-being. Modelling behavior often requires multiple assumptions that can be unrealistic and parameters that are often not known with certainty. Using portfolio analysis is also possible, but that relies on limited distributional information about producers' revenues. We therefore explore the concept of stochastic dominance in this report, which doesn't require unrealistic assumptions, while also taking into account the entire revenue distribution. However, this method often results in no clear choice for the producer.

Finally, the magnitude of risk reduction from these new Federal programs is dependent not only on the structure of the program, but also on the crop and the parameters of the program. For PLC, 2014 Farm Act reference prices lead to varied results among corn, soybeans, and winter wheat. In particular, for soybeans, the percentage of risk reduction is less than a tenth of risk reduction for corn and winter wheat. Also for corn and soybeans, PLC does not necessarily provide higher risk reduction for counties with high revenue risk. For ARC and SCO, as the coverage rate increases, the correlation between the standardized payment and the change in the coefficient of variation decreases, although this correlation remains strong. For corn and soybeans, ARC and SCO tend to have higher risk reduction for high-risk counties and lower risk reduction for low-risk counties, while the risk reduction among counties is more mixed for wheat. Corn and soybeans are grown in a relatively concentrated geographic area where the climate and soil conditions are relatively homogenous compared with where winter wheat is grown, which ranges from one side of the country to the other. As a result, the correlation between higher risk reduction in higher risk counties is stronger for corn and soybeans. In contrast, for winter wheat, idiosyncratic risk plays a larger role, likely due in part to geographic differences, generating a weaker link between the change in risk reduction and the level of risk faced by producers.

One caveat to these simulation results is that only counties with continuous production were included, which may have introduced a selection bias. Counties that sporadically grow a crop may be higher risk than the counties represented in the simulation. Therefore, high-risk counties may be underrepresented. In addition, the results can be sensitive to the assumption of the expected prices and yield used in the simulation, and, for ARC, the assumption of season-average prices in prior years that feed into the calculation of the revenue guarantee.

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Appendix

Looking Ahead

Federal farm programs are set in stone for the life of the 2014 Farm Act—approximately 5 years. However, when Congress introduces a new Farm Bill, it could change the landscape of current Federal farm programs, including adding, eliminating, or making adjustments to current programs. In this appendix, we focus on the future, exploring how potential changes to key program parameters could alter the effectiveness of the Federal programs.

Program Parameters' Importance in Contributing to Revenue Risk Reduction

The simulation approach is used to examine the sensitivity of support to the program parameters. Key parameters affecting payments include the reference price for PLC (appendix table 1) and the coverage rate on benchmark or expected area revenue for ARC and SCO. Changes in these parameters have implications for Government costs, mean producer income, and reduction in the producer's revenue risk. For this report, we focus on the latter impact.

Appendix table 2 displays simulation results for the risk reduction of PLC using the actual reference prices as well as hypothetical reference prices both below and above the actual reference price to demonstrate the sensitivity to the choice of reference price. All else being equal, decreasing the

Appendix table 1
Legislative prices in Title I of two Farm Acts, by covered commodities

Covered commodity	Unit	PLC reference price (2014 Farm Act)[1]	CCP target price (2008 Farm Act)[2]
Wheat	Bushel	5.50	4.17
Barley	Bushel	4.95	2.63
Oats	Bushel	2.40	1.79
Peanuts	Pound	0.2675	0.2475
Corn	Bushel	3.70	2.63
Grain sorghum	Bushel	3.95	2.63
Soybeans	Bushel	8.40	6
Dry peas	Pound	0.1100	0.0832
Lentils	Pound	0.1997	0.1281
Large chickpeas	Pound	0.2154	0.1281
Small chickpeas	Pound	0.2015	0.1036
Canola	Pound	0.2015	0.1268
Flaxseed	Bushel	11.2800	0.1268
Other oilseeds	Pound	0.2015	0.1268
Rice (long grain)	Pound	0.1400	0.105
Rice (medium grain)	Pound	0.1400	0.105
Upland cotton	Pound	NA	0.7125

PLC = Price Loss Coverage program; CCP = Counter-cyclical Payment program; NA = not applicable—cotton is no longer considered a covered commodity under the 2014 Farm Act.
[1]Source: 2014 Farm Act.
[2]Source: 2008 Farm Act. Table reflects final updates of target prices.

Appendix table 2

Simulated national average of payments and change in variability of crop revenue under PLC, assuming alternative reference prices[1,2]

Corn				Soybeans				Winter wheat			
Reference price ($/bu)	Payment ($/acre)	ΔCV	%ΔCV	Reference price ($/bu)	Payment	ΔCV	%ΔCV	Reference price ($/bu)	Payment ($/acre)	ΔCV	%ΔCV
$3.40	0.38	-0.0005	-0.14	$8.10	0.03	-0.0001	-0.02	$5.20	0.76	-0.0031	-0.56
$3.70[3]	3.62	-0.0040	-1.18	$8.40	0. 17	-0.0003	-0.09	$5.50	1.70	-0.0066	-1.19
$4.00	12.16	-0.0122	-3.55	$8.70	0.54	-0.0010	-0.28	$5.80	3.37	-0.0124	-1.98

PLC = Price Loss Coverage program; bu = bushel; ΔCV is CV_1-CV_0, where CV_0 is the coefficient of variation of gross crop revenue and CV_1 is the coefficient of variation of total gross revenue (gross crop revenue plus the PLC payment). Coefficient of variation is the standard error of the revenue divided by its mean.

[1] Simulations assume 2014 expected price and yields.

[2] The results represent a weighted average of the revenues of a representative farmer in each county for which USDA's National Agricultural Statistics Service has reported yield data each year from 1975 through 2013, which is 1,001 counties for corn, 889 counties for soybeans, and 510 counties for winter wheat. In the data summaries, the results for each farmer are weighted by the number of base acres in the county.

[3]Actual reference price in the 2014 Farm Act.

Source: USDA, Economic Research Service.

reference price will lower the frequency with which payments are triggered and lower the size of the payments, thus providing lower revenue-risk reduction (and vice versa for increasing reference prices). Appendix table 2 shows that PLC has the smallest risk reduction out of the three programs. The lowest reference price for corn causes changes in the CV less than 0.001, although increasing the reference price for corn from $3.40 to $4.00 changes the risk reduction from 0.14 percent to 3.55 percent. For soybeans, the reference prices of $8.10 and $8.40 cause changes in the CV for revenue no more than .001. Respectively, at these reference prices for soybeans, revenue risk decreases by 0.02 percent and 0.09 percent. Even at 30 cents higher than the reference price in the 2014 Farm Act, the risk reduction from PLC for soybeans is less than 1 percent. For winter wheat, the changes are moderate, with risk reduction ranging from 0.56 percent to 2.29 percent for the lowest to highest reference prices, respectively.

In the 2014 Farm Act, the coverage rate for ARC is 86 percent of benchmark revenue. Appendix table 3 includes simulation results for not only this current coverage rate, but also coverage rates of 82 percent of benchmark revenue and 90 percent of benchmark revenue. The simulation results illustrate the risk reduction from ARC is much higher than the risk reduction from PLC, at least under the scenario of 2014 expected prices and yields. Corn experiences large risk reduction from ARC relative to soybeans and winter wheat. At coverage rates of 86 percent and 90 percent of benchmark revenue, risk reduction for corn is over 10 percent. Although the risk reduction is not as high for soybeans, the risk reduction for soybeans ranges from 5.36 percent to 7.95 percent for coverage rates of 82 percent to 90 percent of benchmark revenue. Winter wheat is a higher risk crop compared to corn and soybeans. Interestingly, the risk reduction from ARC is smaller for winter wheat compared to corn and soybeans. Even when looking at the ΔCV instead of percent-ΔCV, the changes in winter wheat are still smaller than the changes for corn and soybeans.

Appendix table 3

Simulated national average of payments and change in variability of crop revenue under ARC, assuming alternative ARC coverage rates[1,2]

	Corn			Soybeans			Winter wheat		
Coverage rate	Payment	ΔCV	%ΔCV	Payment	ΔCV	%ΔCV	Payment	ΔCV	%ΔCV
82 percent	21.33	-0.031	-8.94	10.16	-0.020	-5.36	3.53	-0.017	-3.37
86 percent[3]	27.64	-0.035	-10.34	13.78	-0.025	-6.71	4.21	-0.020	-3.82
90 percent	34.23	-0.039	-11.45	17.78	-0.029	-7.95	4.97	-0.022	-4.29

ARC = Agriculture Risk Coverage program; ΔCV is CV_1-CV_0, where CV_0 is the coefficient of variation of gross crop revenue and CV_1 is the coefficient of variation of total gross revenue (gross crop revenue plus the Price Loss Coverage program payment). Coefficient of variation is the standard error of the revenue divided by its mean.

[1]Simulations assume 2014 expected price and yields.

[2]The results represent a weighted average of the revenues of a representative farmer in each county for which USDA's National Agricultural Statistics Service has reported yield data each year from 1975 through 2013, which is 1,001 counties for corn, 889 counties for soybeans, and 510 counties for winter wheat. In the data summaries, the results for each farmer are weighted by the number of planted acres in the county.

[3]Actual ARC coverage rate in the 2014 Farm Act.

Source: USDA, Economic Research Service.

SCO currently allows for individuals to purchase coverage for up to 86 percent of the expected revenue/yield. Like the simulation results for ARC, the sensitivity analysis for SCO includes the current coverage rate of 86 percent as well as alternative coverage rates of 82 percent and 90 percent. Although producers need to have an underlying insurance policy to purchase SCO, indemnity payments from the underlying policy are not included here. By not including any Federal crop insurance indemnity payments, this allows for a more direct comparison between SCO and the other two programs.

Although ARC has higher payments than SCO and PLC for corn and soybeans, appendix table 3 illustrates that changing the coverage rate for SCO causes larger changes in the risk reduction compared to changing the coverage rate for ARC. For example in soybeans, changing the trigger from 82 percent of benchmark revenue to 90 percent of benchmark revenue for ARC results in an additional risk reduction of 2.59 percent.[16] However, for SCO, changing the coverage rate from 82 percent to 90 percent leads to an additional risk reduction of 4.52 percent. This larger increase in risk reduction for SCO holds for corn and winter wheat as well. The larger risk reduction in SCO stems from the harvest price protection built into revenue protection. Revenue protection (RP) is the underlying crop insurance policy used for the SCO simulations. The harvest-price protection calculates the revenue guarantee for SCO using the higher of the planting-time price or the harvest-time price. This flexibility in the guarantee leads to higher risk reduction. Producers of corn, soybeans, and wheat are able to enroll in PLC and SCO, potentially giving some additional downside risk protection over just SCO alone. Even under the scenario of 2014 expected prices and yields, in the case of corn, it appears that the risk reduction will be greater with the combination of PLC and SCO than with ARC; for soybeans, adding PLC provides little benefit, and for winter wheat, SCO alone already gives higher risk reduction benefits than ARC.

[16]In actual practice, setting the SCO coverage rate at 85 percent or lower presumes that the coverage rate in the underlying traditional crop insurance program is less than the 85-percent coverage available for some crops in some regions.

Relationships With Revenue Risk

Unlike the expired Direct Payments, payments from ARC, PLC, and SCO will tend to be counter-cyclical to crop revenue. That is, because PLC, ARC, and SCO payments are triggered when price or revenue fall below a threshold, these payments will tend to be made when farm income falls, thus partially compensating the farmer for the decrease in gross revenue and reducing variability in farm revenue.[17, 18] One way to assess the efficiency of a payment in targeting revenue risk is to examine the correlation of the payment with the change in revenue risk it provides. As revenue risk varies among crops and regions, we can also use correlation analysis to examine to what extent, if any, the programs' risk-reduction impacts target lower versus higher risk producers.

For each crop and program specification, to examine to what extent the payment is associated with revenue risk reduction, appendix tables 5 through 7 present the Pearson correlation coefficients[18] between the standardized payment and the change in CV of revenue (CV of total gross revenue minus CV of gross revenue) the payment provides. The standardized payment is the payment per acre divided by the mean gross crop revenue per acre; standardizing the payment puts it on a unit-free footing, simplifying its comparison to the CV by removing scale effects. If the correlation between the standardized payment and the change in CV is closer to -1, the payment is more closely associated with reducing revenue risk, e.g., the larger the payment, the more negative (decreasing) is the change in CV. Our expectation is that these correlations will be negative due to program design, and that the payments under a revenue program, such as ARC or SCO, will more closely target revenue risk than a program that targets only price, like PLC. However, a variety of factors could affect the measured correlations, including the level of reference prices relative to actual prices and empirical price-yield relationships.

To examine to what extent these payments target lower or higher risk producers, the tables also present the correlation of the change in CV of revenue with the CV of gross revenue. The closer this correlation is to zero, the more uniformly the program treats producers regardless of their revenue risk. The simulated averages of each of these variables for each county are used to calculate the correlation coefficient. In the interest of brevity, the change in the CV for crop revenue with and without support will be denoted as ΔCV and the CV for gross crop revenue (revenue without support payments) will be denoted as CV_0. As with appendix tables 2 through 4, appendix tables 5 through 7 show the results under actual reference prices and coverage rates and under the hypothetical lower and upper values.

For PLC, the correlation between the standardized payment and the change in revenue risk for each crop is negative in most cases, which can be seen in appendix table 5. The correlation coefficients for soybeans, corn, and winter wheat under the references prices in the 2014 Farm Act are -0.61, -0.78, and -0.96 , respectively. The negative correlation indicates that when the standardized payment increases, the risk in the crop revenue is likely reduced. When the reference price for corn is $4.00

[17]The SCO, ARC, and PLC program payments are not guaranteed to be countercyclical to farmer revenue; ARC and SCO are area payments, and, as such, have the possibility of being triggered even if an individual farmer revenue increases, or not being triggered when the farmer's revenue falls. Further, receiving an ARC or PLC payment does not mean a particular farmer's revenue has fallen, since these programs depend on a farmer's base, not what a farmer actually plants.

[18]The Pearson correlation coefficient is a statistic between -1 and 1. Negative 1 for the correlation coefficient indicates a perfectly linear negative relationship between two variables, while positive 1 indicates a perfectly linear positive relationship between two variables. When the correlation coefficient = 0, there is no linear relationship between the two variables.

and \$5.80 for winter wheat, the correlation between standardized payment and ΔCV is positive. This positive correlation indicates upside "risk" may be present. Therefore, total gross revenue, despite being higher with the PLC payment, becomes more volatile if the PLC payments are triggered by a relatively high reference price.

Under PLC, we see a negative relationship for corn and winter wheat between CV_0 and ΔCV, meaning that higher risk areas are likely to see higher decreases in revenue risk. For corn and winter wheat, as the reference price increases, this correlation becomes slightly stronger. For corn, the correlation between CV_0 and ΔCV is weak to moderate, spanning from -0.38 to -0.52 given the reference prices. Appendix table 5 also shows that the correlation for CV_0 and ΔCV is between -0.64 and -0.68 for winter wheat for the given reference prices. However, in the case of soybeans, the correlation between CV_0 and ΔCV is positive for all three reference prices. Although this relationship is fairly weak for soybeans, low-revenue-risk areas are more likely to experience larger decreases in revenue risk compared to higher risk areas.

Appendix table 6 illustrates that, as expected, ARC has more consistent patterns of correlation among the crops compared to PLC. The correlation between ΔCV and the standardized payment is the strongest for winter wheat and the weakest for corn. However, all three crops have strong negative correlation between ΔCV and the standardized payment for the coverage rates of 82 percent and 86 percent, with the correlation stronger than -0.85. As with PLC, strong negative correlation between the standardized payment and ΔCV indicates that increasing the support payments with respect to crop revenue will likely decrease the risk in crop revenue. For corn, soybeans, and winter wheat, there is a decrease in the correlation between ΔCV and the standardized payment when the coverage rate is 90 percent. When the coverage rate is 90 percent, the correlation between ΔCV and the standardized payment for corn, soybeans, and winter wheat is -0.50, -0.76, and -0.81, respectively. One possible explanation for the weakening correlation is the higher frequency of maximum payments at higher coverage rates. A higher frequency of maximum payments causes nonlinearity in the relationship between standardized payments and ΔCV, which weakens the linear relationship.

Despite the strong correlation between ΔCV and the standardized payment for ARC, the correlation between the ΔCV and CV_0 is somewhat weak. The correlation coefficient between ΔCV and CV_0 for corn is -0.40 at the 86-percent coverage rate and -0.43 for soybeans at the same rate. The correlation is weaker for winter wheat at -0.32 for the 86-percent coverage rate. One should note that, on average, the yield variation among farms is substantially higher for wheat compared to soybeans and corn. Therefore, winter wheat farm-level yields are not as closely tied to county yields compared to the yields of corn and soybeans. If farm yields are not closely tied to county yields, then risk reduction cannot be closely tied to CV_0 under a county-based revenue support program.

The correlation results for SCO for corn, soybean, and winter wheat producers, seen in appendix table 7, are more similar to ARC than PLC. The correlation between the standardized payment and ΔCV for SCO is strong and negative, and the correlation weakens as the maximum coverage increases. For example, with a coverage rate of 82 percent for SCO, the correlation between standardized payment and ΔCV for winter wheat is -0.96, but this correlation drops to -0.69 when the coverage rate for SCO is 90 percent. The cause for this drop in correlation is likely the same cause as the drop in correlation for the standardized payment and ΔCV seen in appendix table 6 for ARC. Increasing the coverage rate increases the frequency of maximum payments, which creates a nonlinearity in the trend between standardized payment and ΔCV. The nonlinearity in turn decreases the correlation between the two variables. Unlike ARC, the correlation between CV_0 and ΔCV for SCO remains very similar across coverage rates. The correlation coefficients between CV_0 and ΔCV for SCO are -0.39, -0.45, and -0.21 for corn, soybeans, and winter wheat, respectively, at the coverage rates of 86 percent and 90 percent. Therefore, for SCO, increasing the coverage rate will not increase or decrease the ability to target risk reduction for high-risk areas.

Appendix table 4

Simulated national average of payments and change in variability of crop revenue under SCO assuming alternative coverage rates[1,2,3]

	Corn			Soybeans			Winter wheat		
Coverage rate	Pay-ment	ΔCV	%ΔCV	Payment	ΔCV	%ΔCV	Payment	ΔCV	%ΔCV
82 percent	6.96	-0.016	-4.59	4.58	-0.012	-3.10	3.98	-0.021	-4.00
86 per-cent[4]	12.61	-0.026	-7.49	8.59	-0.021	-5.26	6.79	-0.033	-6.34
90 percent	19.80	-0.036	-10.54	13.79	-0.300	-7.62	10.01	-0.045	-8.69

SCO = Supplemental Coverage Option; ΔCV is CV_1-CV_0, where CV_0 is the coefficient of variation of gross crop revenue and CV_1 is the coefficient of variation of total gross revenue (gross crop revenue plus the Price Loss Coverage program payment). Coefficient of variation is the standard error of the revenue divided by its mean.

[1] Simulations assume 2014 expected price and yields.

[2] The results represent a weighted average of the revenues of a representative farmer in each county for which USDA's National Agricultural Statistics Service has reported yield data each year from 1975 through 2013, which is 1,001 counties for corn, 889 counties for soybeans, and 510 counties for winter wheat. In the data summaries, the results for each farmer are weighted by the number of planted acres in the county.

[3] The SCO calculations assume that the underlying policy is Revenue Protection with 75-percent coverage rate. The SCO payments are net of the farmer-paid SCO premium.

[4] Actual SCO coverage rate in the 2014 Farm Act.

Source: USDA, Economic Research Service.

Appendix table 5

Correlations of the change in variability of revenue (ΔCV) with the payment and with the base variability of revenue: the case of PLC under alternative reference prices[1,2,3]

Corn			Soybeans			Winter wheat		
Reference price ($/bu)	Correlation of %ΔCV with:		Reference price ($/bu)	Correlation of %ΔCV with:		Refer-ence price ($/bu)	Correlation of %ΔCV with:	
	Payment[e]	CV_0		Payment	CV_0		Payment	CV_0
$3.40	-0.75	-0.38	$8.10	-0.59	0.38	$5.20	-0.95	-0.64
$3.70[4]	-0.78	-0.45	$8.40	-0.61	0.36	$5.50	-0.95	-0.66
$4.00	0.14	-0.52	$8.70	-0.64	0.33	$5.80	0.35	-0.68

PLC = Price Loss Coverage program; bu = bushel.

ΔCV is CV_1-CV_0, where CV_0 is the coefficient of variation of gross crop revenue and CV_1 is the coefficient of variation of total gross revenue (gross crop revenue plus the PLC payment). Coefficient of variation is the standard error of the revenue divided by its mean.

[1]Simulations assume 2014 expected price and yields.

[2]The results represent a weighted average of the revenues of a representative farmer in each county for which USDA's National Agricultural Statistics Service has reported yield data each year from 1975 through 2013, which is 1,001 counties for corn, 889 counties for soybeans, and 510 counties for winter wheat. In the data summaries, the results for each farmer are weighted by the number of base acres in the county.

[3]The payment was standardized by dividing it by the mean gross crop revenue.

[4]Actual reference price in the 2014 Farm Act.

Source: USDA, Economic Research Service.

Appendix table 6

Correlations change in variability of revenue (ΔCV) with the payment and with the base variability of revenue: the case of simulated ΔCV for ARC under alternative coverage rates[1,2,3]

Coverage rate	Corn		Soybeans		Winter wheat	
	Correlation of %ΔCV with:		Correlation of %ΔCV with:		Correlation of %ΔCV with:	
	Payment	CV_0	Payment	CV_0	Payment	CV_0
82 percent	-0.90	-0.42	-0.97	-0.46	-0.99	-0.34
86 percent [4]	-0.87	-0.40	-0.95	-0.42	-0.99	-0.32
90 percent	-0.50	-0.41	-0.75	-0.41	-0.81	-0.30

ARC = Agriculture Risk Coverage program.

ΔCV is CV_1-CV_0, where CV_0 is the coefficient of variation of gross crop revenue and CV_1 is the coefficient of variation of total gross revenue (gross crop revenue plus the Price Loss Coverage (PLC) payment). Coefficient of variation is the standard error of the revenue divided by its mean.

[1]Simulations assume 2014 expected price and yields.

[2]The results represent a weighted average of the revenues of a representative farmer in each county for which USDA's National Agricultural Statistics Service has reported yield data each year from 1975 through 2013, which is 1,001 counties for corn, 889 counties for soybeans, and 510 counties for winter wheat. In the data summaries, the results for each farmer are weighted by the number of base acres in the county.

[3]The payment was standardized by dividing it by the mean gross crop revenue.

[4]Actual coverage rate in the 2014 Farm Act.

Source: USDA, Economic Research Service.

Appendix table 7

Correlations change in variability of revenue (ΔCV) with the payment and with the base variability of revenue: the case of SCO under alternative coverage rates[1,2,3]

Coverage rate	Corn		Soybeans		Winter wheat	
	Correlation of %ΔCV with:		Correlation of %ΔCV with:		Correlation of %ΔCV with:	
	Payment	CV_0	Payment	CV_0	Payment	CV_0
82 percent	-0.90	-0.39	-0.96	-0.46	-0.96	-0.22
86 percent [4]	-0.87	-0.39	-0.94	-0.45	-0.94	-0.21
90 percent	-0.63	-0.39	-0.78	-0.45	-0.69	-0.21

SCO = Supplemental Coverage Option; ΔCV is CV_1-CV_0, where CV_0 is the coefficient of variation of gross crop revenue and CV_1 is the coefficient of variation of total gross revenue (gross crop revenue plus the Price Loss Coverage (PLC) payment). Coefficient of variation is the standard error of the revenue divided by its mean.

[1]Simulations assume 2014 expected price and yields.

[2]The results represent a weighted average of the revenues of a representative farmer in each county for which USDA's National Agricultural Statistics Service has reported yield data each year from 1975 through 2013, which is 1,001 counties for corn, 889 counties for soybeans, and 510 counties for winter wheat. In the data summaries, the results for each farmer are weighted by the number of base acres in the county.

[3]The payment was standardized by dividing it by the mean gross crop revenue.

[4]Actual coverage rate in the 2014 Farm Act.

Source: USDA, Economic Research Service.

Appendix table 8

Summary of program payments and total revenue producer ($/acre), soybeans

a. All counties

	Program enrollment					
	Not enrolled[1]	SCO only[2]	ARC only[3]	RP (75%)	RP+SCO+PLC	RP+ARC[3]
Average (net) payment	—	9	14	19	27	31
Average total revenue	498	507	520[2]	517	533	538[2]
Coefficient of variation of revenue[4]	0.40	0.38	0.36	0.30	0.28	0.27
95-percent confidence interval of revenue	[151, 910]	[177, 909]	[195, 912]	[359, 894]	[362, 895][5]	[367, 897][5]

b. Low-risk county (Linn County, IA)

	Program enrollment					
	Unenrolled	SCO only[2]	ARC only	RP (75%)	RP+SCO+PLC	RP+ARC
Average payment (net of premium)	—	8	13	9	17	22
Average total revenue	570	578	583	579	587	592
Coefficient of variation of revenue[4]	0.28	0.26	0.26	0.24	0.22	0.22
95-percent confidence interval	[287, 911]	[315, 909]	[319, 911]	[417, 904]	[413, 902][5]	[417, 904][5]

c. Medium-risk county (Stearns County, MN)

	Program enrollment					
	Not enrolled	SCO only[2]	ARC only	RP (75%)	RP+SCO+PLC	RP+ARC
Average (net) payment	—	10	14	33	42	47
Average total revenue	457	466	471	489	499	503
Coefficient of variation of revenue[4]	0.55	0.53	0.52	0.39	0.37	0.36
95-percent confidence interval	[0, 993]	[42, 993]	[42, 994]	[317, 967]	[312, 966][5]	[317, 968][5]

d. High-risk county (Prentiss County, MS)

	Program enrollment					
	Not enrolled	SCO only[2]	ARC only	RP (75%)	RP+SCO+PLC	RP+ARC
Average (net) payment	—	11	15	41	52	56
Average total revenue	324	335	339	365	376	380
Coefficient of variation of revenue[4]	0.76	0.73	0.72	0.49	0.47	0.47
95-percent confidence interval	[0, 871]	[-6, 877]	[0, 879]	[223, 837]	[217, 843][5]	[223, 845][5]

Note: Payments and total revenue (gross revenue plus payments) are net of the producer-paid premiums for Revenue Protection and Supplemental Coverage Option.

ARC = Agriculture Risk Coverage program; PLC = Price Loss Coverage program; RP = Revenue Protection; SCO = Supplemental Coverage Option. [1]For the summary across all counties, this column "not enrolled" shows statistics for gross revenue where the weighted average across counties is weighted by acres planted to soybeans in the county. However, for the simulations involving ARC, soybean base acres per county is used as the weight. In that case, the average gross revenue, coefficient of variation (CV), and 95-percent confidence interval is $506, 0.38, and [$166, $910], respectively. [2]"SCO only" is not available in practice but is used to allow a direct comparison with ARC. However, it still requires a lower bound on the coverage (since SCO covers down to the underlying policy in place). We therefore impose a lower limit of 75 percent (as if there was an RP policy in place that had a coverage rate of 75 percent. [3]With ARC, the results across counties are weighted by base acres, not planted acres. In this case, the mean and 95-percent confidence interval of "unenrolled" (i.e., gross revenue) are $507/acre and [$166/acre, $911/acre], respectively, and not those in the second column of the table. This confidence interval is nonparametric (i.e., does not assume any particular distribution), and as such, may not be symmetric around the average. [4]"Coefficient of variation of revenue" is the standard deviation of revenue divided by average revenue, and is a standardized measure to allow comparability of variability across programs. [5]While these are likely close to the true interval, we do not believe them—they are the result of averaging across counties while weighting by base acres. Adding ARC (or SCO plus PLC) to RP will not cause the lower end of the distribution to change for any individual county (see fig. 11). It will shift many producers to higher levels of revenues, indicated by the increase in the average total revenue, and will lower the CV of revenue, but will not shift the lower end of the distribution because these are area-based policies/programs and, as a result, will not provide benefits for everyone suffering losses—and there will be enough who do not correlate perfectly with the county outcomes such that the lower bound of the 95-percent confidence interval will remain unchanged. With respect to the upper bound, it is not clear how RP+SCO+PLC can have a higher upper bound than RP alone, given SCO also has a premium associated with it, which should lower that upper bound.

Source: USDA, Economic Research Service.

Appendix table 9

Sensitivity of mean ARC and net SCO payments—with and without gross revenue—to expected prices (E[P]) being 50 percent and 150 percent of the 2014 expected price, soybeans

	ARC		Net SCO[1] (assuming underlying 75-percent coverage revenue policy in place)	
	Lower E[P] $5.68/bu	Higher E[P] $17.04/bu	Lower E[P] $5.68/bu	Higher E[P] $17.04/bu
Mean payments per acre				
All U.S. counties[2]	41 (8 ; 47)	1 (0 ; 10)	4 (-2 ; 29)	13 (-7 ; 86)
Low-risk county (Linn Cty, IA)	47 (3 ; 52)	0 (0 ; 0)	4 (0 ; 35)	12 (-6 ; 105)
Medium-risk county (Stearns Cty, MN)	36 (0 ; 42)	1 (0 ; 27)	5 (-3 ; 28)	14 (-8 ; 84)
High-risk county (Prentiss Cty, MS)	29 (0 ; 31)	3 (0 ; 31)	5 (-3 ; 20)	16 (-9 ; 61)
Gross revenue per acre				
All U.S. counties[1,3]	253 (83 ; 455)	760 (249 ; 1366)	249 (76 ; 455)	748 (227 ; 1365)
Low-risk county (Linn Cty, IA)	285 (144 ; 456)	855 (430 ; 1367)	285 (144 ; 456)	855 (430 ; 1367)
Medium-risk county (Stearns Cty, MN)	228 (0 ; 497)	685 (0 ; 1490)	228 (0 ; 497)	685 (0 ; 1490)
High-risk county (Prentiss Cty, MS)	162 (0 ; 435)	489 (0 ; 1308)	162 (0 ; 435)	487 (0 ; 1308)
Gross revenue plus payment per acre				
All U.S. counties[1]	294 (128 ; 493)	761 (253 ; 1366)	253 (89 ; 454)	760 (266 ; 1363)
Low-risk county (Linn Cty, IA)	331 (194 ; 502)	855 (430 ; 1367)	289 (158 ; 455)	866 (473 ; 1364)
Medium-risk county (Stearns Cty, MN)	264 (42 ; 527)	686 (0 ; 1490)	233 (21 ; 496)	699 (63 ; 1489)
High-risk county (Prentiss Cty, MS)	191 (31 ; 465)	489 (0 ; 1308)	168 (-3 ; 438)	503 (-9 ; 1317)

Note: Actual expected price = $11.36/bu at time of planting in 2014; $5.68 = 0.5*$11.36 and $17.04 = 1.5*$11.36 are used to explore how variations in expected prices can alter program support. ARC = Agriculture Risk Coverage program; SCO = Supplemental Coverage Option; bu = bushel. Numbers in parentheses are lower and upper bounds of a 95-percent confidence interval. [1]"Net SCO" is the SCO payment less what the farmer paid for SCO policy. [2]The statistics for the gross revenue distributions for "all U.S. counties" do not exactly match across the ARC and SCO scenarios, as the former is weighted by base acres and the latter by planted acres. [3]"All U.S. counties" represents the analysis of a representative farmer in all counties for which USDA's National Agricultural Statistics Service has reported soybean yield data each year from 1975 through 2013, which is 889 counties. In the data summaries, the results for each farmer are weighted by the number of planted or base acres in the county.

Source: USDA, Economic Research Service.

Appendix table 10

How ARC and SCO change the expected revenue's lower bound of the 95-percent confidence interval (for all counties, soybeans)

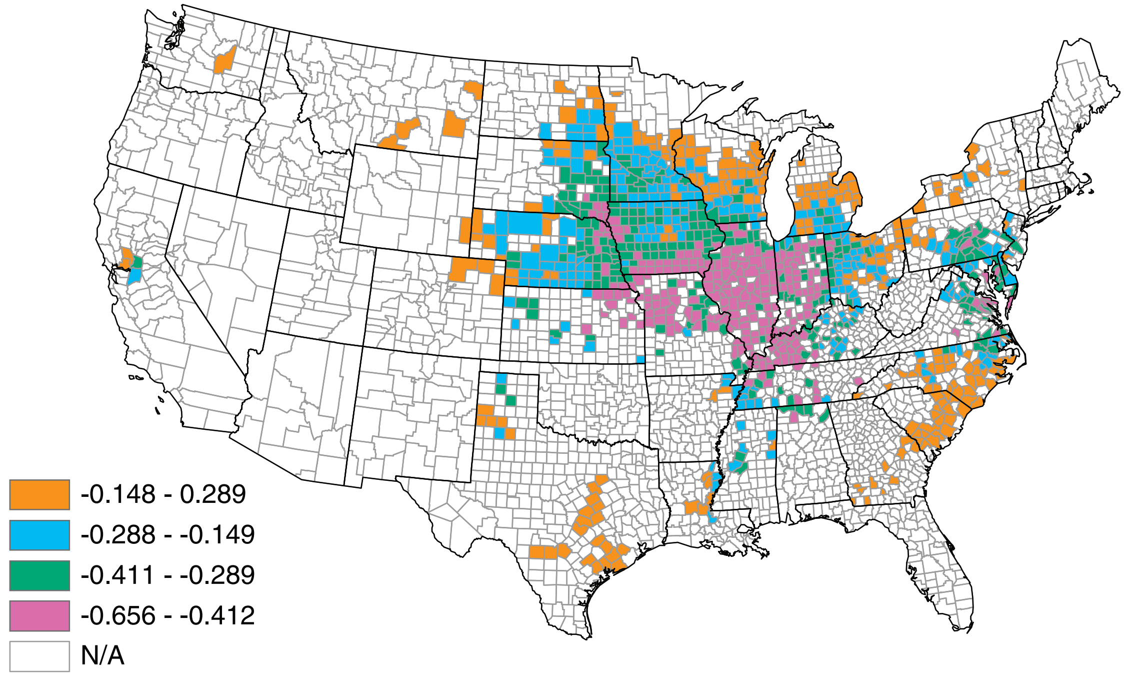
	Lower bound of revenue 95-percent confidence interval ($/acre)		
Fraction of price	Gross revenue per acre	Gross revenue plus program payment per acre	Difference ($/acre)
	Agriculture Risk Coverage (ARC)		
0.5*E[P]	83	125	42
E[P]	166	194	28
1.5*E[P]	249	253	4
	Supplemental Coverage Option (SCO)		
0.5*E[P]	76	89	13
E[P]	151	177	26
1.5*E[P]	227	266	39

ARC = Agriculture Risk Coverage program; SCO = Supplemental Coverage Option.

Source: USDA, Economic Research Service.

Appendix figure 1

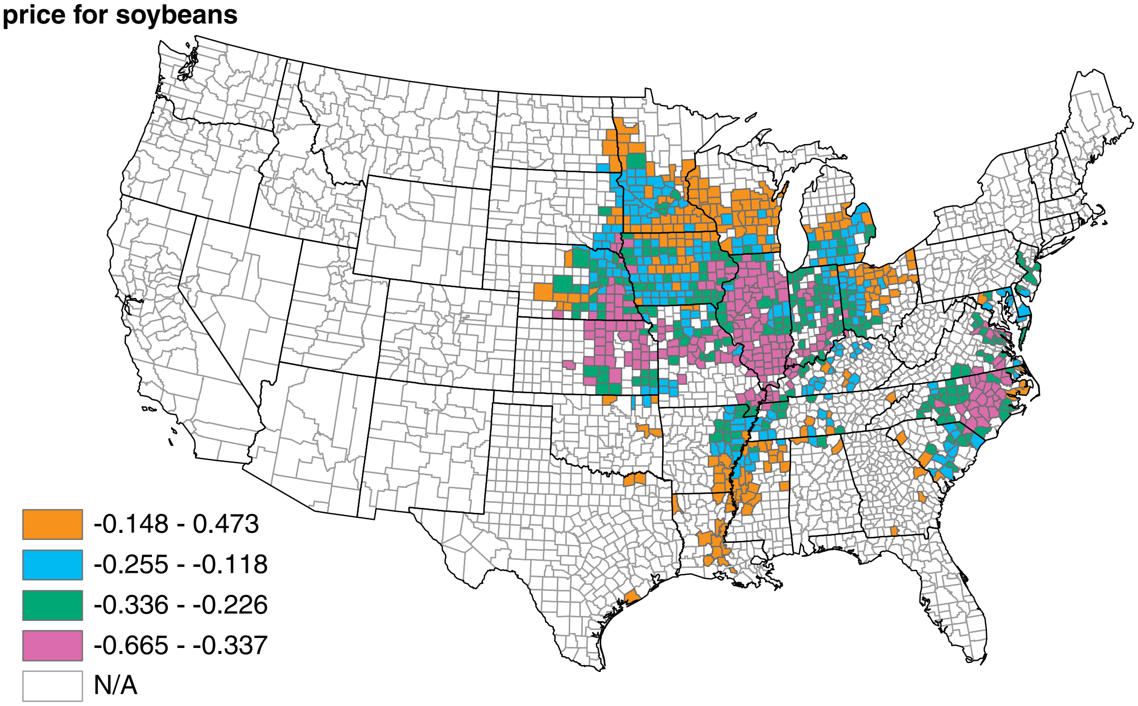
Correlation between the yields of each county's representative farm and the national price for corn



N/A = data not available.
Source: USDA, Economic Research Service.

Appendix figure 2

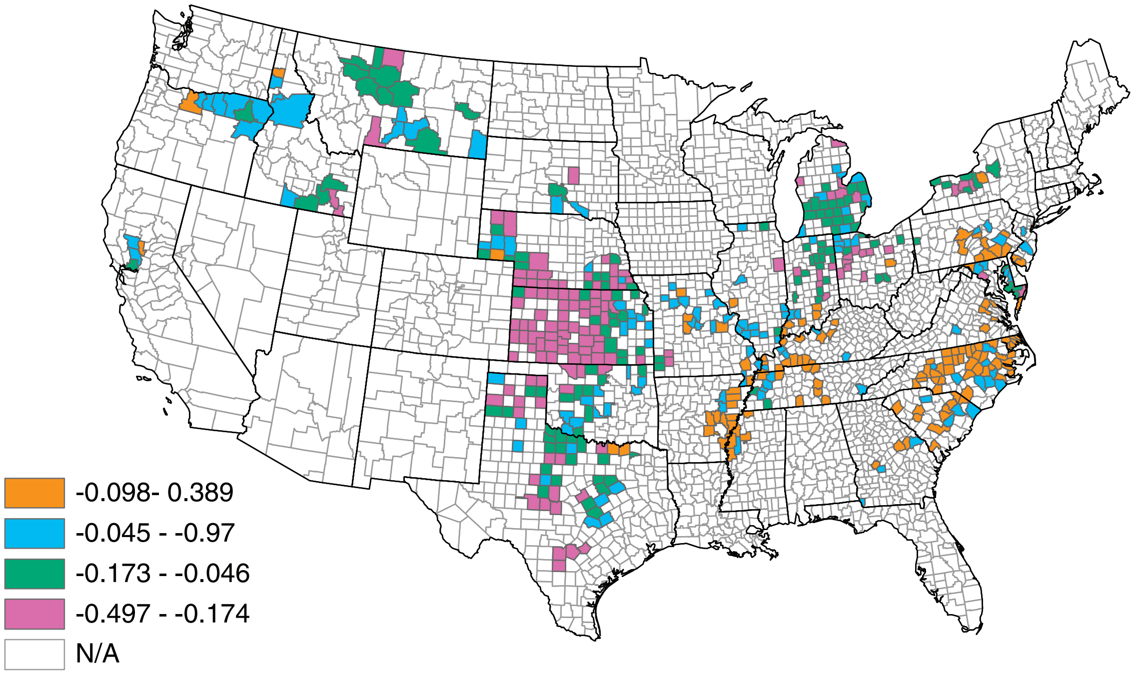
Correlation between the yields of each county's representative farm and the national price for soybeans



N/A = data not available.
Source: USDA, Economic Research Service.

Appendix Figure 3

Correlation between the yields of each county's representative farm and the national price for winter wheat



N/A = data not available.
Source: USDA, Economic Research Service.