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ACRE Program Payments and Risk Reduction

An Analysis Based on Simulations of Crop Revenue Variability

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ACRE Program Payments and Risk Reduction

An Analysis Based on Simulations of Crop Revenue Variability

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Abstract

Crop revenue variability—which differs across crops, regions, and the geographic levels at which revenue is measured—is the focus of the Average Crop Revenue Election program, which was first available to producers in 2009. Using an empirically based simulation model of an extensive set of representative farm acres of corn, soybeans, wheat, and cotton, we analyze how ACRE payments vary under different guarantee price and expected market price scenarios, and how potential ACRE payments and risk reduction are distributed across crops and regions.

Keywords

Crop revenue variability, Average Crop Revenue Election, ACRE, farm risk management

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Contents

Summary

Using crop revenue as the basis for agricultural payments has long been proposed as a way to reform U.S. farm programs. Proponents recognize that revenue is more closely related to farm income than either prices or yields individually. Thus, a revenue-based program can more efficiently stabilize farm income than price-based commodity programs, while lessening annual variability in Government program costs. The Average Crop Revenue Election program or ACRE, an alternative to price-based commodity programs that was first available to producers in 2009, uses a combination of State- and farm-level revenue guarantees that are determined from recent historic prices and yields. This report examines and simulates crop revenue variability for producers of four crops—corn, soybeans, wheat, and cotton—and estimates potential ACRE payments from a broad range of possible revenue outcomes. We analyze how ACRE payments and their effect on farm-level revenue variability would be distributed across crops and production regions. The four crops included in our model accounted for about half of the value of production of U.S. crops between 2002 and 2007 and more than 90 percent of the value of crops for which ACRE is available.

What Is the Issue?

Historic prices and yields that determine ACRE guarantees can change, and future prices and yields that determine payments are not known with certainty. ACRE revenue guarantees are based on a "moving" 2-year average of (national) market prices and 5-year Olympic averages (dropping the highest and lowest values) of State- and farm-level yields. ACRE payments are triggered when both the farm and State revenues fall below guarantee levels at the end of a crop year. The capability of ACRE guarantees to reflect recent prices and yields and to change over time are major differences between ACRE and commodity programs based on fixed target prices and loan rates. If direct and countercyclical payments are designed to combat unexpectedly low market prices, then the ACRE program can be seen as risk protection for producers adjusting to an era of historically high crop prices. As such, its potential benefits are more pronounced for producers of corn, soybeans, and wheat, who can foresee high expected payments based on recent high prices. The prospects for cotton producers under ACRE in the near term are more mixed. Because revenue variability for a particular crop differs across farms and regions, the potential benefits of ACRE also vary.

What Did the Study Find?

ERS researchers develop a simulation model of crop revenue variability at the State and farm levels for an extensive set of representative farm acres of corn, soybeans, wheat, and cotton. This model is used to analyze the distribution, by crop and region, of potential payments and risk reduction from ACRE.

Key variables in determining crop revenue and ACRE payments are prices, yields, and their interactions, factors that differ across crops and regions. Because crop prices depend largely on world markets, variability in the price for a crop is similar across much of the United States. Yields, in contrast,

depend on factors such as weather, diseases, and insects that can affect wide areas at once but are often localized.

An ACRE payment is triggered when annual revenue falls below 90 percent of the benchmark measured at the State level *and* when the farm's annual revenue falls below its benchmark. The magnitude of the ACRE payment depends on the size of the State revenue shortfall, relative to its guarantee, as well as the farm's average yield relative to the State average. Because of this complexity, ACRE payments are not directly related to variability in farm-level revenue.

As such, ACRE is ineffective in covering idiosyncratic risks, shortfalls on an individual farm that are uncorrelated with more widespread losses, and more targeted at systemic or statewide risk. The strength of systemic risk—and thus, the relative effectiveness of ACRE in reducing risk—depends on the level of price variability, the difference between historical prices and expected market prices at a particular time, and the degree to which yield losses on one farm are matched with yield losses on other farms in the State. ACRE is most effective in reducing risk when crop price, which under ACRE is the same for all States and farms, causes revenue to change substantially and when yield losses are widespread.

The effectiveness of the ACRE program in reducing risk, or variability of farm revenue for a crop, is strongly related to the correlation between the farm's revenue variability and variability in State average revenue. The strength of this farm-State correlation differs across crops, States, and across farms within States. It is stronger for corn and soybeans, on average (at the U.S. level weighted by acres planted for farms and States), than it is for wheat and cotton. For example, the top two States in corn and soybean acreage, Iowa and Illinois, have average farm-State revenue correlations of 0.60 and above. In contrast, the top two States in wheat acreage, Kansas and North Dakota, and the top two States in cotton acreage, Texas and Arkansas, have average farm-State revenue correlations of about 0.30 to slightly higher than 0.40.

ACRE payment amounts—based on simulations with expected market prices equal to 2009 guarantee prices—vary across regions, but tend to be highest in the most productive crop regions, as reflected in consistently high yields. ACRE payments for corn and soybeans, for instance, would be high in Midwest areas with high average yields, even though these areas have low yield and revenue variability. For cotton, ACRE payments would be high for irrigated acreage in California and Arizona, where yield levels are high and variability low, and low for Texas, where yield levels are low and variability high.

The geographic distribution of risk reduction for each crop is similar to its ACRE payment distribution: areas where risk reduction is strong tend to be areas with above-average ACRE payments. For soybeans, risk reduction is highest for representative farms in the Midwestern Corn Belt, areas with large shares of planted acres and production, and lowest in Atlantic Coast States, such as North and South Carolina. For corn, risk reduction is also highest in the Corn Belt, though many farms in other corn-producing areas also receive relatively high risk reduction. For wheat, risk reduction is strong in Kansas and North Dakota, major wheat-producing States, but also strong in Ohio, Michigan, and Indiana, States with small shares of U.S. acreage and production. Expected risk reduction for wheat is below average for almost all of the representative farms in Oklahoma and Texas, States with relatively low expected ACRE payments. For cotton, risk reduction from ACRE is also low in the plains of Texas and highest in the irrigated areas in California and Arizona.

How Was the Study Conducted?

The study used data from USDA's National Agricultural Statistics Service and Risk Management Agency to construct a model that simulates random yields, prices, and revenues at farm and State levels for corn, soybeans, wheat, and cotton. The model accounts for correlations among the random variables by use of empirical sampling techniques. The model is national in scope and represents more than 90 percent of the average annual planted acres for corn, soybeans, and wheat and more than 80 percent of the planted acres for cotton.

Introduction

U.S. agricultural policy has long featured programs intended to support or stabilize farm incomes by counteracting the effects of low crop prices and yields. Commodity programs like the countercyclical payment and marketing loan programs have made payments to producers of several major field crops when prices fall short of target levels, while Federal crop insurance and disaster assistance programs have addressed yield shortfalls (though in recent years, much more revenue insurance than yield insurance has been sold).

Using crop revenue as the basis for agricultural programs has, since at least the early 1980s, been proposed and studied as a way to reform U.S. farm programs. A 1983 Congressional Budget Office study looked at replacing price-based commodity programs with revenue-based programs as a way of reducing government spending. Miranda and Glauber (1991) examined the use of regional revenue shortfalls as the basis of a disaster assistance program. The Iowa Farm Bill Study Team recommended that the 1996 farm bill replace commodity programs and crop insurance with a revenue guarantee program; while this proposal was not enacted, it led to the development of federally subsidized crop revenue insurance (Goodwin and Smith, 1995). In 1999, a proposal for a commodity revenue program, called the Supplemental Income Payments for Producers, was introduced in Congress but not adopted (Hart and Babcock, 2000). Proponents and analysts of revenue-based programs have recognized that revenue rather than its components, prices and yields, is more closely related to farm income. Thus, revenue programs can more efficiently stabilize income and lessen the annual variability in government program expenditures than separate price-based and yield-based programs can (Cooper, 2009).

The Food, Conservation and Energy Act of 2008 introduced a commodity program based on revenue, which was first available in 2009 to producers of covered commodities (Zulauf et al., 2008).[1] The Average Crop Revenue Election program, or ACRE, uses a combination of State- and farm-level revenue guarantees that are determined from recent prices and yields.

In this report, we examine and simulate crop revenue variability and estimate, using simulations, ACRE payments for an extensive set of representative farms.[2] Our analysis is national in scope. We analyze how ACRE payments and their effect on farm-level revenue variability would be distributed across crops and production regions. Because the components of revenue—prices, yields, and their interactions—can change from year to year and cause ACRE guarantees to shift, we estimate how expected ACRE payments, based on simulations of many possible revenue outcomes, would differ under a range of scenarios. Our analysis focuses on four crops—corn, soybeans, wheat, and cotton (crops that accounted for about 50 percent of the value of production of U.S. crops between 2002 and 2007, and more than 90 percent of the value of crops for which ACRE is available).

[1]These crops are wheat, corn, barley, grain sorghum, oats, upland cotton, long-grain and medium-grain rice, peanuts, pulse crops (dry peas, lentils, small and large chickpeas), soybeans and other oilseeds (sunflower seed, canola, rapeseed, safflower, mustard seed, flaxseed, crambe, and sesame seed).

[2]Each farm, one for each crop and each county, represents a typical acre of corn, soybean, wheat, or cotton production.

Crop Revenue Variability

Revenue variability depends on the variability of prices and production (yields multiplied by acres) and the interactions between the two. Because crop prices depend largely on world markets, variability in the price for a crop is similar across much of the United States. Yields, in contrast, depend on factors such as weather, diseases, and insects that can affect wide areas at once but are often localized.

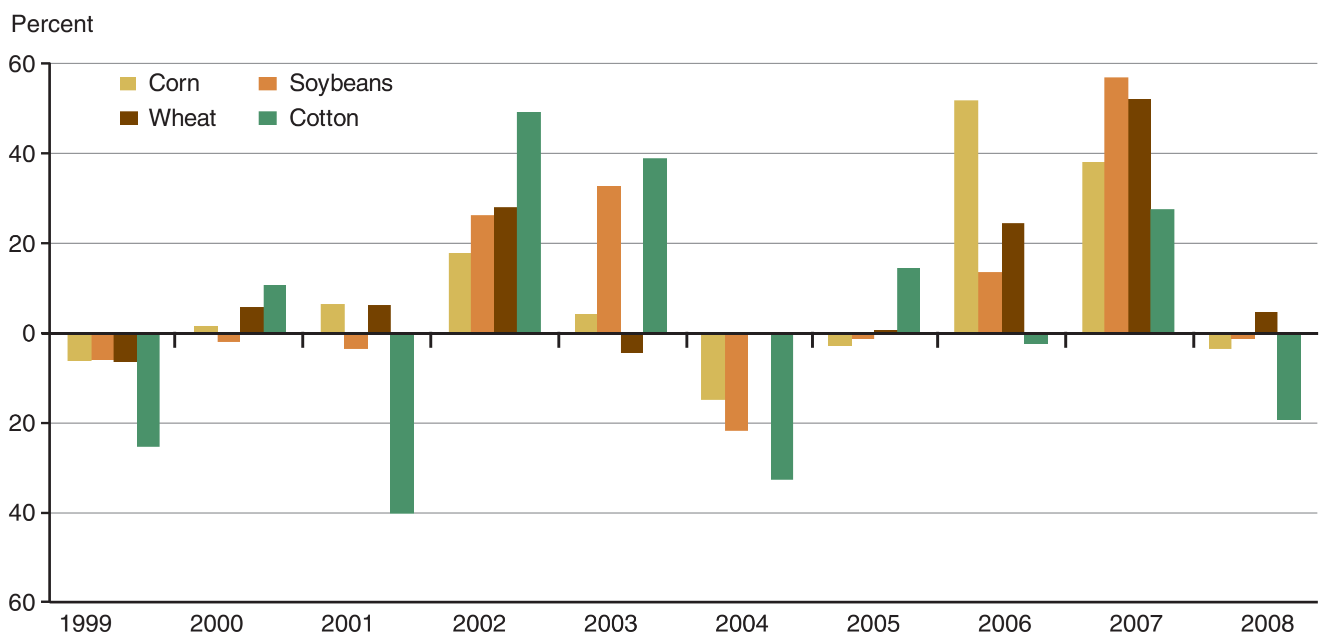
Price Variability

Crop prices are determined by supply and demand in U.S and world markets. Supply factors include stocks-to-use ratios and production in the United States and in other countries (Schnepf and Goodwin, 1999). Demand factors include domestic and foreign incomes, currency exchange rates, and consumer preferences. Price levels can vary across U.S. regions because of transportation costs, differences in product attributes, and marketing seasons. However, price variability for a particular crop is similar across the United States due to potential arbitrage when price differences across regions are not consistent with transportation costs.

Measuring price variability requires the specification of a reference price from which changes are measured and of a timespan over which changes can occur. Price variability measured as changes from year to year in marketing-year average prices provides one perspective. For example, there were sharp increases in corn, soybean, and wheat prices between 2005 and 2006 and between 2006 and 2007, while annual prices for these crops changed relatively little between 2007 and 2008 (fig. 1). These price movements were

Figure 1

Change in marketing-year average price from previous year, 1999 - 2008



Source: USDA, Economic Research Service analysis of data from USDA, National Agricultural Statistics Service.

driven by several factors, including changes in export markets and rapid expansion of domestic biofuel production (Trostle, 2008). Cotton price variability, in contrast, was greatest in the years prior to 2005.

A longer view of prices also suggests that variability for corn, soybeans, and wheat has been especially high in recent years. The variability of annual prices, measured by the coefficient of variation (mean divided by standard deviation), for the 10 years 1999-2008 was 0.35 for corn, 0.33 for soybeans, and 0.39 for wheat. For the 30 years, 1979-2008, the price coefficients were much lower: 0.25 for corn, 0.22 for soybeans, and 0.28 for wheat.

Yield Variability

The localized character of yield variability can be seen by measuring it at different geographic levels. Table 1 shows the average variability of yields from empirically based simulations for corn, soybeans, wheat, and cotton measured at the U.S., State, county, and farm[3] levels. Yield variability, measured as the coefficient of variation, is, by far, the greatest when measured at the smallest area: the farm level. As it is measured over larger areas, variability declines as high yields in one region offset low yields in another. The aggregation effect is especially pronounced between the farm and county levels, suggesting that farm-level factors play a large role in yield variability.

There is a wide range of yield variability for each crop across its production areas. Figures 2a-d illustrate yield variability of representative farms for (a) corn, (b) soybeans, (c) wheat, and (d) cotton in each county. Yield variability for corn and soybeans tends to be lowest in counties that stretch across the center of the Corn Belt. Yield variability for wheat is low in irrigated areas in Washington and Oregon as well as in non-irrigated areas across the middle of Kansas. It is high in the Southern Plains areas of Oklahoma and Texas, as well as in western Kansas and eastern Colorado and parts of the Northern Plains in North Dakota, South Dakota, and Montana. For cotton, yield variability is lowest for irrigated production in California and Arizona and highest for dryland production in the plains of Texas.

[3]Our estimates of farm-level yield variability are consistent with Federal crop insurance premium rates for "basic units," which are usually subdivisions of a farm's crop acreage.

Table 1
Simulated variability of crop yield at different levels: corn, soybeans, wheat, and cotton

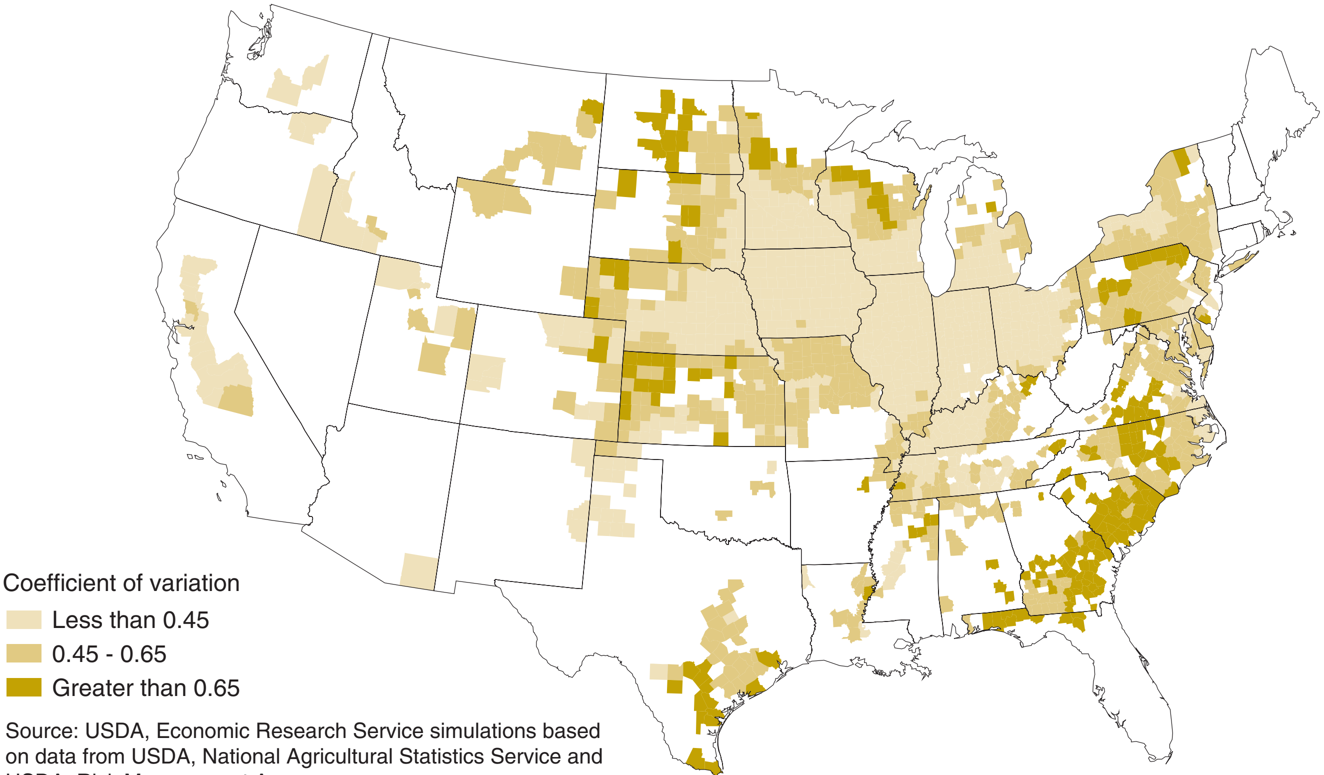
Level	Corn	Soybeans	Wheat	Cotton
		Coefficient of variation		
National	0.074	0.063	0.074	0.103
State	0.107	0.111	0.166	0.163
County	0.136	0.135	0.228	0.242
Farm	0.378	0.375	0.587	0.685

Averages weighted by planted acres. Coefficient of variation = standard deviation divided by mean.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Figure 2a

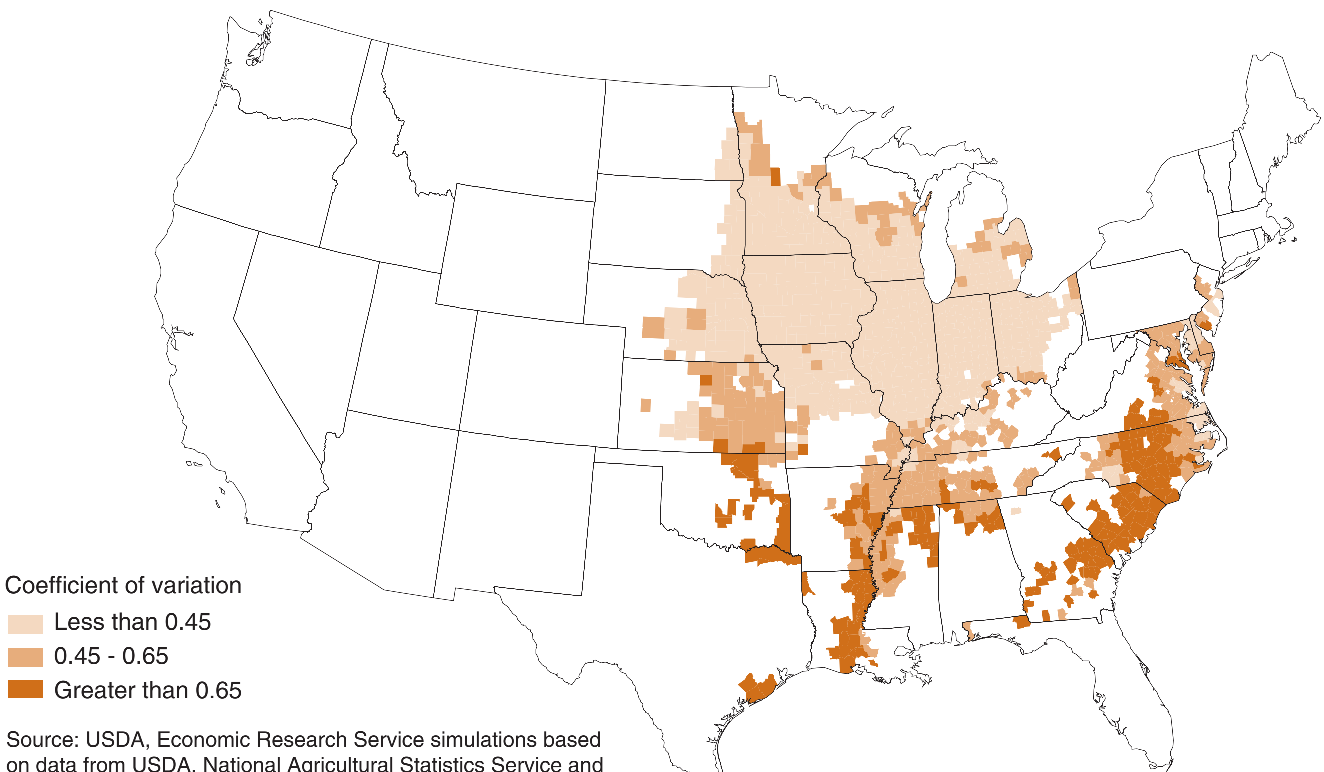
Farm-level yield variability, corn



Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Figure 2b

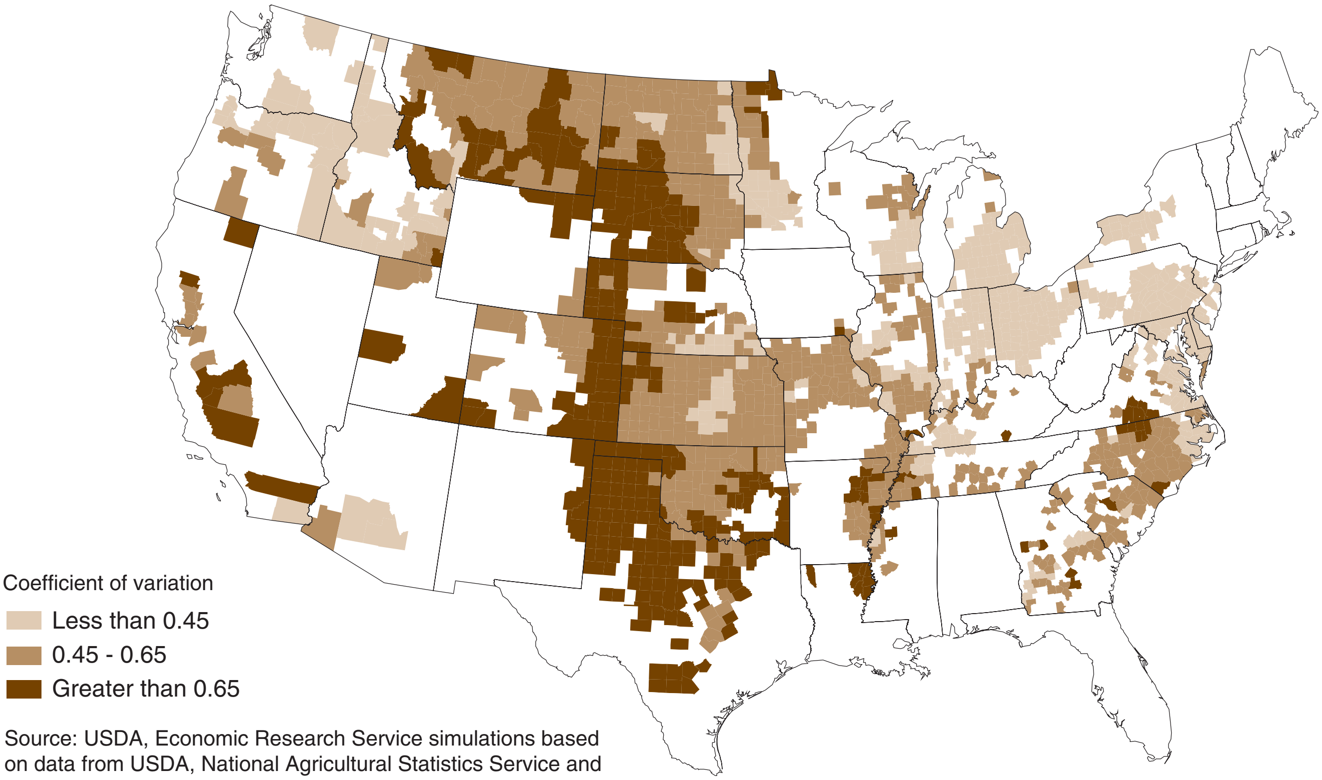
Farm-level yield variability, soybeans



Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Figure 2c

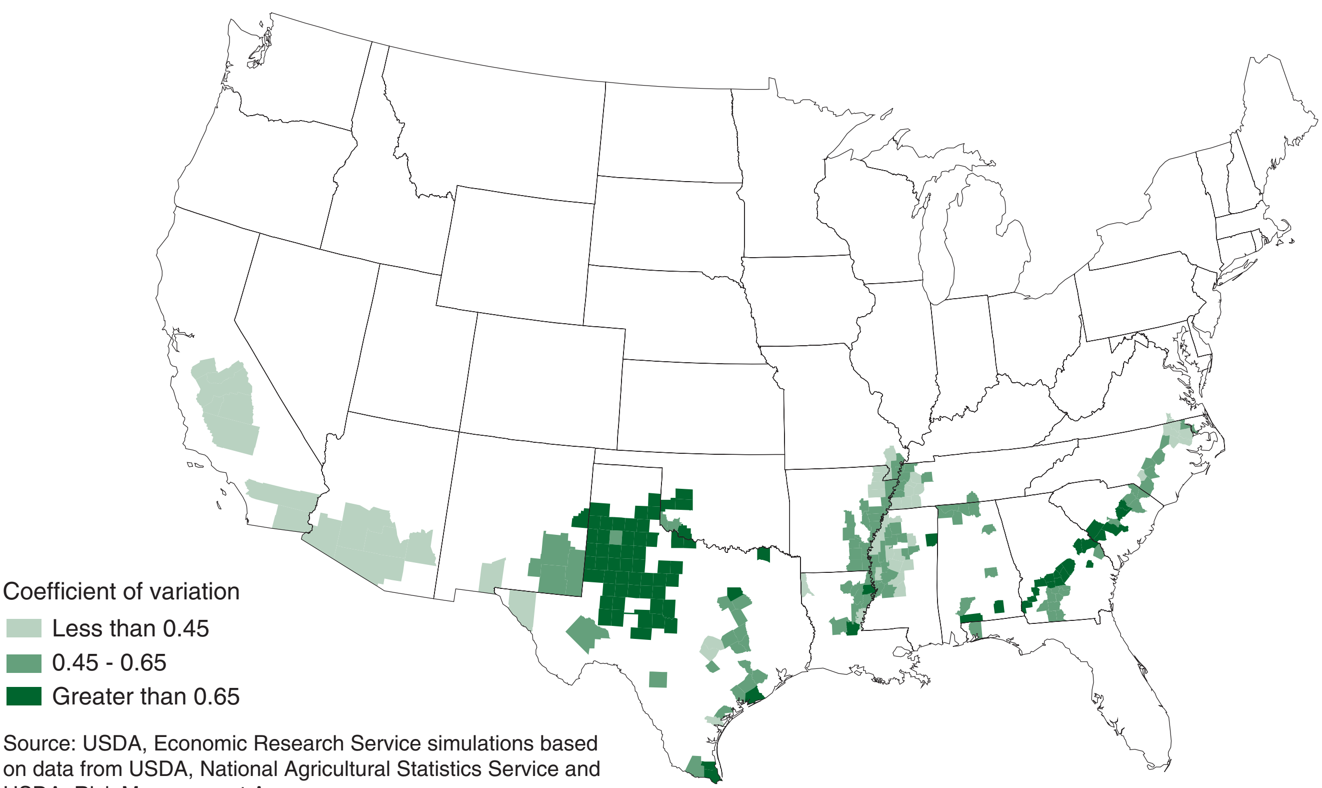
Farm-level yield variability, wheat



Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Figure 2d

Farm-level yield variability, cotton



Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Price-Yield Correlation

The relationship between prices and yields, measured by the statistical correlation, is negative when changes in yield are associated with offsetting changes in prices. In other words, when yield and, as a result, aggregate production, of a commodity increase, price decreases; a fall in yield is associated with a rise in price. Negative price-yield correlation moderates or dampens revenue variability, and is often referred to as a "natural hedge."

The strength of the natural hedge depends on the relative variability of price and yield, the relationship of U.S. production to world supply, and the degree to which U.S. production is concentrated in a geographic area. The negative price-yield correlation tends to be strongest in an area where most farm-level yields are closely related to areawide production and where the area's production normally accounts for a significant share of the world market.

Corn and soybeans, for example, show the strongest negative price-yield correlation in the Midwest, where Illinois and Iowa together account for about a third of the U.S. corn crop. Although the United States typically exports a small portion of its corn crop (20 percent), it dominates world corn trade. This means that corn prices are largely determined by supply-and-demand relationships in the United States, which tends to make prices dependent on yields in the major U.S. production area. The pattern of price-yield correlation for soybeans is similar to the pattern for corn; about 35-45 percent of the annual U.S. soybean crop is exported, and the United States has been the largest supplier in the world soybean market (average annual market share 47 percent, 1999-2008).

U.S. wheat also accounts for a large share of the world market, typically exceeded only by China, the European Union, and India. But in contrast to corn and soybeans, U.S. wheat production is widely dispersed, and different types of wheat, which are not entirely substitutable, are sold in different markets at different times of the year.

Although U.S. cotton plays a large role in world cotton supply, price-yield correlations within the United States are weak. U.S. cotton production has become a small proportion of U.S. domestic cotton use, weakening the correlation between U.S. production and price. The geographic distribution of U.S. cotton production also contributes to the weak price-yield correlations. Although about a third of the U.S. cotton crop is produced in a single State, Texas, cotton production is spread over a wide geographic and climatic range, both within Texas and across the United States. The Delta States of Arkansas, Louisiana, Mississippi, and Tennessee account for about 30 percent of the U.S. cotton crop, while the major cotton-producing States in the Southeast—North Carolina, South Carolina, and Georgia—account for about 17 percent. Growing conditions in these regions are largely independent of each other.

Because yield and price variability for all crops do not entirely offset each other, the variability of revenue exceeds the variability of yield. Under our model simulations, revenue variability, measured as the coefficient of variation, is more than double yield variability for each of the four crops at the national level (table 2). The difference between revenue and yield variability decreases as they are measured at the more disaggregated levels. In other

Table 2
Simulated variability of crop revenue at different levels: corn, soybeans, wheat, and cotton

Level	Corn	Soybeans	Wheat	Cotton
		Coefficient of variation		
National	0.221	0.207	0.193	0.245
State	0.236	0.228	0.250	0.278
County	0.253	0.242	0.302	0.339
Farm	0.447	0.438	0.633	0.741

Averages weighted by planted acres.
Coefficient of variation = standard deviation divided by mean.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

words, as one measures revenue variability at smaller geographic levels it is determined to a greater extent by yield variability, which increases dramatically. Because revenue variability at the farm level is closely linked to yield variability its geographic pattern is similar to farm-level yield variability, though price-yield correlation also plays a role. Areas with low revenue variability, especially for corn and soybeans, tend to be those with large amounts of production.

ACRE: How It Works and What It Covers

The ACRE program makes payments when State average revenue and farm revenue for a crop fall below recent historical levels (USDA/Farm Service Agency, 2009). The State revenue guarantee for ACRE is defined as 90 percent of the State benchmark revenue. The State benchmark is calculated by multiplying the average of the marketing-year average price over the previous 2 years by the average of the State yield over the previous 5 years, disregarding the highest and the lowest yields in this period. Separate State yields and benchmarks for irrigated and non-irrigated production are set by USDA's Farm Service Agency when at least 25 percent but less than 75 percent of the acreage for a crop in a county in a State is irrigated.[4] A farm's benchmark revenue is calculated by multiplying the same price that is used for the State benchmark revenue by the farm's average yield over the previous 5 years, disregarding the highest and lowest yields. The farm revenue guarantee is the farm benchmark revenue plus the amount of premium paid by the producer for Federal crop insurance.

[4]In our model, we use a single composite (irrigated and non-irrigated) yield for each State and representative farm.

ACRE payments, if any, are based on annual outcomes of State and farm revenues for a crop relative to their guarantees. In order for a farm to receive an ACRE payment, State revenue must fall below the State guarantee and farm revenue must fall below the farm guarantee. Both shortfalls are required. The ACRE payment amount per acre is the difference between the State revenue guarantee and the actual State revenue, up to a maximum of 25 percent of the State guarantee, multiplied by the farm productivity index, which is the ratio of the farm average yield to the State average yield.[5] The magnitude of a farm's revenue shortfall, once it falls below the farm revenue guarantee, does not figure in the farm's ACRE payment calculation; however, the farm's average yield relative to the State-level yield does. Total ACRE payment for a farm is the sum of per-acre payments over the number of acres "planted or considered planted," with the restriction that total ACRE payment acres for all crops on the farm cannot exceed its base acres.[6]

[5]Under provisions of the 2008 farm act, the ACRE payment rate is multiplied by 0.833 in 2009, 2010, and 2011; and by 0.85 in 2012. Payments in this report have been multiplied by 0.833.

[6]A producer's decision to enroll in ACRE applies to all "covered commodities and peanuts" on the Farm Service Agency-defined farm. Base acres are a farm's crop-specific acreage of wheat, feed grains, upland cotton, rice, oilseeds, pulse crops, or peanuts eligible to participate in commodity programs. Base acreage includes land that would have been eligible to receive production flexibility contract payments in 2002 and acreage (specified in legislation) planted to other covered commodities (oilseed and peanut producers). Base acreage refers to cropland on a farm, not to specific parcels of land.

Because prices and yields can change from year to year, the State revenue guarantee can change, though under the ACRE program the annual change in the revenue guarantee is limited to no more than 10 percent. The capability of ACRE guarantees to reflect recent historical prices and yields and to change from year to year are major differences between ACRE and commodity programs that are based on legislatively set target prices and loan rates. To participate in ACRE, producers forgo the entire amount of any price-based countercyclical payments as well as portions of their direct payments and marketing loan rates. Thus, the relationships between recent market prices and legislated target prices and loan rates are a major factor influencing producers' ACRE participation decisions.

ACRE coverage differs from Federal revenue insurance coverage, which is based on changes over the crop growing season in futures market prices and determines revenue guarantees and covers losses measured at county or farm (insured unit) levels. Producers participating in ACRE have an incentive to also participate in the Federal crop insurance program because the ACRE farm-level guarantee is increased by the amount paid for the insurance.

How Prices and Yields Affect ACRE Payments

ACRE payments for a farm depend on revenue levels and variability. The components of revenue—prices, yields, and their interactions—can differ from year to year and across crops and their growing regions. We analyze the effects of each component on ACRE payments by simulating revenue variability, using an empirically based model, for an extensive set of States and representative farms for corn, soybeans, wheat, and cotton.[7]

Guarantee Prices and Expected Market Prices

The prices used to set ACRE revenue benchmarks and guarantees, called guarantee prices, are national marketing-year average prices of each crop. The national prices are applied to all State and farm revenue calculations. The guarantee prices are, as mentioned earlier, averages of annual prices over the 2 previous years. These moving averages capture recent market conditions and can change from year to year. In 2009, the first year that ACRE coverage was available, moving-average prices for corn, soybeans, and wheat were dramatically higher than at any point over the previous 10 years, as the sharp price increases in 2007 were included. For cotton in 2009, the moving-average price, while among the highest over the previous 10 years, was only slightly higher than in 2008.

Revenue shortfalls and ACRE payments depend on actual or realized revenue calculated from marketing-year average prices for the particular year covered. A crop's marketing year typically begins around harvest time and extends for 12 months. The eventual market price is not known with certainty until the year is concluded. To estimate potential ACRE payments, we simulate revenue variability for a range of expected prices.

Figures 3a-d illustrate how ACRE payments would vary under various guarantee price and expected market price scenarios for each crop. Each line represents a given guarantee price; the points on the lines indicate U.S. average ACRE payments per planted acre from revenue simulations as expected market prices vary.

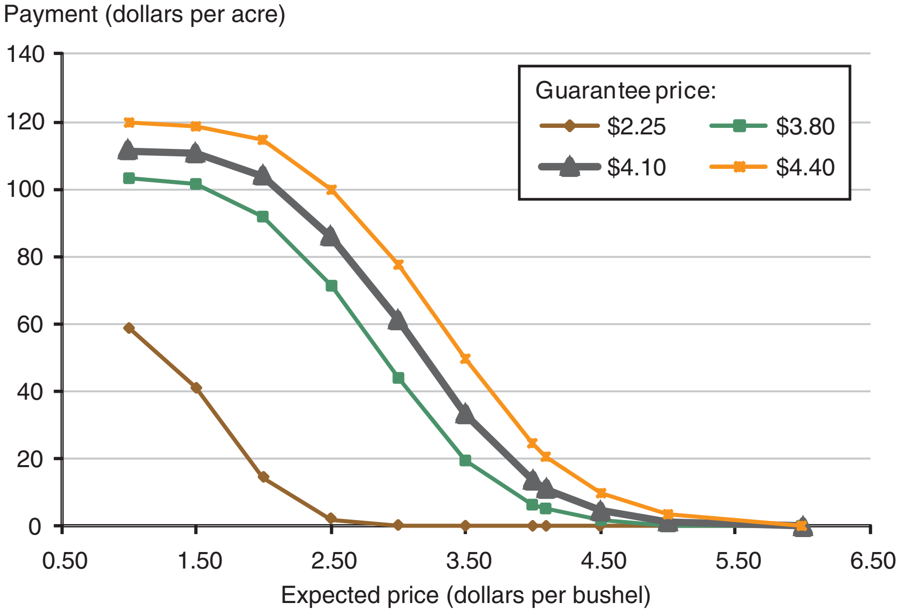
The heavy line on each chart is approximately the guarantee price for 2009: for corn, the guarantee price illustrated is $4.10 per bushel, for soybeans $10 per bushel, for wheat $6.60 per bushel, and for cotton $0.54 per pound. If, for instance, the market price for corn is expected to be the same as the guarantee price, the expected ACRE payment, based on revenue simulations, would be about $11.40 per acre. Similarly, for soybeans the expected ACRE payment would be about $8.60 per acre, for wheat about $5.70 per acre, and for cotton about $8.90 per acre. If, however, the level of the marketing-year average price is expected to be less than the guarantee price, the expected ACRE payment increases (reading to the left on the guarantee-price line).[8] For example, under the $4.10 guarantee price for corn, if the expected market price were $3.50, the average ACRE payment would be about $33 per acre. As the expected market price declines relative to the guarantee price, the ACRE payment increases and gradually flattens as the 25 percent of the State revenue guarantee payment rate limit is reached.

[7] A description of our model and data sources is included in the "Methods and Data" box.

[8] Price forecasts for corn, soybeans, wheat, and cotton for the 2009-10 marketing year that were published in USDA's World Agricultural Supply and Demand Estimates on August 12, 2009, a few days before the 2009 ACRE enrollment deadline, suggested that eventual marketing-year average prices for corn, soybeans, and wheat would be lower than ACRE guarantee prices. Midpoints of the forecast price ranges indicated that the prices would be about 10-20 percent lower than guarantees.

Figure 3a

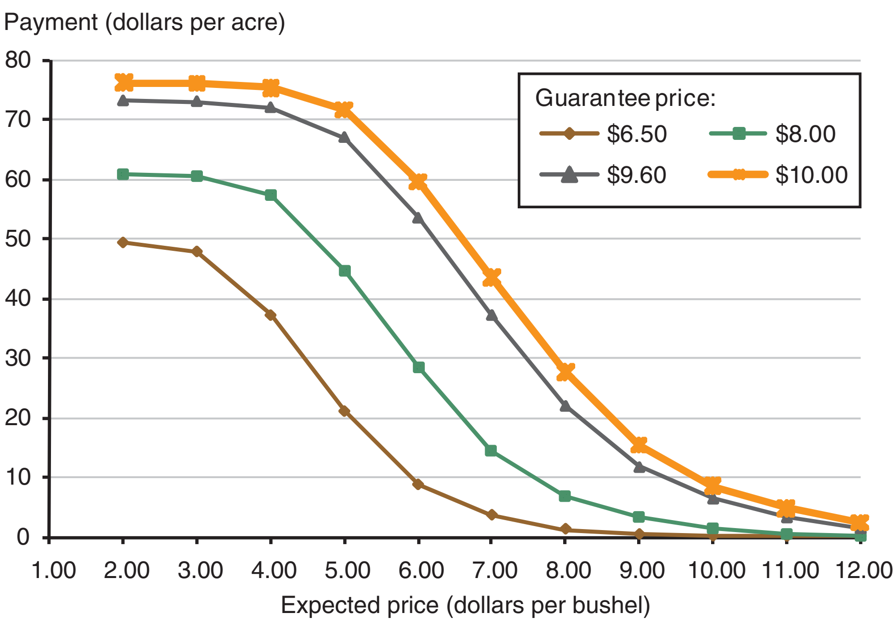
Average ACRE payment for corn under selected guarantee prices and expected prices



Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Figure 3b

Average ACRE payment for soybeans under selected guarantee prices and expected prices

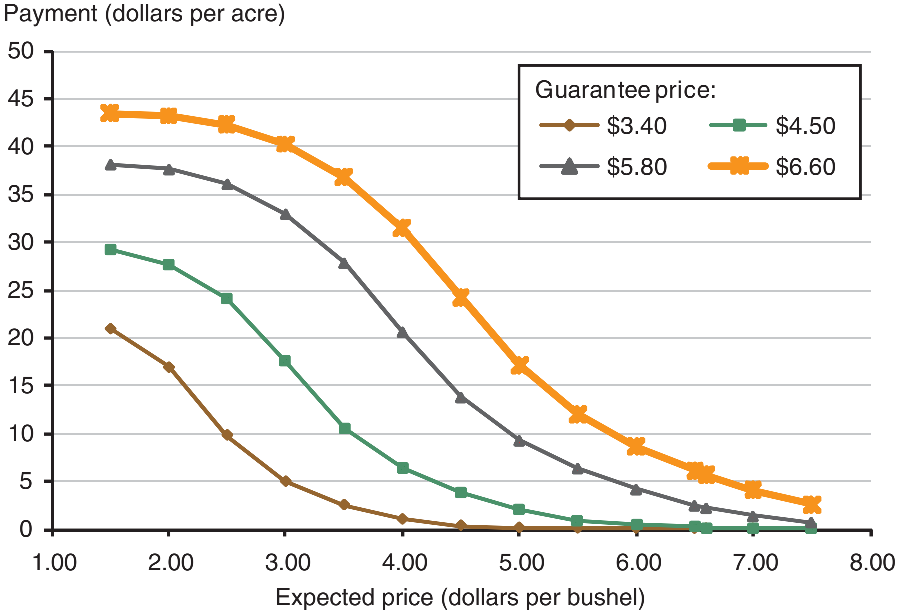


Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Although the dollar amount of expected ACRE payments varies considerably from crop to crop, U.S. average payments relative to expected revenue, when expected market price equals guarantee price, are similar across crops. Suppose, for example, that expected revenue for an average producer in 2009 is based on the U.S. average yield over the previous 5 years with the highest

Figure 3c

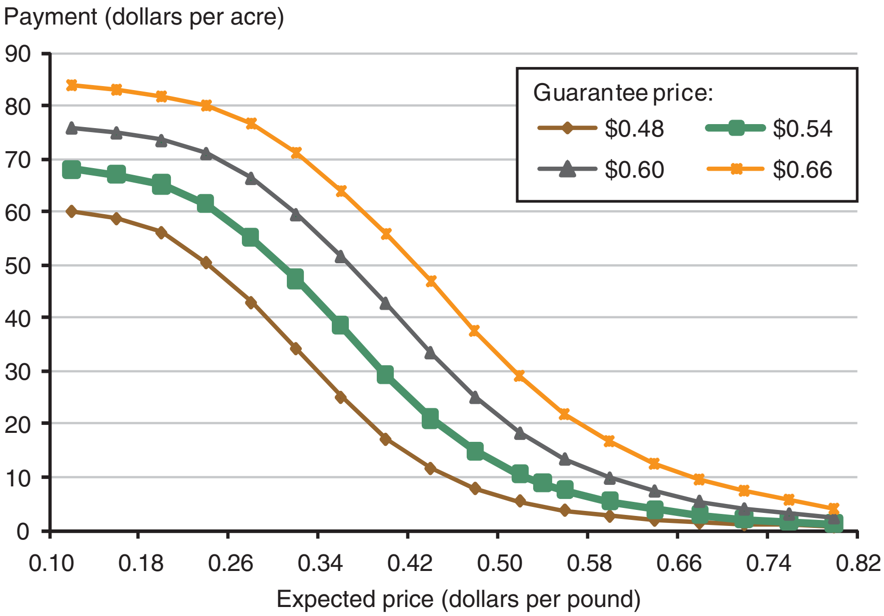
Average ACRE payment for wheat under selected guarantee prices and expected prices



Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Figure 3d

Average ACRE payment for cotton under selected guarantee prices and expected prices



Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

and lowest years omitted, and the market and ACRE guarantee prices are equal at 2009 levels (indicated in the previous paragraph). In this case, expected ACRE payments for each crop would be equal to about 2 percent of expected revenue: corn, soybean, and cotton payments would be 2 percent and wheat would be 2.3 percent.

Methods and Data

The model underlying this research simultaneously simulates random yields, prices, and revenues at farm, county, State, and U.S. levels for corn, soybeans, wheat, and cotton. The model accounts for correlations among the random variables by use of empirical sampling techniques.[1]

The model is based on data for 1,553 counties for corn, 1,164 counties for soybeans, 1,329 counties for wheat, and 233 counties for cotton. These counties represent about 97 percent of the 1998-2007 average annual planted U.S. acres of corn, 92 percent of soybean acres, 94 percent of wheat acres, and 84 percent of cotton acres.

Yield variability is estimated with data from USDA's National Agricultural Statistics Service (NASS) and data from USDA's Risk Management Agency (RMA). To measure yield variability at the county, State and U.S. levels, we estimated a linear time trend of each yield data series, yields from 1975 to 2004, and calculated the residuals (differences between actual yield in individual years and the trend yield). The trend estimate is used to predict the expected yield for 2008. To measure yield variability at the farm level, we use county yield variabilities in conjunction with data from the Federal crop insurance program, which is administered by USDA's RMA. Specifically, we used the 2009 base county premium rate for yield coverage (at the 65-percent coverage level) for each crop. We subtracted from these premium rates the portions that were to cover prevented planting, replanting, and quality adjustments. These adjusted premium rates were used to calibrate an additive farm yield variability term for each county and crop.

Our approach to modeling farm yields uses Miranda's (1991) specification of the relationship between systemic and idiosyncratic variability:

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

where

$\tilde{y}_{ft}$ is the realization of the random yield on farm *f* in year *t*,

$\tilde{y}_{ft}$ is the realization of the random yield in county *c* in year *t*,

$\mu_f = E\left(\tilde{y}_{ft}\right)$, $\mu_c = E\left(\tilde{y}_{ct}\right)$, and ε_{ft} is a normally distributed error term with $E\left(\varepsilon_{ft}\right) = 0$, and $Var\left(\varepsilon_{ft}\right) = \sigma^2$.

[1]Typically, a variance-covariance matrix is used for such simulations. Because such a matrix could include several thousand yields and prices at various levels of aggregation, our model accounts for correlations among random variables by use of sampling techniques that maintain their historical relationships.

Methods and Data (continued)

The coefficient β measures the responsiveness of deviations in farm yield relative to the expected value to deviations in county yield relative to the expected value. In our analysis, the representative farm is assumed to have a $\beta=1$, which Miranda shows would be the acreage-weighted average of all β's in the county. The error term ε_{ft} represents idiosyncratic effects on farm-yield deviations relative to the expected value that are orthogonal to county-yield deviations relative to the expected value. A grid search is conducted for the value of σ (the standard deviation of ε_{ft}) that in a simulation replicates the crop insurance rates.

Price variability is estimated from NASS national price data. National annual marketing-year average (MYA) prices for 1974 through 2007 for each of the four crops are used to calculate a percentage price change from the previous year's price level. The percentage changes in prices were adjusted to account for increased price volatility, as measured from options on futures contracts, in recent years. These price data are placed in a matrix [P] that has T rows of annual prices. Yield data for each of the four crops are placed in a matrix [Y] that contains county-, State-, and U.S.-level yield deviations relative to their expected values. The yield matrix has T rows representing T years of historical yields.

The revenue simulations are generated from 1,000 random 5-year time paths. The revenue variability and ACRE payment estimates in this report are based on year-one outcomes. For every location, a row is simultaneously drawn randomly from yield matrix [Y] and price matrix [P] (i.e., all yield deviations from trend and price changes are drawn from the same historical year) to maintain the empirical correlations between prices and yields, between yields at different levels of aggregation, and between yields in different counties. The idiosyncratic portion of farm yield is independently drawn (5 draws) for each representative farm for each of the 1,000 draws.

Yield Levels and Variability

In the ACRE program, prices in the revenue calculations are measured only at the national level while yields are measured at State and farm levels. Hence, differences in yields across States and farms lead to differences in revenue and in ACRE payments.[9]

High yield variability, however, does not simply translate to high revenue variability and a high ACRE payment. At both the State and farm levels, yield variability (coefficient of variation) tends to be inversely related to average yield level: generally, the higher the average yield, the lower the variability, and vice versa.[10] The inverse relationship between variability and average level holds for revenue, but is weaker than it is for yield because of the negative correlation between price and yield.

[9]Official ACRE program guarantees and benchmark State yields for 2009 are available from USDA's Farm Service Agency at http://www.fsa.usda.gov/Internet/FSA_File/acrerev_yieldmaps.pdf. State revenue variability values, from our model simulations, are listed in appendix table 1.

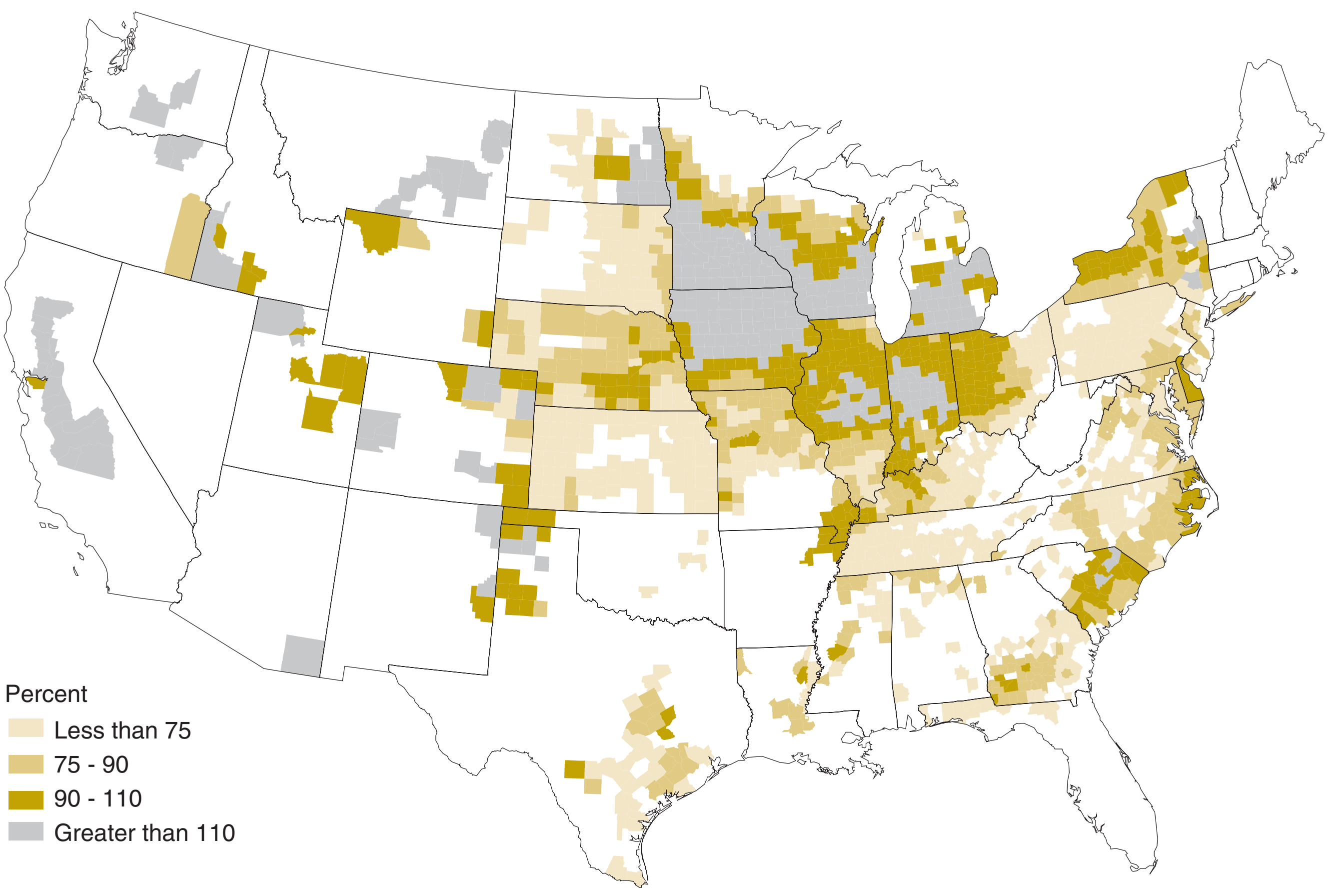
[10]Correlation coefficients in our model between benchmark (average) yields and yield variability at the farm level are -0.70 for corn, -0.84 for soybeans, -0.64 for wheat, and -0.76 for cotton. At the State level, they are -0.70 for corn, -0.82 for soybeans, -0.74 for wheat, and -0.81 for cotton.

Figures 4a-d show expected ACRE payments, based on simulated crop revenue variability, per acre for representative farms (one per crop per county) relative to national average ACRE payments. For corn (fig. 4a), ACRE payments would be high in Midwest areas with high average yields, even though these areas have low yield and revenue variability and strong negative price-yield correlations. ACRE payments also tend to be high along the Southeast and Middle Atlantic coast where average yields are low and yield and revenue variability are high. The pattern is similar for soybeans (fig. 4b). Representative farms in the Midwest with low revenue variability tend to receive relatively high ACRE payments because of their high yields, while those in Louisiana, Mississippi, and Georgia receive relatively high payments because of high revenue variability.

ACRE payments per acre of wheat (fig. 4c) would be very high in eastern Washington, Oregon, and Idaho, where white wheat is produced, reflecting the high average irrigated yields for these representative farms. In major spring wheat-producing areas in western Minnesota and eastern North Dakota, payments tend to be about equal to or slightly above the U.S. average ACRE payment. The representative farm acres in large winter wheat-producing areas in central Kansas have ACRE payments that range from average to above average, reflecting high average yields and relatively

Figure 4a

ACRE payment as percent of U.S. average ACRE payment, corn



Notes: Expected ACRE payment based on simulations with guarantee price and expected marketing-year average price of $4.10 per bushel. U.S. average ACRE payment = $11.38 per acre.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

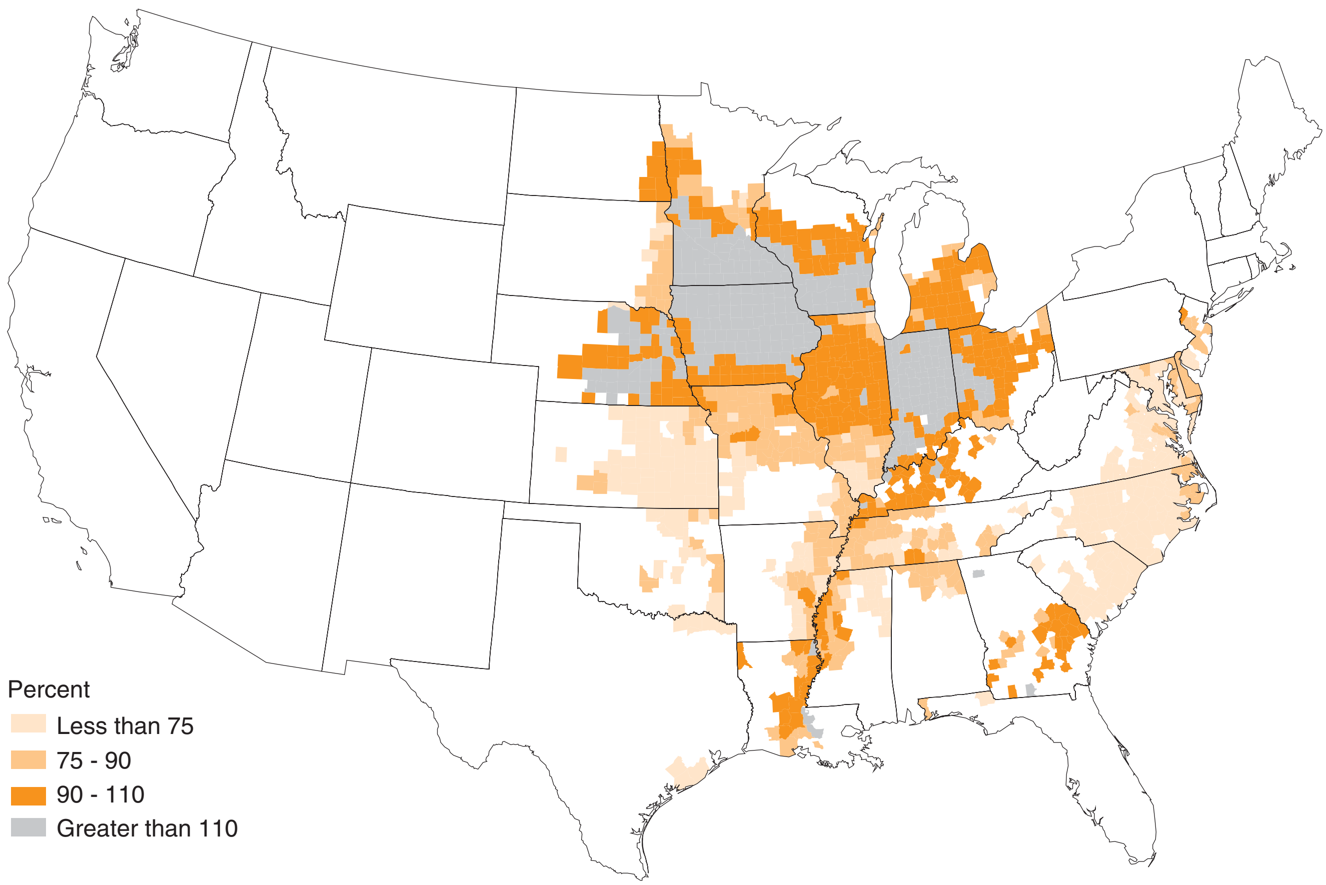
low revenue variability. In the plains areas of Oklahoma and Texas, ACRE payments would be low, reflecting low yield levels. Payments per acre for wheat would be high in Illinois, Indiana, and Michigan, States with small shares of the U.S. wheat crop, due to both high yield levels and high revenue variability.

For cotton (fig. 4d), expected ACRE payments would be very high in California and Arizona, States with moderate revenue variability but very high expected yields. In many areas in Texas, ACRE payments for cotton would be low, due to low average yields, even though farm-level revenue variability is high. In the Mississippi River Delta, ACRE payments for cotton would, in most areas, be above average, reflecting moderate State-level revenue variability and yield levels that are between those of dryland areas in Texas and the irrigated areas in Western States such as Arizona.

Distributions of ACRE payments, it should be noted, depend on the relative importance of the price and yield components of revenue variability, which can shift from year to year under the ACRE program. The distributions shown in figures 4a-d, for instance, are based on revenue variability that is generated under the situation where the expected market price is equal to the ACRE guarantee price. If the expected market price (the level at which we

Figure 4b

ACRE payment as percent of U.S. average ACRE payment, soybeans

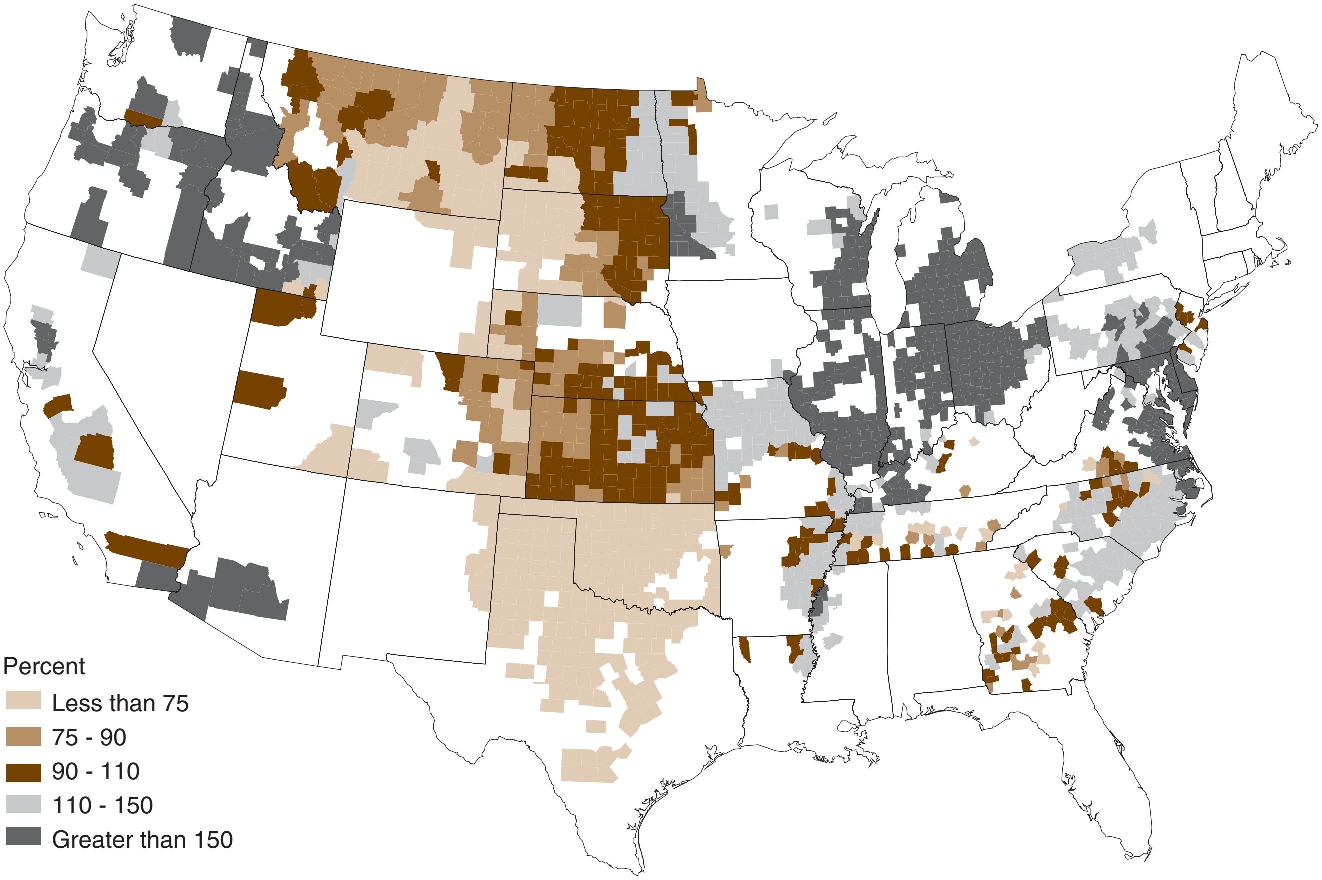


Notes: Expected ACRE payment based on simulations with guarantee price and expected marketing-year average price of $10.00 per bushel. U.S. average ACRE payment = $8.56 per acre.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Figure 4c

ACRE payment as percent of U.S. average ACRE payment, wheat



Notes: Expected ACRE payment based on simulations with guarantee price and expected marketing-year average price of $6.60 per bushel. U.S. average ACRE payment = $5.69 per acre.

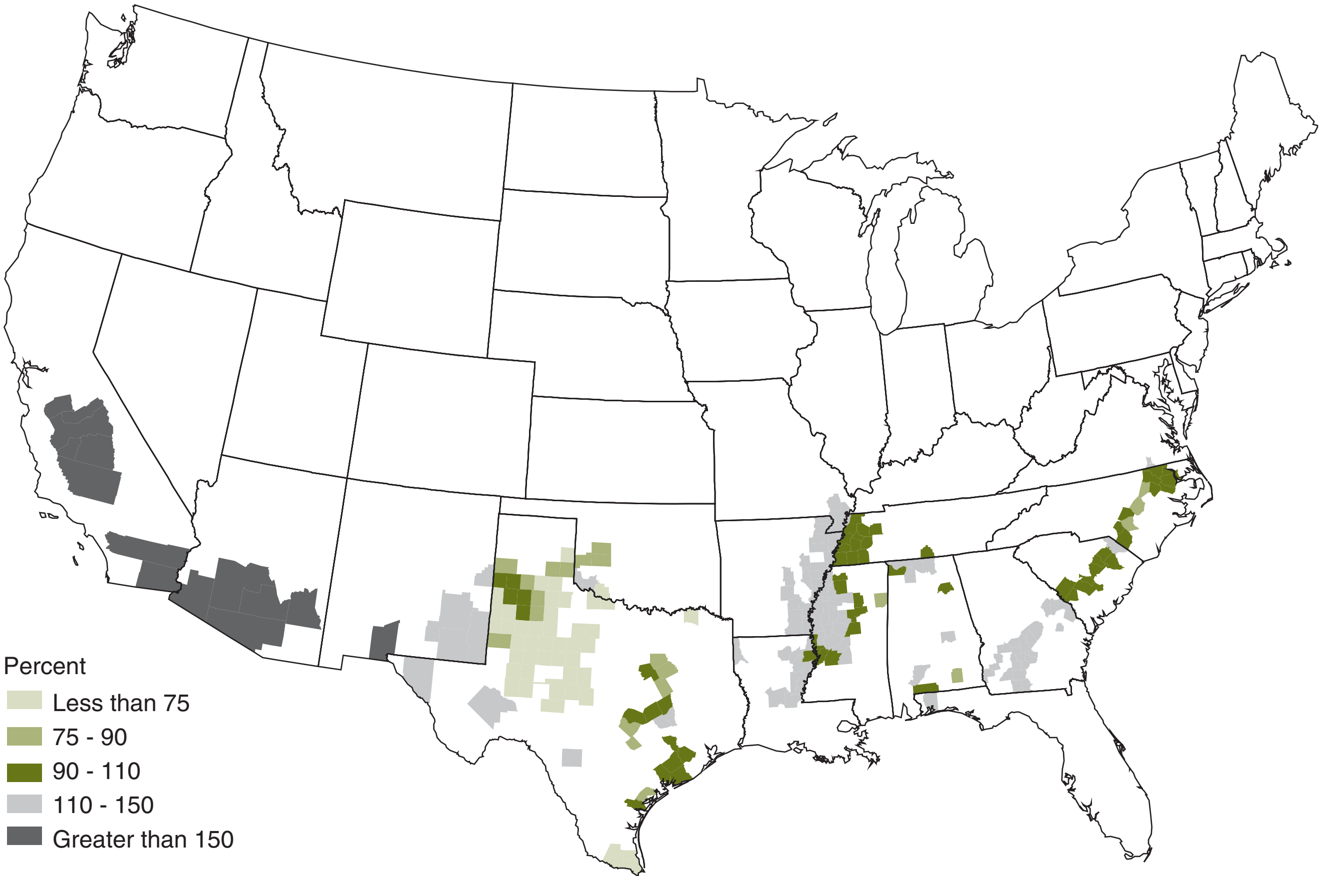
Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

center our simulations of variability) were greater than the guarantee price, the likelihood that a price decline would be the main cause of a revenue shortfall would be reduced; thus, yield variability would be a stronger factor in revenue variability. In this case, ACRE payments would shift to farms in areas of greater yield variability. Conversely, if the expected market price were below the guarantee price, price would be the stronger factor driving revenue variability. Because the same price is applied to all State and farm revenue calculations, when price is the stronger factor ACRE payments would shift to farms in areas with low yield variability.

Changes in yields can also affect the relative importance of price and yield in revenue variability. Yield changes, however, are less likely than price changes to shift ACRE payments. The outlook for expected yields at the beginning of the crop season is less likely than that of expected prices to be sharply below its recent history, and year-to-year changes in guarantee yields under ACRE would be more moderate than price changes because of the different lengths of historical periods used to calculate guarantees. The guarantee yield is a 5-year average, less the high and low years, while the guarantee price is a 2-year average.

Figure 4d

ACRE payment as percent of U.S. average ACRE payment, cotton



Notes: Expected ACRE payment based on simulations with guarantee price and expected marketing-year average price of $0.54 per pound. U.S. average ACRE payment = $8.90 per acre.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

ACRE Payments and Risk Reduction

Whether an ACRE payment is triggered or not depends on the probability that annual revenue will be below 90 percent of the benchmark measured at the State level and whether the farm's annual revenue falls below its benchmark; the magnitude of the ACRE payment depends on the size of the State revenue shortfall, relative to its guarantee, as well as the farm's average yield relative to the State average. Because of this complexity, ACRE payments are not directly related to farm-level revenue variability (fig. 5).

Under the simulated scenario of expected price equal to guarantee price, more than half of ACRE payments would go to farms with below-average revenue variability (fig. 6).[11] For corn and soybeans, for example, many farms and acres characterized by low revenue variability are located in States with relatively low revenue variability but above-average expected revenue. For wheat and cotton, the shares of ACRE payments that go to low-revenue-variability farms are driven by representative farm acres in irrigated areas that have expected yields and revenue that are much higher than the U.S. average.

[11]Farm revenue variability quartiles were constructed by ranking representative farms (one for each crop in each county) by revenue coefficient of variation and by weighting each representative farm by the number of acres planted, 2000-09. Total ACRE payments are payments per acre multiplied by acres planted.

Revenue Variability at Farm and State Levels

The effectiveness of the ACRE program in reducing risk, or variability of farm revenue for a crop, is strongly related to the correlation between the farm's revenue variability and variability in State farm revenue (fig. 7). When the correlation of variability is high (systemic risk), year-to-year increases or decreases in farm revenue tend to be widespread across the State. Revenue shortfalls on a farm that are independent of shortfalls on other farms are referred to as idiosyncratic risks. Because ACRE payments and risk reduction depend largely on the farm-State correlation and use U.S. average prices, they tend to address systemic risk.

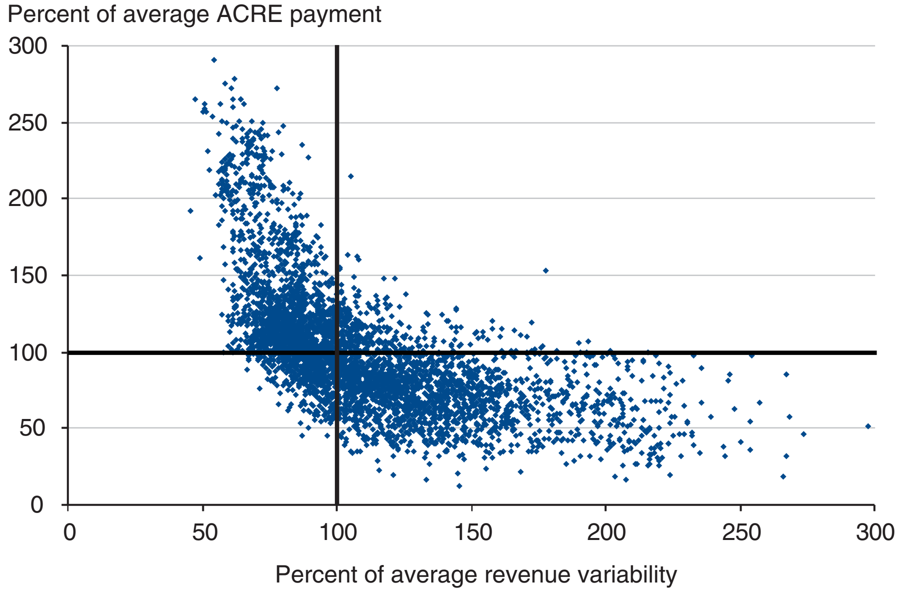
The strength of systemic risk—and thus, the relative effectiveness of ACRE in reducing risk—depends on the level of price variability, the difference between historical prices and expected market prices at a particular time, and the degree to which yield losses on one farm are matched with yield losses on other farms in the State. ACRE is more effective in reducing risk when crop price, which under ACRE is the same for all States and farms, becomes a stronger component of revenue variability and when yield losses are widespread. ACRE is ineffective in covering idiosyncratic risks, shortfalls on an individual farm that are uncorrelated with more widespread losses. Federal crop insurance policies, which in most cases are based on farm-level variability, cover idiosyncratic as well as systemic risk.

While the strength of the correlation between revenue on individual farms and aggregate State farm revenue differs across States and across farms within States, on average (at the U.S. level weighted by acres planted for farms and States), it is stronger for corn and soybeans than it is for wheat and cotton (table 3).[12] This is because large shares of U.S. corn and soybean production and acreage are concentrated in States where farm yield levels and variability—and thus, ACRE revenue levels and variability—are closely related. For example, the top two States in corn and soybean acreage, Iowa

[12]Average farm-State revenue correlations for each crop and State are listed in appendix table 2.

Figure 5

Revenue variability and ACRE payments

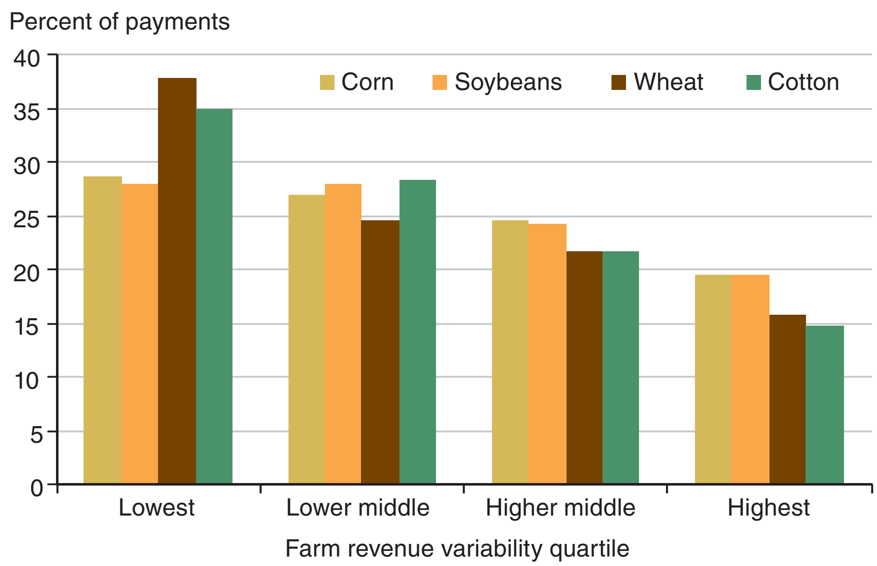


Note: Representative farm observations, all crops.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Figure 6

Distribution of total ACRE payments by farm revenue variability



Notes: Total ACRE payments = ACRE payment per acre multiplied by acres represented.

Farm revenue variability quartiles = Ranking of representative farms, weighted by acres represented, by revenue coefficient of variation.

Acres represented by each crop-county farm are average annual acres planted, 2000-09.

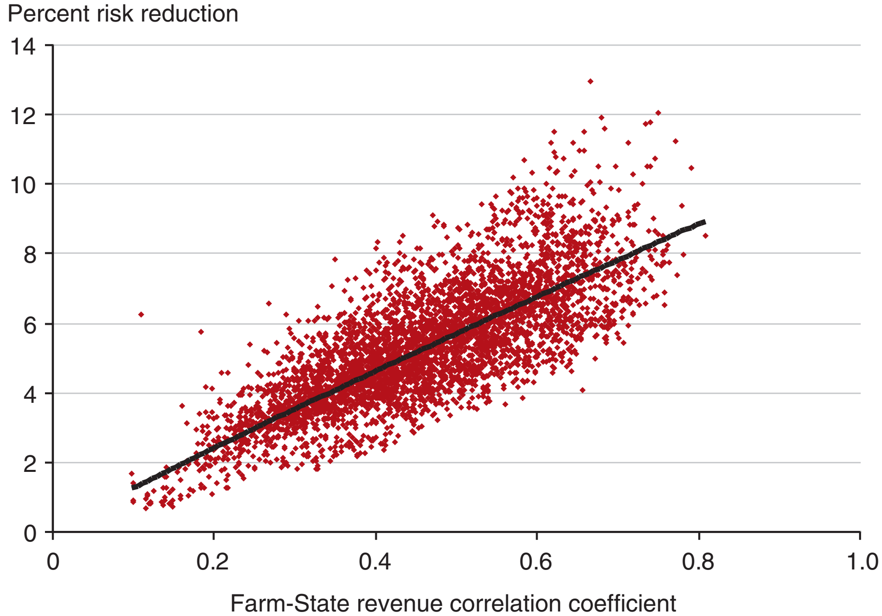
Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

and Illinois, have average farm-State revenue correlations of 0.60 and above. In contrast, the top two States in wheat acreage, Kansas and North Dakota, and the top two States in cotton acreage, Texas and Arkansas, have average farm-State revenue correlations of about 0.30 to slightly higher than 0.40.[13]

[13]Because our model uses composite irrigated and non-irrigated representative farm and State revenues, we underestimate the relevant correlation between farm and State revenue and risk reduction under ACRE in those areas where separate irrigated and non-irrigated farm acres can be linked to separate irrigated and non-irrigated guarantees at the State and farm levels.

Figure 7

Risk reduction from ACRE and farm-State revenue correlation



Notes: Representative farm observations, all crops. Risk reduction from ACRE = percent decrease in coefficients of variation of revenue when ACRE payments are included.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Table 3

Correlation between farm and State simulated revenues and risk reduction from ACRE: corn, soybeans, wheat, and cotton

Item	Corn	Soybeans	Wheat	Cotton
	Coefficient of variation			
Correlation of farm revenue with State revenue	0.55	0.54	0.40	0.39
	Percent			
Risk reduction from ACRE	5.4	6.4	5.4	4.8

Based on simulations with expected market price equal to guarantee price.

Averages weighted by planted acres.

Coefficient of variation = standard deviation divided by mean.

Risk reduction from ACRE = percent decrease in coefficient of variation of revenue when ACRE payments are included.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.

Average risk reduction from ACRE payments, or percentage decrease in the coefficient of variation of revenue, is especially strong, among the four crops, for soybeans.[14] While corn and soybeans have similar average farm-State revenue correlations, average risk reduction may be stronger for soybeans because, under the price scenario simulated, the expected ACRE payment is a slightly higher proportion of expected revenue for soybeans than it is for corn. The relatively weak average risk reduction for corn may also be due, in part, to the composite (irrigated and non-irrigated) farm-State revenue correlation

[14]Because ACRE payment amounts do not depend on the severity of a farm's revenue shortfall (below the farm guarantee), it is possible for a farm to receive an ACRE payment that is less or more than the farm's shortfall. If the payment exceeds the shortfall, then the coefficient of variation of revenue—our measure of risk reduction—could be larger when ACRE payments are included.

in Nebraska, which ranks third among corn producing States and accounts for about 10 percent of U.S. corn acreage.[15]

The average risk reduction for wheat, which is similar to corn, is driven by strong risk reduction in areas that contain large shares of U.S. wheat acreage and production—Kansas, North Dakota, and Montana—and especially strong risk reduction in the irrigated areas of Washington. The average risk reduction for cotton is the weakest among the four crops. About 45 percent of U.S. cotton acreage is in Texas, where farm revenue has an especially low correlation with State revenue.

The geographic distribution of risk reduction for each crop is similar to its ACRE payment distribution: areas where risk reduction is strong tend to be areas with above-average ACRE payments.[16] For soybeans, risk reduction is highest for representative farms in the Midwestern Corn Belt, areas with large shares of planted acres and production, and lowest in Atlantic Coast States, such as North and South Carolina. For corn, risk reduction is also highest in the Corn Belt, though many representative farms in other corn-producing areas also receive relatively high risk reduction. For wheat, risk reduction is strong in Kansas and North Dakota, major wheat-producing States, but also strong in Ohio, Michigan, and Indiana, States with relatively small shares of U.S. acreage and production. Expected risk reduction for wheat is below average for almost all of the representative farms in Oklahoma and Texas, States with relatively low expected ACRE payments. For cotton, risk reduction from ACRE is also low in the plains of Texas and highest in the irrigated areas in California and Arizona.

[15]The average correlation in our model for Nebraska corn, 0.52, is below the U.S. average, 0.54, and considerably less than the correlations in the top two States, Iowa and Illinois, 0.64. About 60 percent of Nebraska corn acreage is irrigated and 40 percent non-irrigated. Each of these production practices could be covered separately under ACRE, which would allow many Nebraska corn acres to be more closely tied to separately defined State averages than is the case in our model.

[16]The correlation between representative farm ACRE payment and risk reduction, as percentages of their averages per crop, is 0.790.

Conclusions

Crop revenue variability—which differs across crops, regions, and the geographic levels at which it is measured—is the basis for payments under three agricultural programs that provide risk management and farm income support to producers. Since the mid-1990s, subsidized revenue insurance has been available under the Federal crop insurance program, and revenue plans of insurance (both farm- and county-triggered plans) accounted for about 55 percent of all insured acres in 2008; revenue insurance accounted for about three-quarters of the insured acres of corn, soybeans, wheat, and cotton (Dismukes and Coble, 2006). Two revenue-based programs were introduced under provisions of the 2008 Farm Act: (1) the Supplemental Revenue Assistance Payments (SURE)[17] program, which provides payments for revenue losses due to natural disasters, and (2) the Average Crop Revenue Election program, or ACRE, an alternative to the commodity price programs available for major field crops.

[17]The SURE program is a supplement to coverage under Federal crop insurance or coverage under the Noninsured Crop Disaster Assistance Program (NAP) for crops for which insurance is not available.

These programs measure revenue at different levels—farm enterprise (crop), whole-farm, and State, for example—and with different prices—marketing-year averages and futures markets—that affect payment levels, program costs and farm-level risk reduction. ACRE payments are based on crop revenue variability at State and farm levels. Key factors affecting ACRE revenue variability and payments include future crop prices and their recent historical levels, measured at the national level, and yield levels and variability, measured at State and farm levels.

A producer's decision to participate in ACRE depends on individual considerations, including an assessment of ACRE benefits relative to benefits from legislatively set direct payment, target price, and loan rate commodity programs, the mix of crops on the farm, and the producer's willingness and ability to bear risk. At the initial enrollment deadline for ACRE in August 2009, about 8 percent of farms with almost 13 percent of eligible base acres elected to participate, less than what might have been expected based on price and yield analysis alone, suggesting that other factors such as learning and negotiation costs were substantial in ACRE's first year. ACRE enrollment was greatest in regions that typically grow wheat, corn, and soybeans (Woolverton and Young, 2009).

Our simulations indicate that, under price and yield conditions and ACRE guarantees similar to those that prevailed in 2009, expected benefits to ACRE would be higher for corn, soybeans, and wheat than for cotton. Although the geographic distribution of simulated ACRE payments is generally similar to actual enrollment, there were notable differences. For instance, even though our model indicates an ACRE payment for wheat in Oklahoma below the U.S. average, the actual enrollment rate in 2009 for wheat in Oklahoma was the second highest among wheat producing States, about 33 percent of base acres. In 2009, the ACRE enrollment deadline was August 14. At that time winter wheat producers had nearly complete knowledge of their farm and State yields for the 2009 crop. Oklahoma yields were expected to be below the State benchmark. In subsequent years, the ACRE enrollment deadline is June 1.

A robust evaluation of the effectiveness of ACRE in providing payments and risk reduction to producers needs to consider a range of scenarios and possible revenue outcomes. Historical prices and yields that determine ACRE guarantees can change, and future prices and yields that determine payments are not known with certainty. Our simulations of crop revenue variability, which model price and yield uncertainty, lead to several general conclusions about ACRE coverage:

- Expected payments increase as revenue guarantee levels, based on recent history, increase and as market prices decline relative to guarantees.

- ACRE payments and risk reduction per acre tend to be large in areas where yield levels and thus expected revenue are high, even though yield and revenue variability, measured as a coefficient of variation, are relatively low in many of these areas.

- Correlation between farm revenue and State revenue, which differs across crops and regions, is important in determining the degree of risk reduction provided under ACRE.

References

Congressional Budget Office. 1983. *Farm Revenue Insurance: An Alternative Risk-Management Option for Crop Farmers*. Aug.

Cooper, Joseph. 2009. *Economic Aspects of Revenue-Based Commodity Support*. Economic Research Report Number 72. Economic Research Service, USDA. April. www.ers.usda.gov/Publications/ERR72/.

Dismukes, Robert, and Keith H. Coble. 2006. "Managing Risk With Revenue Insurance." *Amber Waves*. Vol. 4, Issue 5. Economic Research Service, USDA. Nov. www.ers.usda.gov/AmberWaves/November06/Features/Managing.htm.

Goodwin, Barry K., and Vincent H. Smith. 1995. *The Economics of Crop Insurance and Disaster Aid*. Washington, DC: AEI Press.

Hart, Chad E., and Bruce A. Babcock. 2000. "Counter-Cyclical Agricultural Program Payments: Is It Time to Look at Revenue?" Center for Agricultural and Rural Development Briefing Paper 99-BP 28. Dec. http://www.card.iastate.edu/publications/DBS/PDFfiles/99bp28.pdf.

Miranda, Mario J. 1991. "Area-Yield Insurance Reconsidered." *American Journal of Agricultural Economics*. Vol. 73, No. 2. May.

Miranda, Mario J., and Joseph W. Glauber. 1991. "Providing Crop Disaster Assistance through a Modified Deficiency Payment Program," *American Journal of Agricultural Economics*. Vol. 73 No. 4, Nov.

Schnepf, Randall D., and Barry K. Goodwin. 1999. "Long-Run Price Risk in U.S. Agricultural Markets." Selected paper presented at American Agricultural Economics Association Annual Meeting, Nashville, TN. http://ageconsearch.umn.edu/bitstream/21687/1/sp99sc02.pdf.

Trostle, Ronald. 2008. *Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices*. Outlook Report No. (WRS-0801). Economic Research Service, USDA. July. www.ers.usda.gov/publications/wrs0801/.

U.S. Department of Agriculture, Farm Service Agency. 2009. *2009 Average Crop Revenue Election (ACRE) Program, Fact Sheet*, March 18. http://www.fsa.usda.gov/Internet/FSA_File/acre.pdf.

Woolverton, Andrea, and Edwin Young. 2009. *Factors Influencing ACRE Program Enrollment*. Economic Research Report 84. Economic Research Service, USDA. Dec. www.ers.usda.gov/Publications/ERR84/.

Zulauf, Carl R., Michael R. Dicks, and Jeffrey D. Vitale. 2008. "ACRE (Average Crop Revenue Election) Farm Program, and Farm Decision Analysis," *Choices*. Agricultural and Applied Economics Association. Vol. 23, No. 3. http://www.choicesmagazine.org/magazine/pdf/article_33.pdf.

Appendix

Appendix table 1
Simulated variability of crop revenue at State level: corn, soybeans, wheat, and cotton

State	Corn	Soybeans	Wheat	Cotton
	Coefficient of variation			
Alabama	0.234	0.295	0.294	0.285
Arizona	0.251	0.243	0.209	0.250
Arkansas	0.248	n/a	0.260	0.243
California	0.242	n/a	0.267	0.265
Colorado	0.257	n/a	0.295	n/a
Delaware	0.247	0.237	0.257	n/a
Florida	0.277	0.285	n/a	0.266
Georgia	0.257	0.339	0.278	0.278
Idaho	0.247	n/a	0.220	n/a
Illinois	0.227	0.199	0.266	n/a
Indiana	0.235	0.220	0.248	n/a
Iowa	0.237	0.230	0.285	n/a
Kansas	0.196	0.214	0.217	n/a
Kentucky	0.236	0.231	0.276	n/a
Louisiana	0.246	0.317	0.265	0.272
Maryland	0.245	0.216	0.259	n/a
Michigan	0.263	0.243	0.241	n/a
Minnesota	0.248	0.245	0.236	n/a
Mississippi	0.233	0.280	0.264	0.248
Missouri	0.236	0.201	0.265	0.271
Montana	0.257	n/a	0.296	n/a
Nebraska	0.227	0.213	0.238	n/a
New Jersey	0.270	0.225	0.264	n/a
New Mexico	0.245	n/a	0.360	0.257
New York	0.266	n/a	0.241	n/a
North Carolina	0.294	0.209	0.283	0.240
North Dakota	0.261	0.261	0.240	n/a
Ohio	0.247	0.223	0.227	n/a
Oklahoma	0.232	0.329	0.257	0.360
Oregon	0.254	n/a	0.263	n/a
Pennsylvania	0.235	n/a	0.252	n/a
South Carolina	0.347	0.271	0.268	0.295
South Dakota	0.203	0.224	0.233	n/a
Tennessee	0.233	0.240	0.285	0.263
Texas	0.247	0.304	0.259	0.292
Utah	0.233	n/a	0.246	n/a

Appendix table 1

Simulated variability of crop revenue at State level: corn, soybeans, wheat, and cotton (continued)

State	Corn	Soybeans	Wheat	Cotton
	Coefficient of variation			
Virginia	0.265	0.224	0.265	0.245
Washington	0.257	n/a	0.237	n/a
West Virginia	0.263	n/a	0.261	n/a
Wisconsin	0.242	0.240	0.262	n/a
Wyoming	0.234	n/a	0.251	n/a

n/a = not available.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service.

Appendix table 2

Correlation between farm simulated revenue and State simulated revenue, by State: corn, soybeans, wheat, and cotton

State	Corn	Soybeans	Wheat	Cotton
	Coefficient of variation			
Alabama	0.380	0.409	0.494	0.498
Arizona	0.639	0.368	0.418	0.609
Arkansas	0.427	n/a	0.379	0.439
California	0.517	n/a	0.415	0.666
Colorado	0.460	n/a	0.304	n/a
Delaware	0.464	0.497	0.646	n/a
Florida	0.326	0.321	n/a	0.435
Georgia	0.347	0.344	0.541	0.387
Idaho	0.555	n/a	0.544	n/a
Illinois	0.637	0.590	0.497	n/a
Indiana	0.618	0.604	0.534	n/a
Iowa	0.640	0.670	0.460	n/a
Kansas	0.337	0.416	0.384	n/a
Kentucky	0.548	0.478	0.547	n/a
Louisiana	0.386	0.359	0.274	0.449
Maryland	0.488	0.433	0.604	n/a
Michigan	0.548	0.523	0.581	n/a
Minnesota	0.607	0.597	0.417	n/a
Mississippi	0.425	0.398	0.447	0.497
Missouri	0.454	0.439	0.452	0.552
Montana	0.429	n/a	0.433	n/a
Nebraska	0.524	0.561	0.350	n/a
New Jersey	0.489	0.413	0.632	n/a
New Mexico	0.573	n/a	0.309	0.454
New York	0.526	n/a	0.545	n/a
North Carolina	0.481	0.324	0.504	0.488

Appendix table 2

Correlation between farm simulated revenue and State simulated revenue, by State: corn, soybeans, wheat, and cotton (continued)

State	Corn	Soybeans	Wheat	Cotton
		Coefficient of variation		
North Dakota	0.433	0.560	0.412	n/a
Ohio	0.609	0.582	0.589	n/a
Oklahoma	0.441	0.358	0.394	0.431
Oregon	0.510	n/a	0.683	n/a
Pennsylvania	0.403	n/a	0.616	n/a
South Carolina	0.392	0.299	0.472	0.458
South Dakota	0.405	0.549	0.309	n/a
Tennessee	0.497	0.418	0.505	0.516
Texas	0.448	0.230	0.264	0.303
Utah	0.450	n/a	0.357	n/a
Virginia	0.476	0.401	0.569	0.651
Washington	0.616	n/a	0.680	n/a
West Virginia	0.398	n/a	0.495	n/a
Wisconsin	0.494	0.537	0.546	n/a
Wyoming	0.440	n/a	0.386	n/a

Based on simulations with expected market price equal to guarantee price. Averages weighted by planted acres.

n/a = not available.

Source: USDA, Economic Research Service simulations based on data from USDA, National Agricultural Statistics Service and USDA, Risk Management Agency.