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Alternatives to a State-Based ACRE Program: Expected Payments Under a National, Crop District, or County Base

Robert Dismukes, Keith H. Coble, David Ubilava, Joseph C. Cooper, Christine Arriola

Abstract

The Average Crop Revenue Election, or ACRE, program is a commodity support program that bases coverage on aggregate State-level and individual farm-level revenue variability. Changing the level of aggregation from State to one closer to the farm level—Crop Reporting District or county—would generally increase payments. This report models how expected payments and the level of risk reduction from programs triggered at alternative levels would vary across crops—corn, soybeans, wheat, cotton, grain sorghum, and rice. It also considers how benefits from the alternative revenue programs would vary relative to benefits from direct payment and price-based commodity programs.

Keywords: Average Crop Revenue Election, ACRE, commodity support, crop revenue variability, farm risk management

Acknowledgments

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Contents

Summary

This report simulates crop revenue variability to examine expected program payments and consequences on farm-level risk if the area trigger were changed from the State level to a national, Crop Reporting District, or county level. The analysis is national in scope and covers seven crops: corn, soybeans, wheat, cotton, grain sorghum, long-grain rice, and medium/short-grain rice, which accounted for 98 percent of the value in 2010 of crops for which ACRE was available. We analyze how the change in revenue program benefits would vary across crops and regions and how benefits from the revenue programs would stack up against benefits from direct payment and price-based commodity programs (countercyclical, marketing loan guarantees) available under the 2008 Farm Act.

What Is the Issue?

Enacted in 2008, the Average Crop Revenue Election or ACRE program uses a combination of State- and farm-level revenue guarantees or payment triggers that are established from recent prices and yields. At the initial enrollment deadline for ACRE in August 2009, only 8 percent of farms with about 13 percent of eligible base acres elected to participate, despite the program's unique ability to align guarantee prices with increases in field crop prices. In 2010, the second year in which ACRE was available, few additional acres were enrolled.

The ACRE participation decision is complex. Prospective enrollees must weigh the benefits of ACRE relative to those of other programs that must be forgone and learn about a markedly different program that uses both farm- and State-level revenue triggers. Switching the aggregate (State) revenue trigger to a lower level, one closer to the farm level, has been suggested as a way to make ACRE more attractive to producers.

What Did the Study Find?

Changing the aggregate level of revenue used to trigger payments in a program such as ACRE would change expected benefits and, perhaps, enrollment levels. Moving from ACRE's State level to one closer to the farm level would generally increase payments and reduce risk.

- If expected market prices equal revenue program guarantee prices, the increase in payments and risk reduction would be greatest for crops such as wheat, cotton, and grain sorghum—crops with widely varying yield across regions and, thus, large differences in revenue variability across levels of aggregation. The average expected payments for these crops would increase 28-32 percent if the revenue program trigger were changed from State to county. Corn and soybean production is more concentrated geographically with less varied yields, so the increase in expected payments would be less, 16-19 percent. Payments for rice would change little if the aggregate revenue trigger were changed because most of the crop is irrigated, with price largely determining revenue variability.

- The relationship between expected market price in the covered year and the revenue program guarantee price affects the changes in expected payments under alternative levels of revenue aggregation. If the expected market price **increases** relative to the guarantee, then difference in expected payments across levels of aggregation would increase as yield variability becomes a stronger factor in determining revenue variability and payments; if the expected market price **decreases** relative to the guarantee, expected payments increase but differences in payments across levels of aggregation decrease.
- Because revenue benchmarks or guarantees used in the revenue programs are designed to change over time, it is important to consider the different crop guarantee price scenarios in evaluating the benefits of a revenue program relative to price-based programs. If crop prices continue to increase, guarantees and expected payments under ACRE or a similar program would increase, while expected payments under programs that are based on legislatively fixed targets would decrease. And as the crop's price increases, the size of the direct payment for a crop decreases relative to the expected payment from the revenue program. Changes in prices, and thus revenue program guarantees, appear to be much more important than level of aggregation/trigger to producers weighing the revenue election.
- Risk reduction from a program that uses an aggregate revenue trigger depends greatly on the correlation between the aggregate measure of revenue and actual farm revenue. While risk reduction increases as the level of aggregation used in the revenue program diminishes, farm-level revenue is largely uncorrelated with revenue at even the smallest level of aggregation, the county. In addition, expected payments and risk reduction are limited by the cap of revenue program payments at 25 percent of the guarantee.

While a county-level revenue program would generally produce larger expected payments and risk reduction for participants than a State-level program, it would increase government administrative costs as program benchmarks and guarantees would need to be determined for a greater number of aggregate units.

How Was the Study Conducted?

To study the effects of changing the aggregation level used for the trigger in a revenue program, we constructed three hypothetical revenue program alternatives that maintain the structure of the ACRE program but substitute national-, district- and county-level revenue for the State-level revenue trigger. 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 national, State, Crop Reporting District, and county levels. The model is national in scope and represents about 95 percent of the 2010 planted U.S. acres of corn, 89 percent of soybean acres, 89 percent of wheat acres, 84 percent of cotton acres, 74 percent of the grain sorghum acres, and more than 90 percent of rice acres.

Introduction

Crop price has served as a basis for commodity support payments for about 70 years. Tying support payments to low prices had its impetus shortly after the end of World War I as commodity prices plunged (Gardner, 2002). Using crop revenue, rather than prices, as the basis for agricultural income support programs has been studied as a way to reform U.S. farm programs since at least the early 1980s. A rationale for using revenue is that it is more closely related to farm income than its components, prices and yields. As such, revenue programs can more efficiently stabilize income and lessen the annual variability in government program expenditures than separate price-based or yield-based programs can (Cooper, 2010).

The Food, Conservation and Energy Act of 2008 (the 2008 Farm Act) introduced a revenue-based option to the set of price-based programs available to field crop producers. The Average Crop Revenue Election or ACRE program uses a combination of State- and farm-level revenue payment triggers that are established from recent prices and yields. At the initial enrollment deadline for ACRE in August 2009, about 8 percent of farms with about 13 percent of eligible base acres elected to participate (USDA, Farm Service Agency, 2011a). Few additional acres were enrolled the following year (USDA, Farm Service Agency, 2011b).

The ACRE participation decision is complex. Crop producers must weigh the benefits of ACRE relative to those of other programs that must be forgone and learn about a markedly different program that uses both farm-level and State-level revenue triggers. Switching the aggregate (State) revenue trigger to a lower level, one closer to the farm level, may make the program more attractive to producers (Babcock, 2010; Paulson and Babcock, 2008; Zulauf et al., 2010).

This report simulates crop revenue variability to examine expected program payments and consequences on farm-level risk if the area trigger were changed from the State level to a national, Crop Reporting District[1], or county level. Our analysis is national in scope and covers seven crops: corn, soybeans, wheat, cotton, grain sorghum, long-grain rice, and medium/short-grain rice.[2]

[1]A Crop Reporting District is a multiple county unit within a State.

[2]The crops in our analysis accounted for 98 percent of the value in 2010 of crops for which ACRE was available. ACRE uses different prices and yields to measure revenue for long-grain and medium/short-grain rice.

Determinants of Revenue Variability

Revenue variability depends on the variability of prices and production (yields multiplied by acres) and the interactions between the two (Cooper, 2009; Dismukes et al., 2010). Because crop prices depend largely on world markets, variability in the price for a crop is similar across much of the United States due to potential arbitrage. Yields, in contrast, depend on factors such as weather, diseases, and insects that can affect wide areas at once but are often localized. Thus, the area over which revenue is measured will affect the measured revenue variability (Coble et al., 2007).

Yield variability, measured as the coefficient of variation in model simulations[3], is by far the smallest at the national level, the largest level of aggregation. As yields are measured over smaller areas, variability generally increases, though the increase varies by crop and location. For instance, average yield variability at the State level for corn is about 40 percent higher at the national level (table 1). For wheat, which is grown under a wide variety of conditions, average State yield variability is about 140 percent of national yield variability. In contrast, yield variability for long-grain rice, which is grown only under irrigation and thus has relatively low yield variability, is about 16 percent higher at the State than at the national level.[4]

At the next smallest level (relative to State), the Crop Reporting District or district, yield variability increases about 25-45 percent for cotton, grain sorghum, and wheat, but increases only 2-5 percent for medium/short-grain and long-grain rice. At the county level, yield variability is, on average, about 10-20 percent higher than at the district level for corn, soybeans, long-grain rice, cotton, and grain sorghum; for wheat, it is only slightly (less than 1 percent) higher. Yield variability at the representative farm[5] level is much higher than at the county level.

[3]Coefficient of variation is the standard deviation divided by the mean. For details on how simulations were generated, see Methods and Data section.

[4]In our model medium/short-grain rice is only produced in a single State, California; there is no difference between the State and national revenues.

[5]In our model, yield and revenue variability at the farm level are for a typical, or representative, acre for a crop in a county. Farm-level variability, therefore, refers to an individual crop, not to the combined variability of multiple crops that could be grown on a farm.

Table 1
Yield and revenue variability at different levels of aggregation

Item/Level	Corn	Soybeans	Wheat	Cotton	Grain sorghum	Rice, long-grain	Rice, Medium/short-grain
	Coefficient of Variation						
Yield variability:							
National	0.069	0.058	0.056	0.076	0.099	0.037	0.061
State	0.097	0.099	0.135	0.119	0.123	0.043	0.061
District	0.110	0.113	0.169	0.152	0.167	0.045	0.062
County	0.122	0.125	0.195	0.184	0.202	0.052	0.067
Farm	0.359	0.372	0.520	0.672	0.776	0.335	0.263
Revenue variability:							
National	0.195	0.188	0.185	0.197	0.214	0.272	0.288
State	0.207	0.205	0.215	0.225	0.230	0.275	0.288
District	0.214	0.213	0.240	0.250	0.256	0.275	0.288
County	0.221	0.220	0.261	0.274	0.283	0.276	0.289
Farm	0.413	0.425	0.558	0.715	0.829	0.440	0.395

Averages weighted by acres harvested in 2010. District = Crop Reporting District. Medium/short-grain rice is for a single State, California. Based on simulations.

Revenue variability, which depends on both yield and price, is greater than yield variability at all levels of aggregation. Under our simulations, revenue variability at the national level is more than double yield variability for each of the seven crops (table 1). The difference between revenue and yield variability decreases as they are measured at the more disaggregated levels. In other words, revenue variability is determined more by yield variability at smaller levels of aggregation.

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 plays a role.[6] Revenue variability for corn and soybeans tends to be lowest in counties that stretch across the center of the Corn Belt, an area with low yield variability that also has the strongest negative correlation between yield and price. Revenue variability for wheat—which, in contrast to corn and soybeans, includes different types of wheat that are sold in different markets at different times of the year—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 western Kansas and eastern Colorado and parts of the Northern Plains in North Dakota, South Dakota, and Montana.

[6]The relationship between prices and yields, measured by statistical correlation, is negative when changes in yield are associated with offsetting changes in price. Negative price-yield correlation moderates or dampens revenue variability, and is often referred to as a "natural hedge."

The distribution of U.S. cotton production over diverse growing conditions and the weak correlations between U.S. cotton production and price result in wide range of revenue variability. For cotton, revenue variability is lowest for irrigated production in California and Arizona and highest for dryland production in the plains of Texas. Grain sorghum revenue variability is generally low in Kansas and high in Oklahoma and Texas. Rice revenue variability differs little across its growing regions because yields vary little and price variability, which is the same across regions, largely determines revenue variability.

ACRE and Alternative Revenue Program Triggers

To study the effects of changing the aggregation level used for the trigger in a revenue program, we maintain the structure of the ACRE program but substitute national-, district-, and county-level revenue for the State-level revenue trigger. Payments are based on annual outcomes of the aggregate and farm revenues for a crop relative to their guarantee or benchmark. The programs use a double trigger. For a farm to receive a payment, revenue at the aggregate level (national, State, district, or county) must fall below its guarantee—90 percent of its benchmark—and farm revenue must fall below its benchmark.[7] Both conditions have to be met. The program payment per acre is the difference between the revenue guarantee and the actual revenue at the aggregate level, up to a maximum of 25 percent of the guarantee, multiplied by a farm productivity index, which is the ratio of the farm average yield to the average yield at the aggregate level. Under provisions of the 2008 Farm Act, the ACRE payment 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.

ACRE program benchmarks or expected revenues are based on recent historical prices and yields. Because prices and yields can change from year to year, the revenue guarantee can change, though the annual change in the guarantee is limited to no more than 10 percent.[8] To examine the effects of changes in prices used to set the revenue guarantees, we construct four scenarios, each with a different set of crop guarantee prices:

(1) prices approximately equal to the "guarantee prices"[9] of ACRE in 2010;

(2) prices 20 percent higher than the 2010 prices;

(3) prices 20 percent lower than the 2010 prices; and

(4) prices equal to the target prices, set under the 2008 Farm Act, for the price-based countercyclical program. (The prices for each of the scenarios are listed in appendix table 1.)

The eventual crop prices for the marketing year, which are not known at the revenue program signup, are used to calculate actual revenue and hence revenue program payments. As a base case in our analysis, we model revenue variability and payments under the condition that the expected marketing-year average price is equal to the revenue guarantee price. In this case, payments would be triggered simply by the variability of revenue around its expected level. In addition to our base case, we examine cases where expected marketing-year average prices are above and below the revenue guarantee prices.

[7]The ACRE 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, dropping the highest and lowest yields in this period. 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, dropping 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.

[8]The results presented in this report are from simulations for 1 year, so they do not include the potential effect of the year-to-year changes in the revenue guarantee over a multiple-year time path.

[9]Guarantee price is the average of the marketing-year average price over the previous 2 years.

Expected Payments Under Programs Triggering at Different Aggregation Levels

Increasing the level of revenue aggregation in a revenue program from State to national would, on average, reduce expected revenue program payments for each crop; changing from the State to a more local level would, on average, increase expected payments. Table 2 shows the percent change, relative to the State-triggered ACRE, in the U.S. average expected payment under revenue programs using different triggers.[10] These proportional changes in payments, with expected market price equaling revenue guarantee price, are constant as the level of guarantee prices increase or decrease, even though the dollar amounts of the payments would increase or decrease with the guarantee prices. (Expected payments in dollars per acre under each of the four guarantee price scenarios are in appendix table 2.)

Shifting to a national trigger from a State trigger would result in the largest proportional decrease in expected payments, about 23 percent, for cotton, reflecting the aggregation of its diverse production areas. For soybeans, grain sorghum, corn, and wheat, expected payments would drop 8-12 percent. For long-grain rice, for which there is little difference in yield or revenue variability between the national and State level, a switch from a State to a national trigger would reduce expected revenue program payments just 2 percent.

If a revenue trigger at a substate level were used, then expected payments for grain sorghum, cotton, and wheat would see the greatest proportional increases: 28-32 percent under a county revenue trigger and 13-17 percent at the crop district level of aggregation. Soybean and corn payments would increase about 16 and 19 percent for a county trigger and 7-10 percent for a district trigger (table 2). The relative increases in expected payments for the district- or county-triggered program are consistent with correlation of yields across levels of aggregation; for instance, the more correlated the district or county yield is with the State yield, the smaller the increase in expected payment.

Expected payments for rice would change little. This is because yield variability for rice is smaller than for the other crops and changes little as it is

Table 2

Difference in average expected payment, relative to State-triggered program, from revenue programs triggered at different levels of aggregation

Level	Corn	Soybeans	Wheat	Cotton	Grain sorghum	Rice, long-grain	Rice, medium/short-grain
	Percent						
National	-11.3	-8.4	-11.5	-23.3	-10.1	-2.1	0
District	10.4	6.8	15.3	13.1	17.1	Less than 1	Less than 1
County	18.8	15.5	28.0	28.5	32.0	2.3	Less than 1

Averages weighted by acres harvested in 2010. District = Crop Reporting District. Medium/short-grain rice is for a single State, California. Based on simulations of expected market price equal to revenue program guarantee price.

[10]Average expected payments are based on representative farm acres weighted by acres harvested in 2010. The ACRE program bases payments on USDA's Farm Service Agency (FSA) definition of "planted and considered planted" acres. This excludes, for instance, wheat planted for grazing. Because there are no county-level data on the FSA-defined acres, we use harvested acres.

measured at smaller levels of aggregation. Therefore, revenue variability for rice is driven largely by price variability, which under the revenue program does not change from one level of aggregation to another.

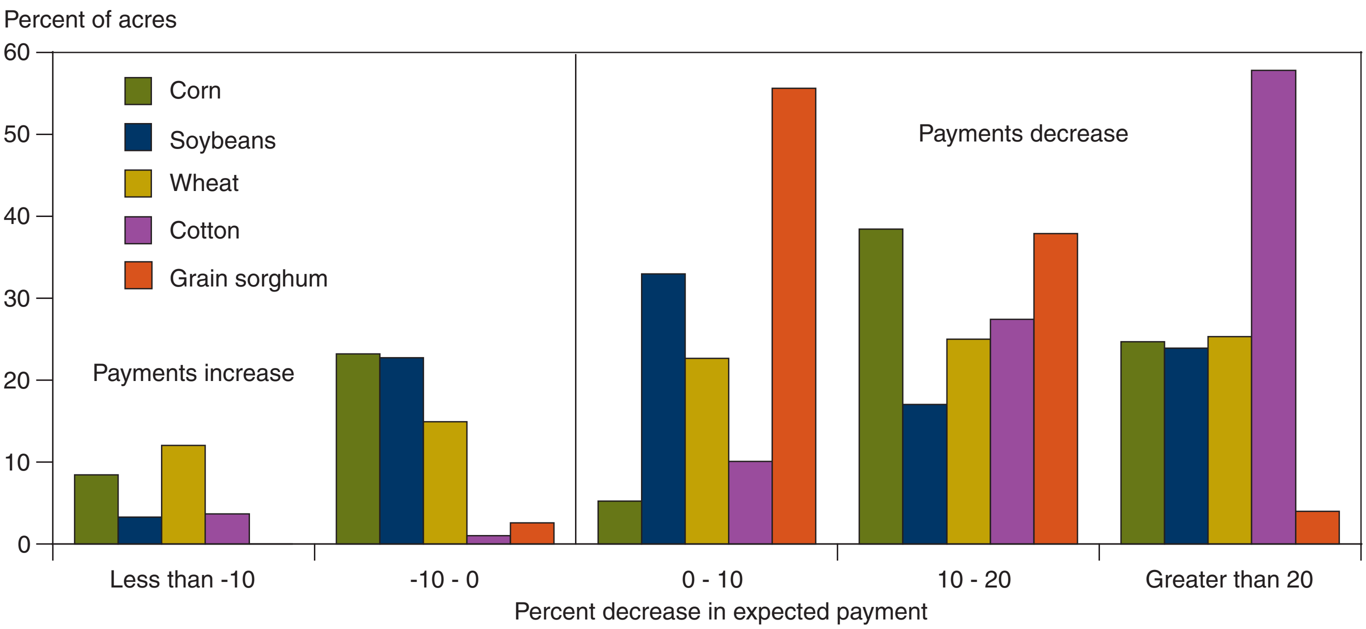
Change in Expected Payments Varies Across Farms

Not all representative farm acres (one per crop per county) would see the average change in expected payments; some would see greater changes than the average, and some less. The change in expected payment between State- and national-triggered programs depends on revenue variability for a particular State relative to national revenue variability, as well as the correlations between farm revenue and State and national revenue. In most, but not all, cases, revenue variability at the national level is less than revenue variability at the State level, and farm revenue is less closely related to national revenue than to State revenue. In these cases, expected payments would decrease if the revenue program trigger were changed from the State to the national level.

Figure 1 shows the proportion of total representative farm acres for each crop by the percent to which expected payments would change, according to simulations with expected market price equal to revenue guarantee price. For corn, soybeans, and wheat, expected revenue program payments would decrease on 70-75 percent of the representative farm acres, but would increase on 25-30 percent of the acres. Payments would decrease in moving from a State to a national trigger for nearly all acres of cotton, grain sorghum, and long-grain rice, with more than half of the cotton acres having an expected decrease in payments of over 20 percent.

Figure 1

Proportion of acres by percent decrease in expected payment between State- and national-triggered revenue programs, by crop



Acres = Harvested acres of representative farms. Based on simulations with expected market price equal to guarantee price. Average decrease in expected payment for rice is less than 2 percent; expected payments would decrease slightly on about 94 percent of the representative farm acres of rice.

Figures 2a-e show for each crop the regional distribution of the percent change in expected payments under a national versus State revenue trigger. For corn (fig. 2a) and soybeans (fig. 2b), the greatest decreases, as a percent of the U.S. average expected payment, would be in the areas away from the heart of the Corn Belt. For wheat (fig. 2c), the greatest decreases would be in the Mid-Atlantic States, Montana, eastern Colorado, Michigan, and in counties along the Mississippi River. For cotton (fig. 2d) and grain sorghum (fig. 2e)—crops for which nearly all acres would have a substantial decrease in expected payments—the areas with the largest drops in payments would be in the plains of Texas for cotton and in Nebraska for grain sorghum.

While the average expected payment would increase if the level of aggregation used for the revenue program were changed from the State to the county level, the degree of change would vary from one farm acre to another. The change in expected payment from a State to county trigger for the representative farm acres is driven largely by the differences in revenue variability[11] across counties and farms within a State. When revenue variability for a particular county is greater than its State's revenue variability, switching to a county revenue trigger would increase expected payments. States with a wide range of revenue variability across counties and farms would see a wide range of increases in expected payments.

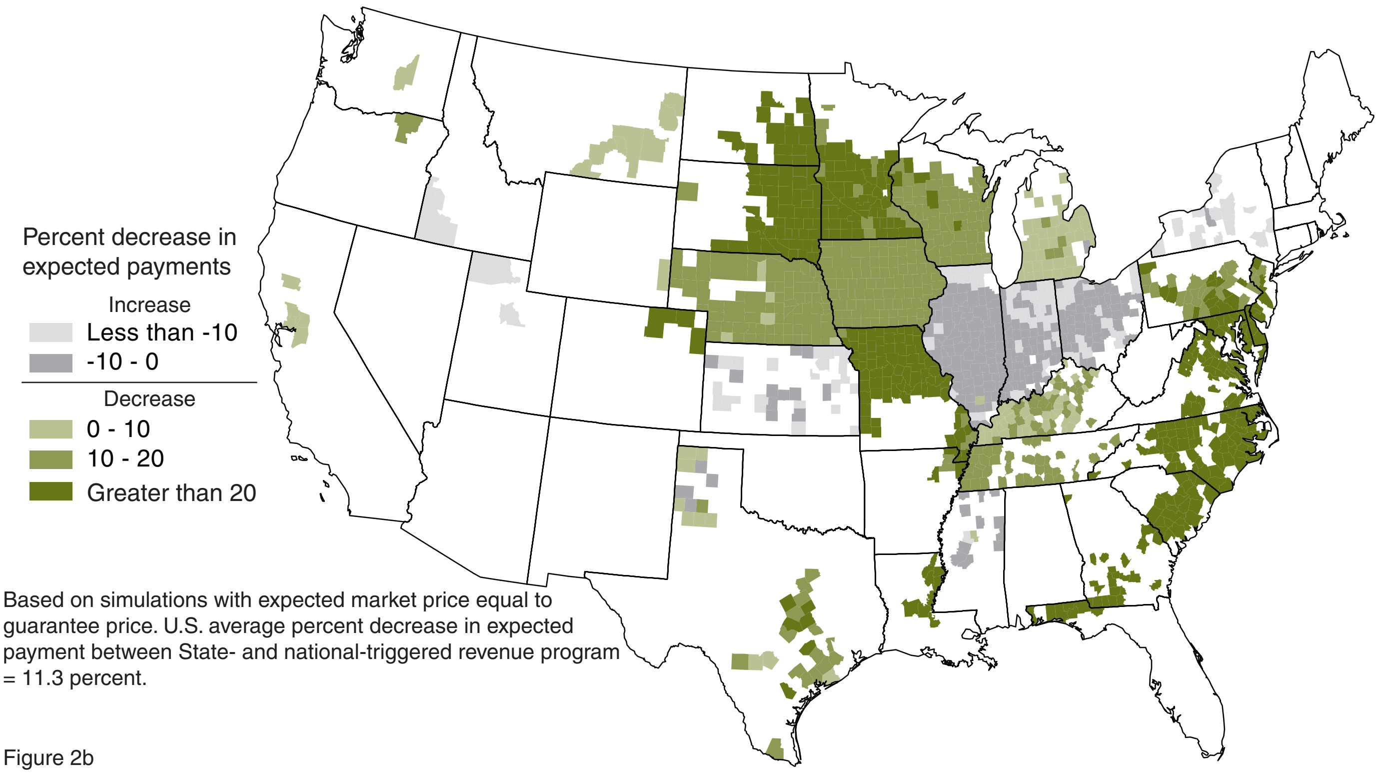
Figure 3 shows the proportion of total representative farm acres for each crop, according to simulations with expected market price equal to revenue guarantee price, by the degree to which expected payments would increase if the revenue trigger were changed from State to county. For corn and soybeans, expected revenue program payments would increase on about 80 percent of farm acres, whereas about 90 percent of wheat, cotton, grain sorghum, and rice acres would receive higher payments.

Increases in payments under a county revenue trigger would be largest for the representative corn acres in eastern and southern Illinois and southern Iowa (fig. 4a). Increases for soybeans (fig. 4b) would be largest in northern Iowa and eastern Kansas. For wheat (fig. 4c), increases would be large in the Northern Plains and in eastern and western Kansas. For cotton (fig. 4d) and grain sorghum (fig. 4e), farm acres from counties in Texas with high yield and revenue variability would see large increases in payments in moving from a State to a county trigger.

[11]Revenue variability in the ACRE program and the alternative revenue programs is calculated with a single national price for each crop. Yield variability and price-yield correlations differ at the different levels of aggregation.

Figure 2a

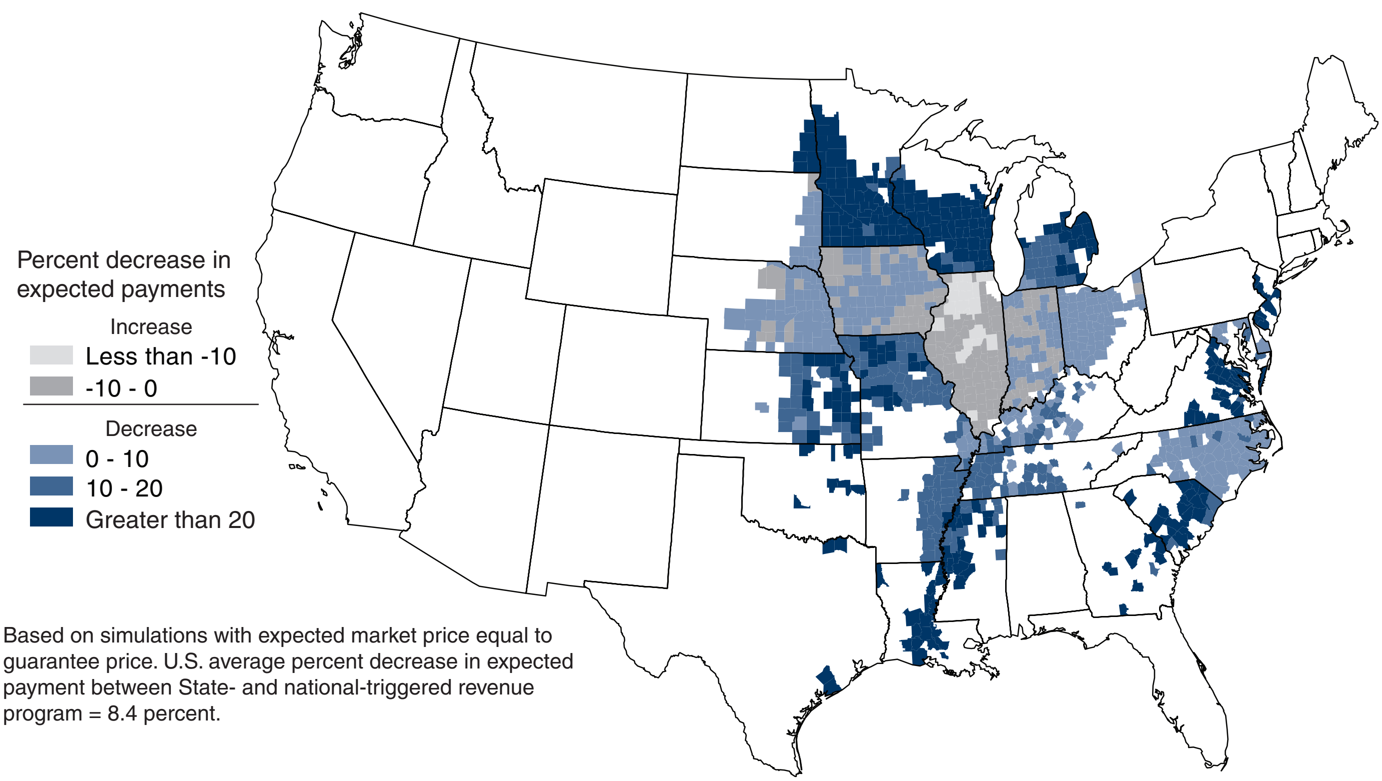
Percent decrease in expected payment between State- and national-triggered revenue program, corn



Based on simulations with expected market price equal to guarantee price. U.S. average percent decrease in expected payment between State- and national-triggered revenue program = 11.3 percent.

Figure 2b

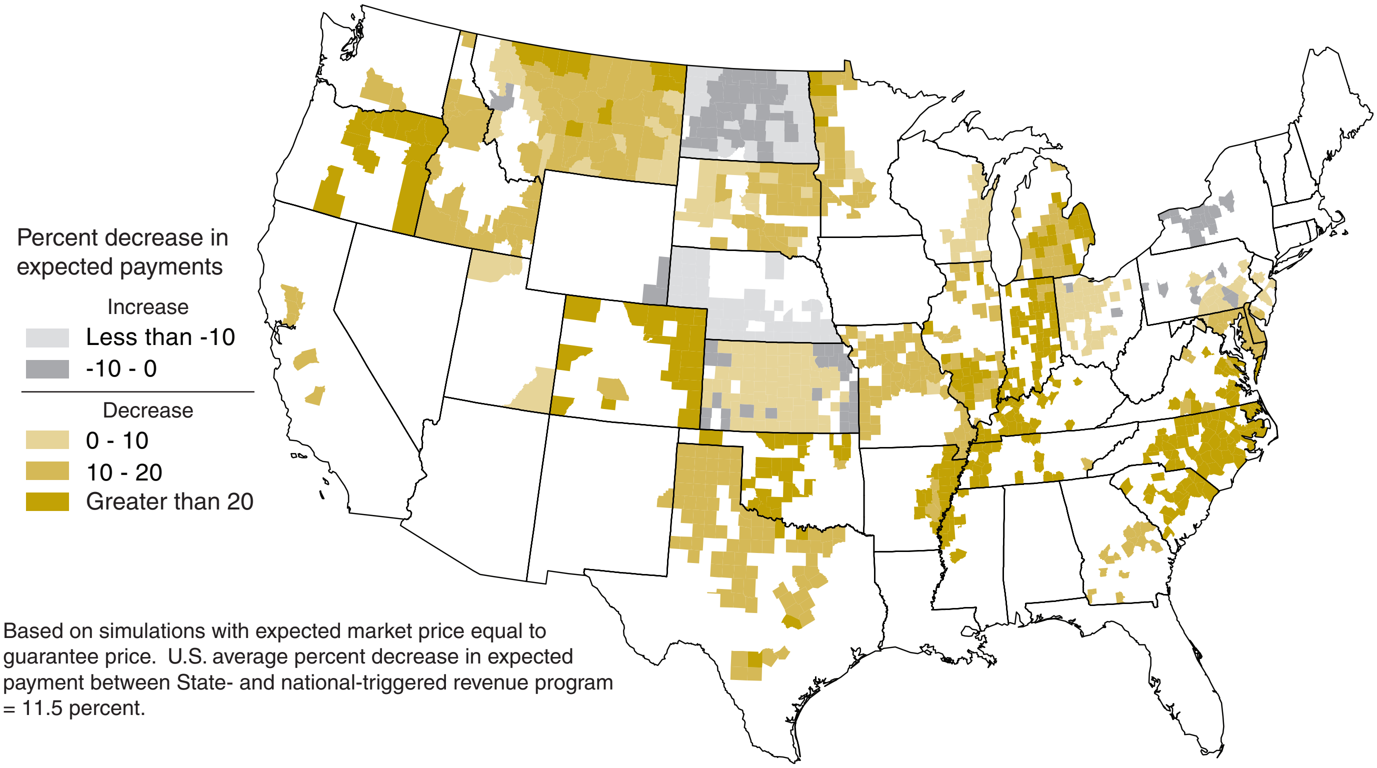
Percent decrease in expected payment between State- and national-triggered revenue program, soybeans



Based on simulations with expected market price equal to guarantee price. U.S. average percent decrease in expected payment between State- and national-triggered revenue program = 8.4 percent.

Figure 2c

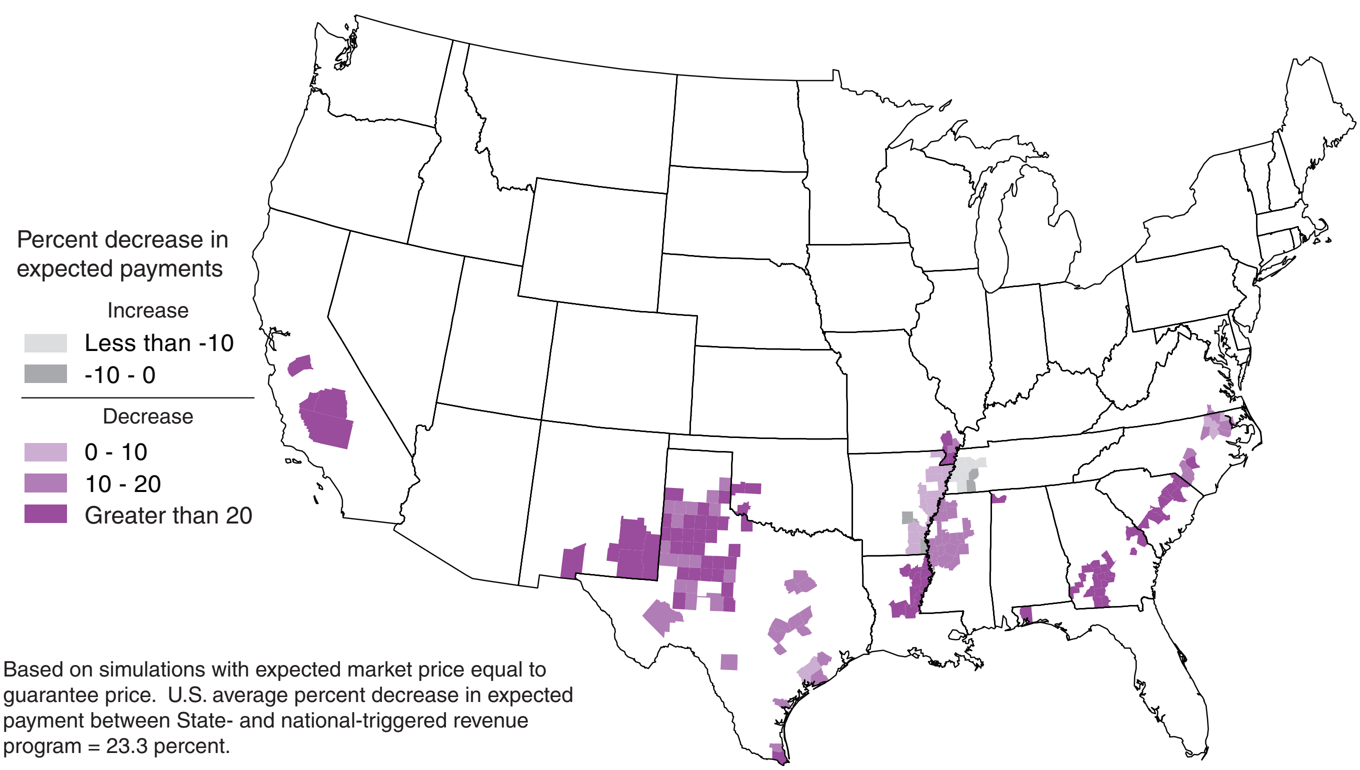
Percent decrease in expected payment between State- and national-triggered revenue program, wheat



Based on simulations with expected market price equal to guarantee price. U.S. average percent decrease in expected payment between State- and national-triggered revenue program = 11.5 percent.

Figure 2d

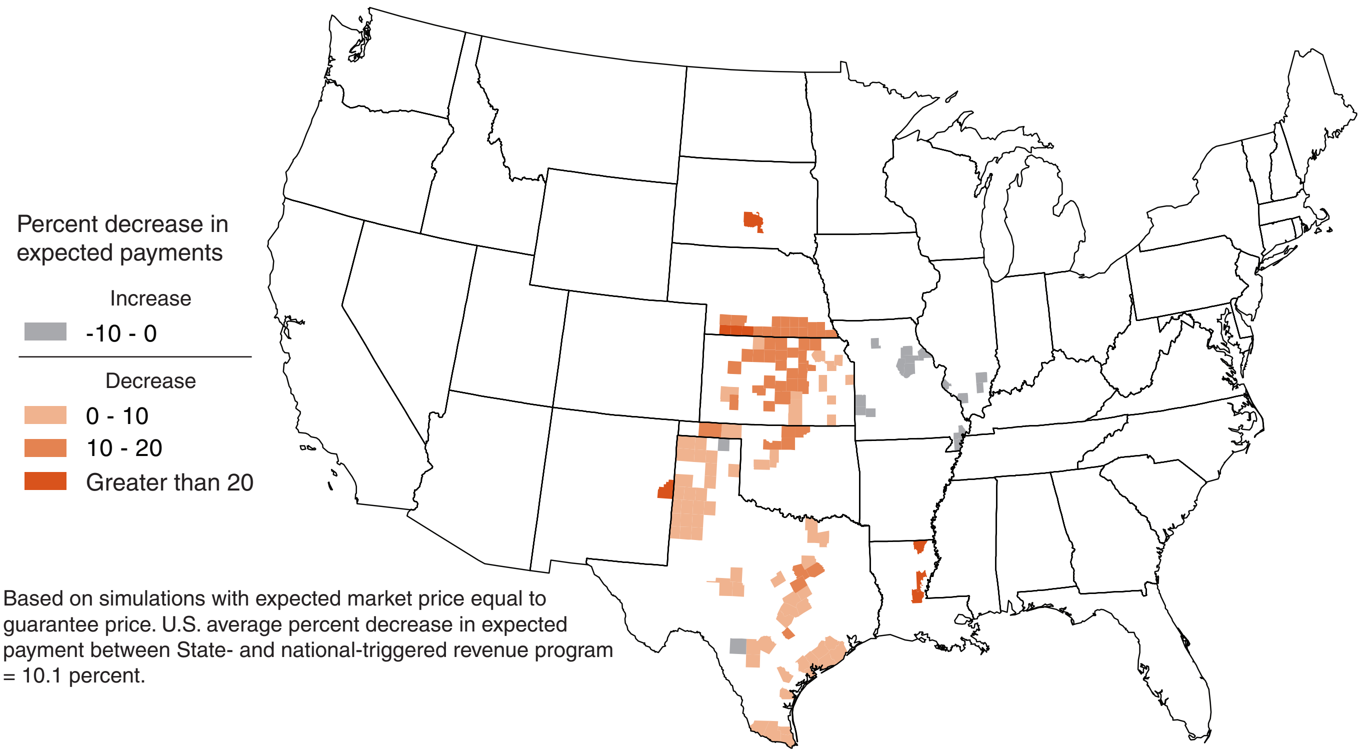
Percent decrease in expected payment between State- and national-triggered revenue program, cotton



Based on simulations with expected market price equal to guarantee price. U.S. average percent decrease in expected payment between State- and national-triggered revenue program = 23.3 percent.

Figure 2e

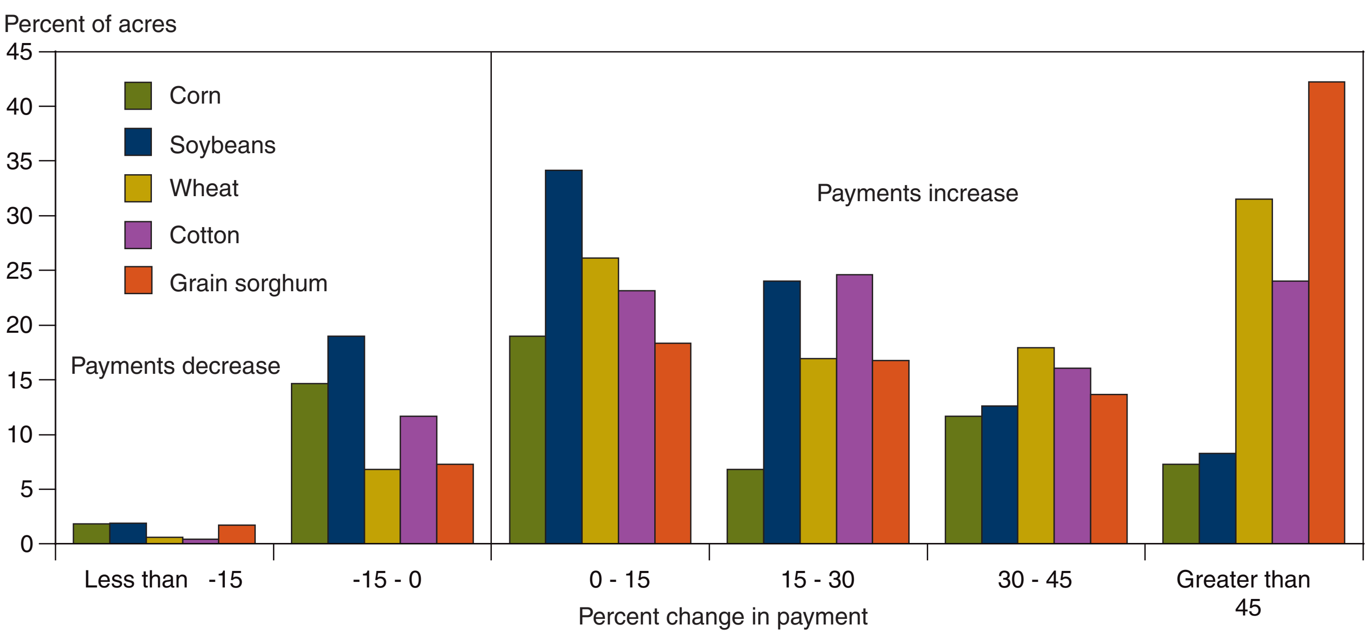
Percent decrease in expected payment between State- and national-triggered revenue program, grain sorghum



Based on simulations with expected market price equal to guarantee price. U.S. average percent decrease in expected payment between State- and national-triggered revenue program = 10.1 percent.

Figure 3

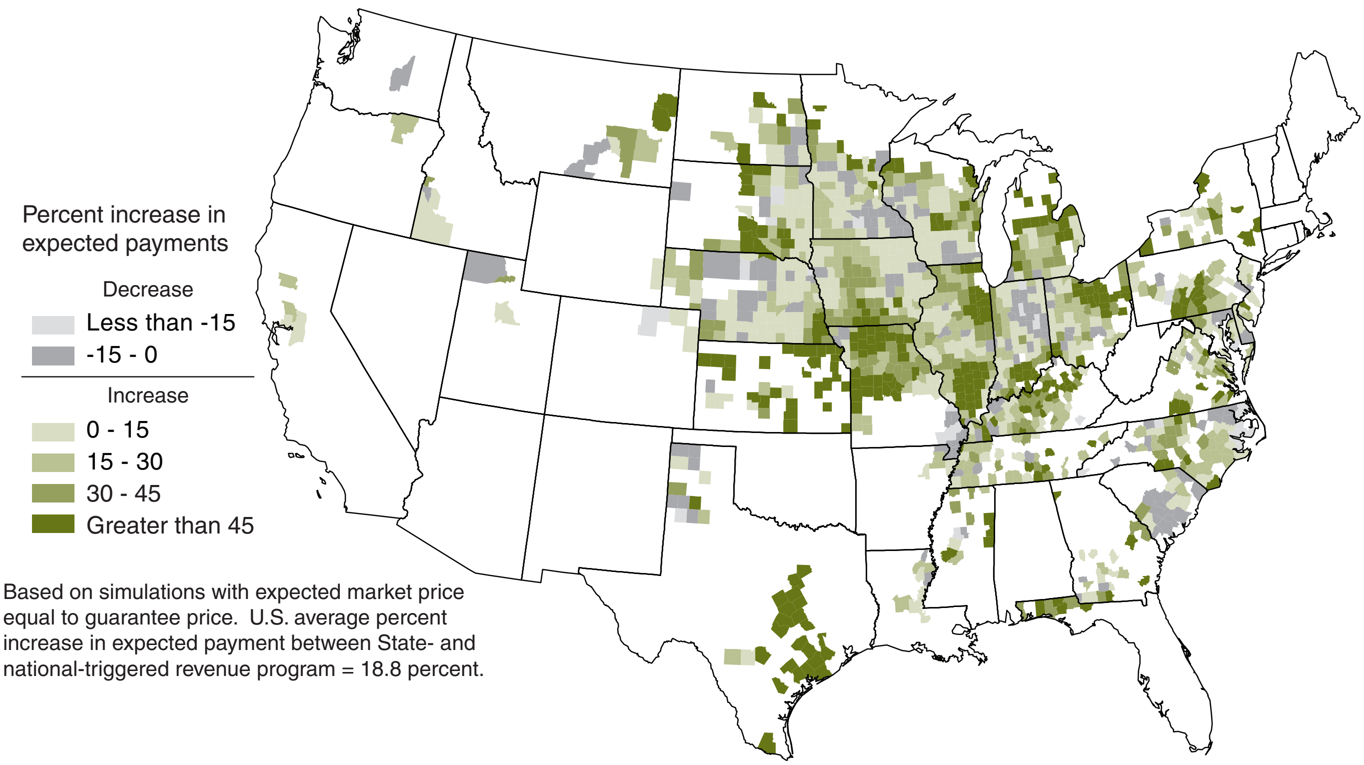
Proportion of acres by percent change in expected payment between State- and county-triggered revenue programs, by crop



Acres = Harvested acres of representative farms. Based on simulations with expected market price equal to guarantee price. Average increase in expected payment for rice is 1-2 percent; expected payments would increase slightly on about 57 percent of the representative farm acres of rice.

Figure 4a

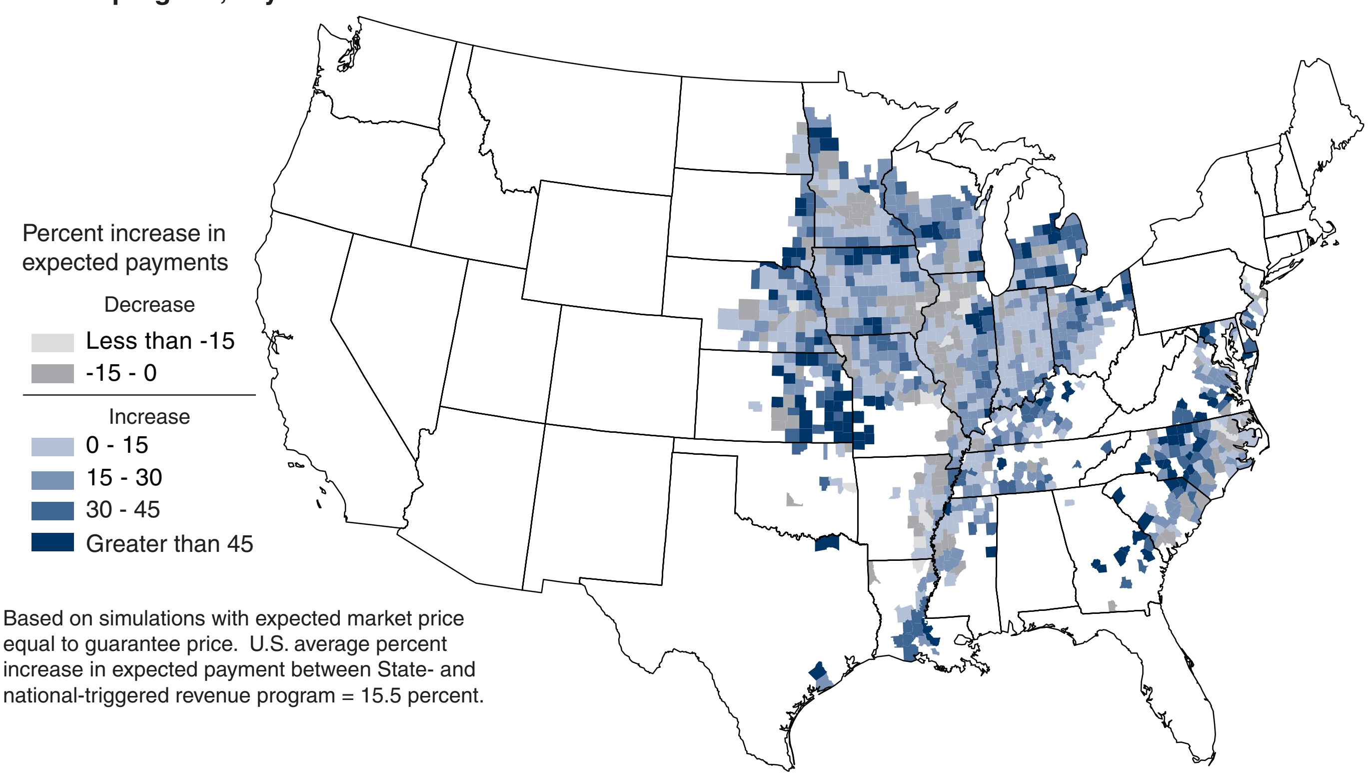
Percent increase in expected payment between State- and county-triggered revenue program, corn



Based on simulations with expected market price equal to guarantee price. U.S. average percent increase in expected payment between State- and national-triggered revenue program = 18.8 percent.

Figure 4b

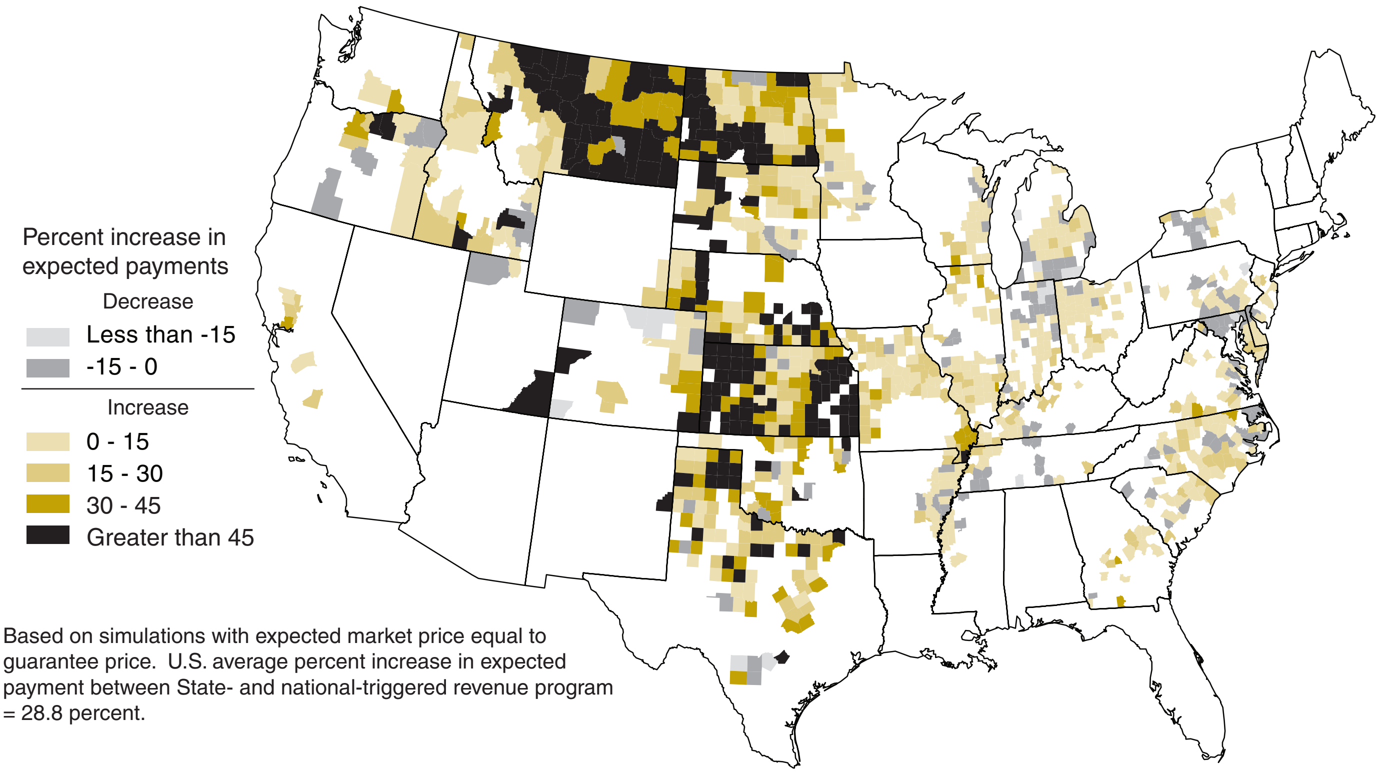
Percent increase in expected payment between State- and county-triggered revenue program, soybeans



Based on simulations with expected market price equal to guarantee price. U.S. average percent increase in expected payment between State- and national-triggered revenue program = 15.5 percent.

Figure 4c

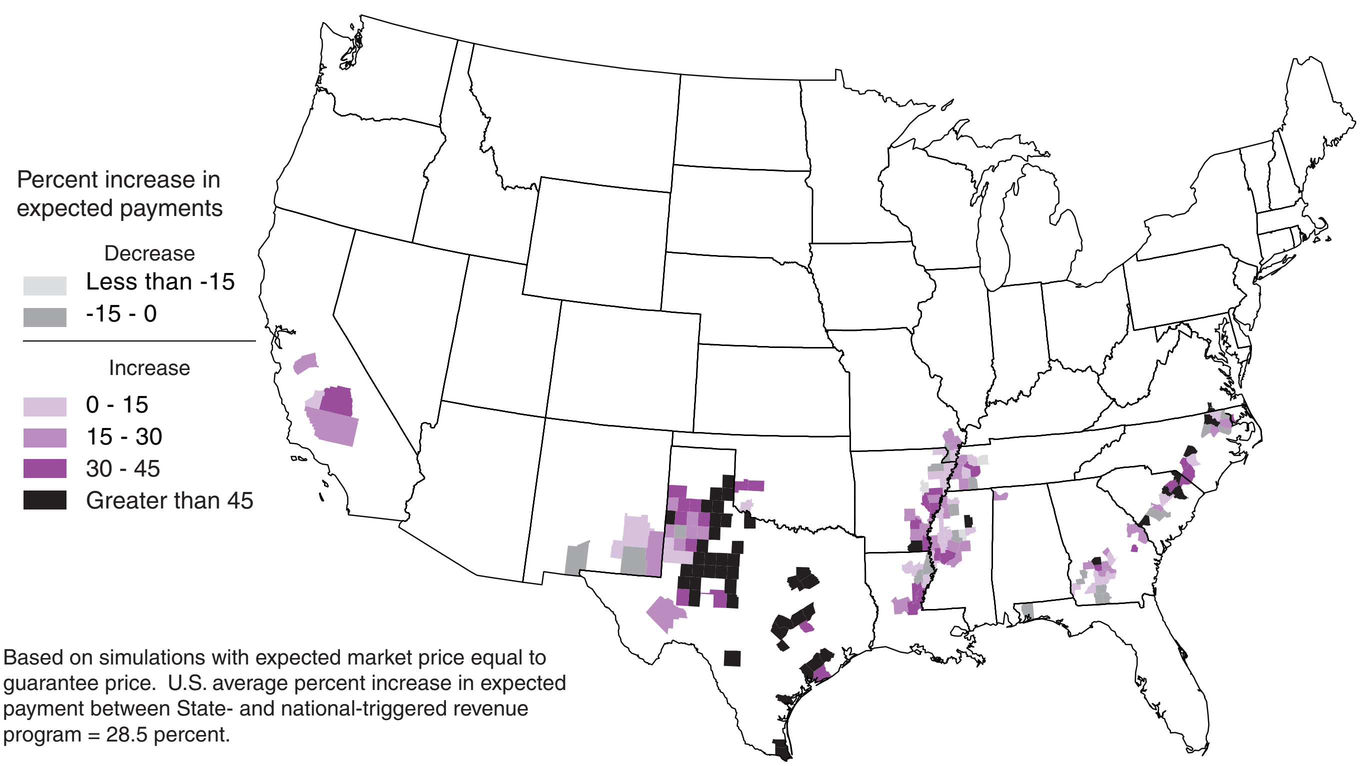
Percent increase in expected payment between State- and county-triggered revenue program, wheat



Based on simulations with expected market price equal to guarantee price. U.S. average percent increase in expected payment between State- and national-triggered revenue program = 28.8 percent.

Figure 4d

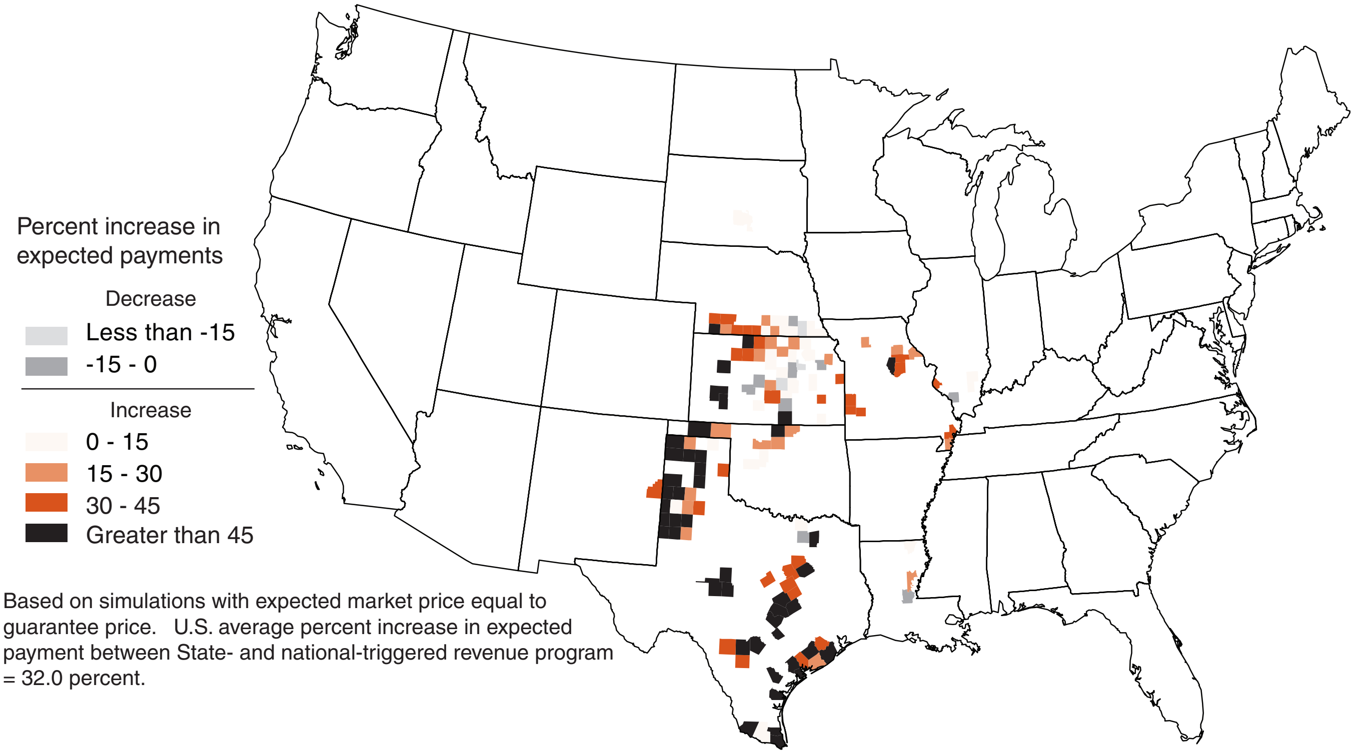
Percent increase in expected payment between State- and county-triggered revenue program, cotton



Based on simulations with expected market price equal to guarantee price. U.S. average percent increase in expected payment between State- and national-triggered revenue program = 28.5 percent.

Figure 4e

Percent increase in expected payment between State- and county-triggered revenue program, grain sorghum



Based on simulations with expected market price equal to guarantee price. U.S. average percent increase in expected payment between State- and national-triggered revenue program = 32.0 percent.

Change in Expected Payments When Expected Market and Program Guarantee Prices Diverge

Because guarantee prices in the revenue program are average prices over the previous 2 years and expected market prices are anticipated prices for the coming year, they will not necessarily be equal. (The base case will not hold.) For example, at the 2010 ACRE signup deadline, June 1, one measure of expected corn price for the 2010 marketing year—the midpoint of USDA's World Agricultural Supply and Demand Estimates (WASDE) price projection for corn made in May—was $3.50, 8 percent below the 2010 ACRE guarantee price. And the May 2010 WASDE price projection indicated that the marketing-year average price for wheat could be about 20 percent below its ACRE guarantee price.

As market price expectations diverge from revenue program guarantee prices, the weight of price relative to yield in triggering a revenue payment changes. As expected price increases, it becomes less likely that price will be the source of any revenue loss; yield variability becomes a stronger factor in determining the revenue payment. In these cases, because yield variability changes with level of aggregation—generally increasing as the level of aggregation gets smaller (due to less averaging effect)—differences in payments across alternative trigger levels would be greater than they would be under the base case of expected price equal to guarantee price. In contrast, when expected price decreases relative to the revenue guarantee price, price becomes a stronger factor. In these cases, expected payments increase but the differences in payments across the levels of aggregation would be less than they would under the base case.

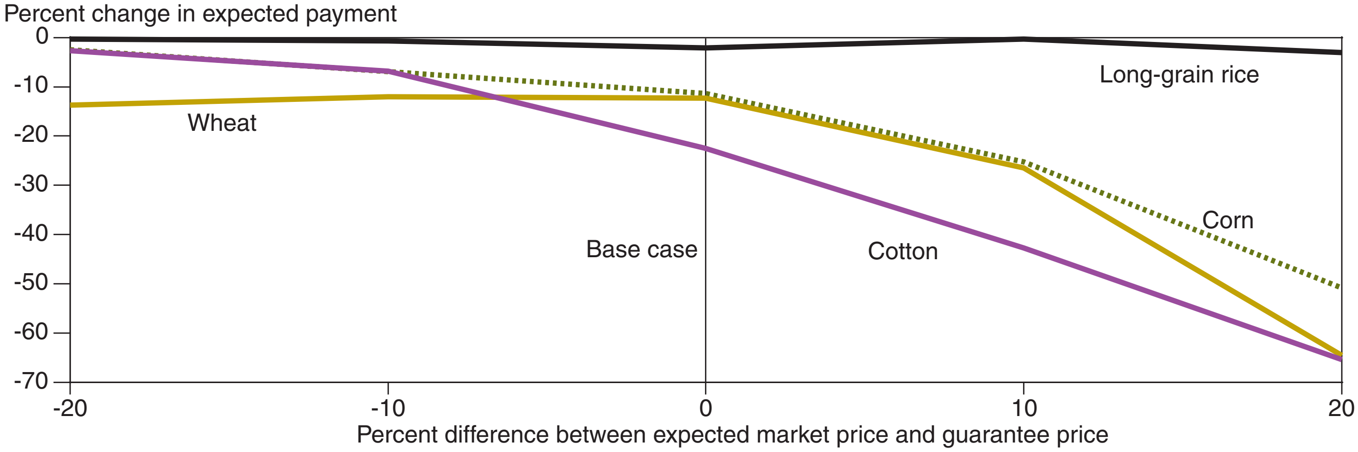
While the difference between expected prices and guarantee prices affect expected payments as alternative units—national, Crop Reporting District, and county—are substituted for State-level revenue, the level of expected payment, in dollars per acre, for the State-based ACRE program also depends on the difference between expected prices and revenue guarantee prices. As expected prices increase relative to guarantee prices, the expected payment decreases; when expected prices decrease, the expected payment increases (Dismukes et al., 2010).

Because yield variability and how it changes from one level of aggregation to another varies across crops, the effect on expected payments relative to the State-based ACRE of the movement of expected market prices relative to guarantee prices differs across crops. Crops with relatively large changes in yield variability across levels of aggregation—cotton and grain sorghum—would see particularly strong changes in expected payments when prices are above revenue guarantee prices and yield variability is a larger factor in revenue variability. Under a national-triggered program (fig. 5a), if expected price were 10 percent above guarantee price, expected payments would decrease relative to the State-triggered program by about 25 percent for corn and wheat and more than 40 percent for cotton, much larger than the 11- to 23-percent decrease under the base case (expected price equal to guarantee price). If expected price were 10 percent below the guarantee price, expected payments for corn, wheat, and cotton under the national-triggered program would decrease relative to the State-triggered program by 7-12 percent. For long-grain rice, there is little difference between a national-triggered and a State-triggered program because there is little difference in yield variability at the different levels.

Under revenue programs triggered at substate levels—crop district (fig. 5b) and the county (fig. 5c)—the proportional difference in payments as expected market price increases relative to guarantee price also reflects the difference in yield variability and how it varies across levels of aggregation and crops. If, for instance, expected price were 10 percent above guarantee price, expected payments for corn would be 13 percent greater under a district-triggered program than under a State-triggered program (versus 10 percent higher when expected price equals guarantee price). For cotton, however, expected payments would be 40 percent greater under the district-triggered program, much greater than the State-district difference (13 percent) under the base case when yields are less a factor in revenue. Under a county-triggered program, if expected price were 10 percent greater than guarantee price, payments for corn would be 27 percent greater than under the State-triggered program; for cotton, expected payments would be 64 percent greater.

Figure 5a

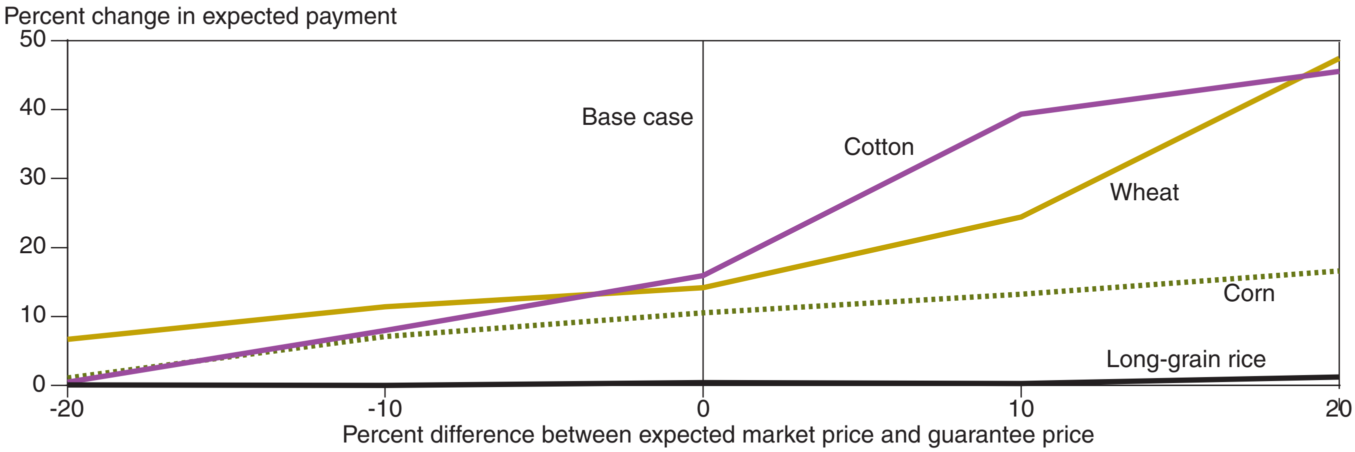
Percent change in expected payment between national- and State-triggered revenue programs as expected market price varies relative to guarantee price



Average payment weighted by planted acres.

Figure 5b

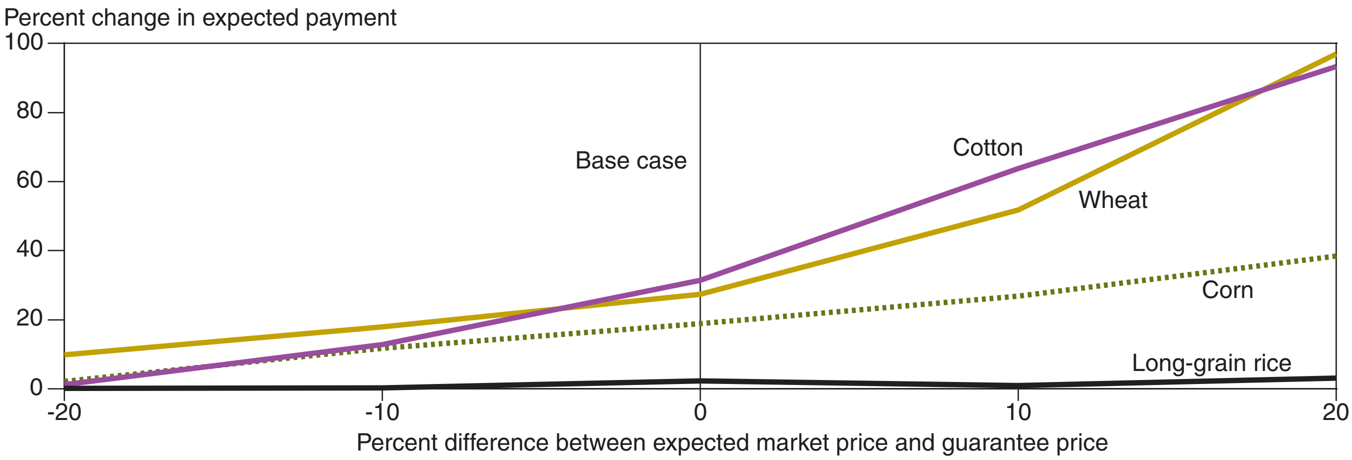
Percent change in expected payment between district- and State-triggered revenue programs as expected market price varies relative to guarantee price



District = Crop Reporting District. Average payment weighted by planted acres.

Figure 5c

Percent change in expected payment between county- and State-triggered revenue programs as expected market price varies relative to guarantee price



Average payment weighted by planted acres.

Risk Reduction Under Different Revenue-Level Triggers

The effectiveness in reducing risk, or variation of farm revenue for a crop, of a revenue program triggered at an aggregate level depends greatly on the relationship between crop revenue at the farm level and crop revenue at the aggregate level. The higher the correlation between an individual farm and aggregate trigger level, the more likely that the program payment will coincide with the farm-level loss.

The strength of correlation between individual and aggregate revenue differs across crops and levels of aggregation. On average, when market price equals guarantee price (base case), the correlation is stronger for corn, soybeans, and rice than it is for wheat, cotton, and grain sorghum (table 3). For corn, a large share of U.S. production is concentrated in the Corn Belt and the United States dominates the world corn trade; thus, Corn Belt yields have a large effect on aggregate production and price. For rice (and other crops grown under irrigation), much of revenue variability is determined by price variability, which, in the simulations, is identical across farms and aggregate regions.

Correlation between farm- and aggregate-level revenue generally increases as the aggregation level decreases. The difference in correlation across levels of aggregation is especially large for wheat and cotton, reflecting the geographic spread and differences in yield variability for these crops across regions. At the other extreme is rice, which has little yield variability. Farm-level variability of rice revenue correlates strongly with the aggregate level whether it be national, State, district, or county.

Although the correlation between farm and aggregate revenue is highest at the county level, farm-level revenue diverges strongly even at this smallest level of aggregation; for grain sorghum, cotton, and wheat, the correlation coefficient ranges from 0.33 to 0.47 (table 3).

Another way of looking at how well a revenue program covers farm risk is to consider how often a farm-level revenue shortfall would coincide with a

Table 3

Correlation between farm revenue and revenue at different levels of aggregation

Level	Corn	Soybeans	Wheat	Cotton	Grain sorghum	Rice, long-grain	Rice, medium/ short-grain
	Correlation coefficient						
National	0.50	0.47	0.32	0.31	0.29	0.62	0.74
State	0.52	0.51	0.40	0.35	0.30	0.62	0.74
District	0.54	0.53	0.44	0.36	0.32	0.62	0.74
County	0.55	0.55	0.47	0.37	0.33	0.63	0.74

Averages weighted by acres harvested in 2010. District = Crop Reporting District. Medium/short-grain rice is for a single State, California.

shortfall at the aggregate level. When market price equals guarantee price (base case), farm revenue would fall below the revenue program benchmark most frequently for cotton, grain sorghum, and long-grain rice, though there is little difference, with the exception of medium/short-grain rice, across the crops (table 4).

The ACRE program and the alternative programs simulated here require that both the aggregate-level trigger and the farm-level trigger be met in order for a payment to occur. Under these programs, the magnitude of the payment is determined by the size of the shortfall at the aggregate level and the farm productivity index: the ratio of farm average yield to aggregate yield. The level of risk reduction—percentage decrease in the coefficient of variation of farm revenue—afforded by revenue programs triggered at different levels of aggregation generally follows the pattern of payments, increasing as the level of aggregation decreases. The increase in risk reduction between a State-level and a county-level program is largest for cotton and wheat (fig. 6). The change in risk reduction is smallest for rice, even though the levels of risk reduction for rice are highest.

Risk reduction under the revenue programs is limited. The gap in correlation between farm and aggregate revenue, along with the limit on payments as specified in ACRE (25 percent of the revenue guarantee), suggests that a considerable amount of revenue risk would not be covered by the revenue program, even from a program triggered at the smallest level of aggregation. Consider the case of a farm with revenue identical to (average) aggregate revenue. In this case, the revenue risk coverage from the aggregate trigger would be at its maximum.[12] With a revenue guarantee level of 90 percent of the benchmark and a maximum payment of 25 percent of the guarantee, losses between 90 percent and 67.5 percent (90 minus 25 percent of 90)

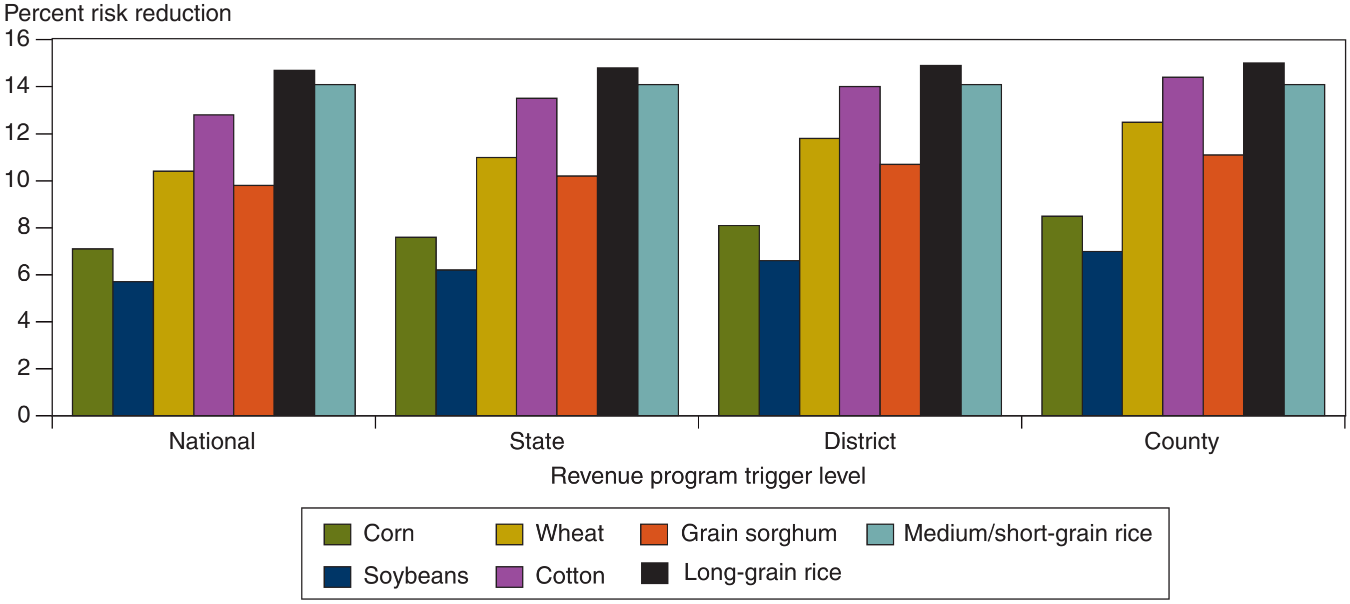
[12]We assume in this example that the farm productivity index is 1, farm average yield equals State average yield.

Table 4
Frequency of farm revenue loss and coincidence with revenue trigger at different levels of aggregation

Item	Corn	Soybeans	Wheat	Cotton	Grain sorghum	Rice, long-grain	Rice, medium/short-grain
	Frequency						
Farm loss	0.480	0.484	0.489	0.509	0.495	0.502	0.472
Farm loss and triggering at level:							
National	0.167	0.186	0.170	0.195	0.189	0.241	0.215
State	0.177	0.178	0.199	0.218	0.195	0.247	0.215
District	0.187	0.192	0.223	0.222	0.206	0.254	0.217
County	0.193	0.201	0.232	0.239	0.219	0.255	0.222
Farm loss and no triggering at level:							
National	0.313	0.298	0.319	0.314	0.306	0.261	0.257
State	0.303	0.306	0.290	0.291	0.300	0.255	0.257
District	0.293	0.292	0.266	0.287	0.289	0.248	0.255
County	0.287	0.283	0.257	0.270	0.276	0.247	0.250

Loss = revenue loss as defined in ACRE. Based on simulations with expected market price equal to ACRE guarantee price. Averages weighted by acres harvested in 2010. District = Crop Reporting District. Medium/short-grain rice is for a single State, California

Figure 6
Risk reduction from revenue programs triggered at different levels of aggregation



Risk reduction = percent decrease in coefficient of variation of revenue due to revenue program. Based on simulations of expected market price equal to guarantee price. Guarantee price scenario I. Data for all guarantee price scenarios listed in appendix table 3.

of the program-defined revenue guarantee would be covered. Risk-averse producers who want to cover more risk might need to use other instruments, including the Federal crop insurance and the Supplemental Revenue Assistance programs.

The effect of 25-percent payment cap on the revenue guarantee varies from crop to crop and increases as the level of aggregation used in the program gets smaller. Under our simulations, switching from the State-triggered ACRE program to a county trigger increases the frequency at which the limit would be binding for corn from about 7 percent of the time that payments are triggered to about 14 percent. For wheat, the binding frequency grows from about 14 percent of the time to about 26 percent; for cotton, the frequency grows from 18 percent of the time to 24 percent.

Payments Under a Revenue Versus Price-Based Program

Under the ACRE program, producers elect to forgo payments and other benefits of the price-based commodity support programs that are available under the 2008 Farm Act. Specifically, ACRE participants must give up any countercyclical program payments, 20 percent of direct payments, and 30 percent of marketing loan rates (USDA/Farm Service Agency, 2009).

The decision to participate in ACRE is complex (Woolverton and Young, 2009). Among the factors to consider:

- A farm[13] must have farm program base acres,[14]
- ACRE applies to all of a farm's crops for which ACRE is available,[15]
- All landowners for the farm must agree in writing to enroll in ACRE,

[13]For program purposes a farm is an entity with a FSA Farm Serial Number.

[14]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.

[15]Crops for which ACRE is available are wheat, corn, barley, grain sorghum, oats, upland cotton, long-grain and medium/short-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).

- A farm can enter ACRE at any year covered by the 2008 Farm Act, but must remain enrolled for the duration of the act (through 2012), and
- ACRE participants trade direct payments, which are certain, for revenue program payments, which depend on the variability of revenue.

The decision rests largely on the relative advantages of ACRE versus those of the countercyclical payment, marketing loan, and direct payment program. The ACRE program is more nimble, adjusting benchmarks and guarantees to reflect recent historical prices and yields, whereas other commodity programs use legislatively fixed target prices, payments rates, and loan rates. As market prices for crops increase (dramatically so in the last 5 years), revenue program guarantees increase, whereas the expected benefits of fixed target price and loan rate programs decrease.

We consider the expected payments from a revenue program triggered at different levels of aggregation relative to the forgone payments—as specified under ACRE—under the four guarantee price scenarios (table 5).[16] Under guarantee price scenario I—where simulated guarantee prices and market prices are approximately equal to the 2010 ACRE guarantee prices—expected revenue program payments, on average, exceed forgone payments for each of the crops except cotton and long-grain rice, crops with large direct payments.[17] Under this guarantee price scenario, expected revenue program payments for cotton—revenue program price about 20 percent below the target price and slightly above the marketing loan rate—would be less than half of the forgone payments at all levels of aggregation. In contrast, for soybeans—where revenue program price is about 60 percent higher than the non-ACRE target price—expected payments from the revenue program would greatly exceed forgone payments, regardless of aggregation level.

Under guarantee price scenario II—with expected market prices and revenue guarantee prices 20 percent higher than scenario I—expected payments from a revenue program would exceed forgone payments at all revenue program trigger levels for all crops except cotton. The revenue payments for long-grain rice are only slightly above forgone payments, across all levels of aggregation.

Under guarantee price scenario III—with expected market prices and guarantee prices 20 percent lower than the 2010 ACRE guarantee prices—revenue program payments would be reduced such that they would exceed or would roughly equal forgone payments for only soybeans, corn, and medium/short-grain rice, across all aggregation trigger levels. Wheat's revenue guarantee price would be about 10 percent above the non-ACRE target price, and moving from a State-triggered to a county-triggered revenue program would increase the average revenue program payment so that it would nearly equal the forgone payments. Cotton's revenue guarantee price would be about 40 percent below its target price, so the average expected revenue program payment would not exceed 30 percent of forgone payments, even at the county aggregation level.

Under guarantee price scenario IV—with market prices and revenue guarantee prices equal to the non-ACRE target prices under the 2008 Farm Act—revenue program payments for all crops at all levels of aggregation

[16] We adjusted, at the representative county-crop farm level, commodity program payments that are made per base acre to harvested acres, the unit of the revenue program payments. The average ratios of planted acres to base acres for each crop and selected States are listed in appendix table 3. State-by-State breakouts of the relationship of revenue program payments to forgone payments are in appendix tables 4a-d.

[17] In our model, the amounts of direct payments per acre forgone are $5.37 for corn, $1.69 for soybeans, $4.44 for wheat, $14.75 for cotton, $5.91 for grain sorghum, $26.84 for long-grain rice, and $28.95 for medium/short-grain rice.

Table 5

Expected payments from revenue programs triggered at different levels relative to payments forgone under ACRE, by guarantee price scenario and crop

Level	Corn	Soybeans	Wheat	Cotton	Grain sorghum	Rice, long-grain	Rice, medium/short-grain
	Ratio						
Scenario I:							
National	1.14	1.69	1.03	0.44	1.02	0.98	1.21
State	1.19	1.82	1.06	0.45	1.05	0.98	1.21
District	1.24	1.90	1.10	0.46	1.10	0.98	1.21
County	1.28	2.00	1.13	0.47	1.16	0.98	1.21
Scenario II:							
National	1.20	1.86	1.07	0.64	1.14	1.02	1.29
State	1.27	2.02	1.11	0.66	1.17	1.03	1.29
District	1.33	2.12	1.16	0.68	1.23	1.03	1.29
County	1.37	2.24	1.20	0.71	1.30	1.03	1.29
Scenario III:							
National	0.98	1.42	0.88	0.27	0.82	0.90	1.13
State	1.03	1.54	0.91	0.28	0.84	0.90	1.13
District	1.07	1.61	0.94	0.28	0.89	0.90	1.13
County	1.10	1.68	0.97	0.29	0.94	0.91	1.13
Scenario IV:							
National	0.83	0.77	0.80	0.74	0.86	0.87	0.90
State	0.87	0.85	0.82	0.77	0.89	0.87	0.90
District	0.89	0.90	0.85	0.80	0.93	0.87	0.90
County	0.91	0.96	0.87	0.83	0.98	0.87	0.90

Averages weighted by acres harvested in 2010. Guarantee price scenario I is expected market prices and revenue program guarantee prices approximately equal to ACRE program guarantee prices for 2010. Guarantee price scenario II is prices 20 percent higher than guarantee price scenario I; guarantee price scenario III is prices 20 percent lower than guarantee price scenario I. Guarantee price scenario IV is prices equal to target prices. Prices for each scenario are listed in appendix table 1. District = Crop Reporting District.

would be less than forgone payments, though payments from a county-level revenue program would be 90 percent or more of forgone payments for corn, soybeans, grain sorghum, and medium/short-grain rice. The ratio of revenue-to-price-based payments would be lowest for cotton.

Figures 7a-d show the proportion of representative farm acres for each of the seven crops where the revenue program payments would exceed the forgone payments under each guarantee price scenario.[18] Under guarantee price scenario I (fig. 7a) for corn, soybeans, cotton, long-grain rice, and medium/short-grain rice, the level of aggregation used to trigger revenue payments makes little difference in the proportion of acres where revenue program payments exceed forgone payments. For soybeans and medium/short-grain rice, all representative farm acres would have revenue payments greater than forgone payments at all levels of aggregation. For these crops, expected market prices and revenue guarantee prices greatly exceed the fixed

[18]If expected payments from the revenue programs exceed the forgone payments then we count all of the acres for that county and crop as having revenue payments exceeding forgone payments.

Figure 7a

Percent of acres with revenue program payments, triggered at different levels, greater than other commodity payments forgone, guarantee price scenario I

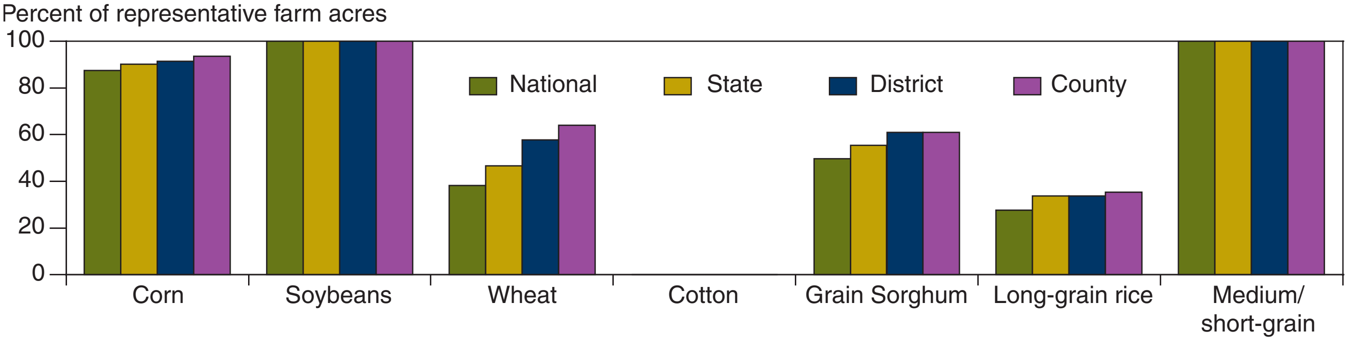


Figure 7b

Percent of acres with revenue program payments, triggered at different levels, greater than other commodity payments forgone, guarantee price scenario II

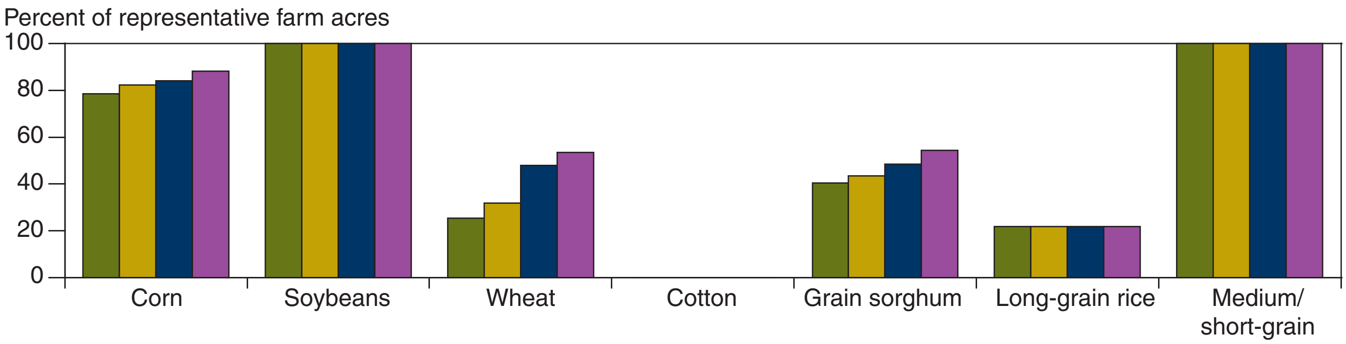


Figure 7c

Percent of acres with revenue program payments, triggered at different levels, greater than other commodity payments forgone, guarantee price scenario III

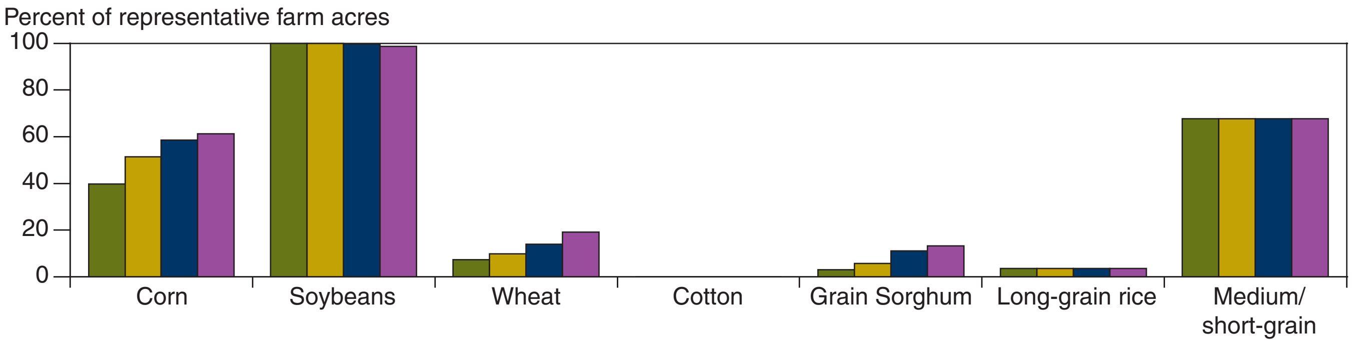
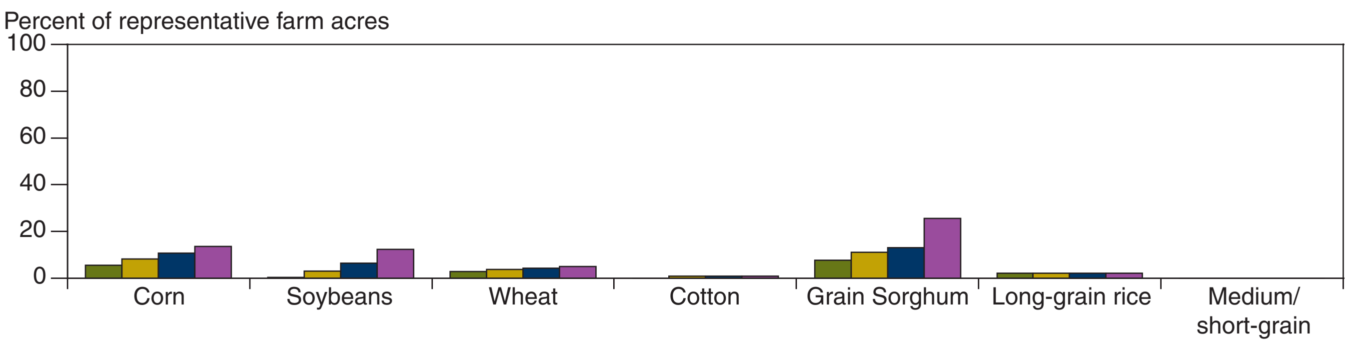


Figure 7d

Percent of acres with revenue program payments, triggered at different levels, greater than other commodity payments forgone, guarantee price scenario IV



Representative farm = average farm for crop in a county. Acres = acres harvested in 2010. District = Crop Reporting District.

target prices. For corn—which under guarantee price scenario I also would have prices well above non-ACRE targets—the proportion of representative farm acres where revenue payments would exceed forgone payments ranges from just less than 80 percent for the national-triggered program to about 85 percent for the county-triggered program. For long-grain rice, there is little difference across program trigger levels because revenue variability differs little across levels of aggregation. For cotton, forgone payments exceed expected revenue payments for all representative farm acres under all revenue program levels. By contrast, reducing the trigger level for wheat and grain sorghum leads to steeply increasing proportions of acres where revenue payments exceed forgone payments.

Under guarantee price scenario II (fig. 7b), the proportions of farm acres where revenue program payments exceed forgone payments at different aggregation levels are similar to those of scenario I for all crops except long-grain rice. Under guarantee price scenario III (fig. 7c), the proportions of such acres are lesser than under scenarios I and II across all levels of aggregation for all crops but soybeans and cotton. Under guarantee price scenario IV (fig. 7d), few acres would have revenue payments greater than forgone payments, regardless of level of aggregation.

Conclusions

Changing the level of revenue aggregation used to trigger payments in a program like ACRE would alter expected payments and the reduction in farm revenue risk from the program. Generally, moving to a smaller aggregation, one closer to the farm level, would increase payments and risk reduction. This is because revenue variability, particularly yield variability, and correlation between aggregate and farm-level revenue increase as the aggregation level decreases.

If expected market prices equal revenue program guarantee prices (the base case), then the change in revenue program payments would be greatest for crops—such as wheat, cotton, and grain sorghum—with large differences in revenue variability across levels of aggregation. The average expected payments for these crops would increase 28-32 percent if the revenue program trigger were changed from State to county. Corn and soybean production is more concentrated geographically with less varied yields, so the increase in expected payments would be less, 16-19 percent. Payments for rice would change little if the aggregate revenue trigger were changed because most of the crop is irrigated, with price largely determining revenue variability.

Not all farms would see the average changes in expected payments; some would see changes greater than average, and some less. The change in expected payment between a State-triggered and a county-triggered program, for instance, depends on the revenue variability for a particular county relative to the State, as well as the ratio of the farm's yield to the State and county yield (farm productivity index) and correlations between farm revenue and State/county revenue—all factors that differ by crop, county, State, and farm.

The relationship between expected market prices and revenue program guarantee price affects the changes in payments from alternative levels of revenue aggregation. If expected market price **increases** relative to the guarantee, then the difference in payments across levels of aggregation would increase as yield variability becomes a stronger factor in determining revenue variability and payments; if expected market prices **decrease** relative to guarantees, expected payments increase but differences across levels of aggregation decrease.

Risk reduction from a program that uses an aggregate revenue trigger depends greatly on the correlation between the aggregate measure of revenue and actual farm revenue. While risk reduction increases as the level of aggregation used in the revenue program diminishes, for all crops that we examined except rice, farm-level revenue is largely uncorrelated with revenue at even the smallest level of aggregation, the county. In addition, expected payments and risk reduction are limited by the cap of revenue program payments at 25 percent of the guarantee. This suggests that while the revenue coverage under an aggregate revenue program and revenue coverage under Federal crop revenue insurance may overlap, the amount of overlap—payment from both programs for the same revenue loss—could be small (Zulauf et al., 2010).[19]

[19]Both ACRE and subsidized Federal crop insurance offer revenue coverage. The two programs, however, define revenue differently, using different yields and prices; crop insurance offers revenue coverage that triggers at the county or farm level (insured unit), while ACRE uses a combined State and farm trigger. Producers participating in crop insurance pay a portion of the actuarially based insurance premium; there is no premium charge for coverage under ACRE.

Because revenue benchmarks or guarantees used in the revenue programs are designed to change over time, it is important to consider the different crop guarantee price scenarios in evaluating the benefits of a revenue program relative to the price-based programs available under the 2008 Farm Act. If crop prices continue to increase, guarantees and expected payments under ACRE or a similar program would increase, while expected payments under programs that are based on legislatively fixed targets would decrease. And as the crop's price increases, the size of the direct payment for a crop decreases relative to the expected payment from the revenue program. Changes in prices, and thus revenue program guarantees, appear to be much more important than level of aggregation/trigger to producers weighing the revenue election.

While a county-level program would generally produce larger expected payments and risk reduction than a State-level program, it would increase government administrative costs as program benchmarks and guarantees would need to be determined for more aggregate units and would not, without additional resources, be feasible. For the current State-level ACRE program, which has 22 covered commodities, USDA's Farm Service Agency (FSA) uses USDA National Agricultural Statistics Service (NASS) data, where available, to determine yields. However, these data are not produced for many State-crop combinations. Of the 670 State-crop combinations in the 2009 ACRE program, NASS data were not available for 407 (Tice, 2011). In a few cases, NASS data can be supplemented with data from USDA's Risk Management Agency (RMA). For the remaining State-crop combinations, FSA must use historical data and relationships with similar crops and States to derive benchmark yields.[20] Moving to a county-based program would require additional investments in data to ensure credible program parameters and program integrity. And for some county-crop combinations, the number of farms would be so few that NASS would have to sample the same producers year after year, unduly burdening survey respondents.

[20]When at least 25 percent and less than 75 percent of the acreage for a crop in a State is irrigated, the ACRE program requires that FSA establish separate State-level yields for irrigated and non-irrigated production.

Experience with county-level yield and revenue insurance under the Federal crop insurance program illustrates the data challenges with a county-crop program. In 2009 and 2010, RMA deleted about a third of the county revenue and yield insurance programs, Group Risk Plan (GRP) and Group Risk Income Protection (GRIP), for corn, soybeans, grain sorghum, cotton, and peanuts (USDA, Risk Management Agency, 2009). While most of these counties had little or no participation in GRP or GRIP, NASS' ability to produce estimates for counties outside the major growing areas for these crops was uncertain.

Methods and Data

The model underlying this research simultaneously simulates random yields, prices, and revenues at farm, county, Crop Reporting District, State, and U.S. levels for corn, soybeans, wheat, cotton, grain sorghum, and long-grain and medium/short-grain rice. The model accounts for correlations among the random variables by use of empirical sampling techniques.

The model is based on data for 1,199 counties for corn, 1,014 counties for soybeans, 985 counties for wheat, 177 counties for cotton, 139 counties for grain sorghum, 54 counties for long-grain rice, and 8 counties for medium/short-grain rice. These counties represent about 95 percent of the 2010 planted U.S. acres of corn, 89 percent of soybean acres, 89 percent of wheat acres, 84 percent of cotton acres, 74 percent of grain sorghum acres, 94 percent of long-grain rice acres, and 100 percent of medium/short-grain acres.[1]

Yield variability was 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, Crop Reporting District, State, and U.S. levels, we estimated a linear time trend of each yield data series, yields from 1975 to 2009, 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 2010.

To measure yield variability at the farm level, we used 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.[2] These rates are for "basic units," as defined in crop insurance policy provisions. Basic units are intermediate between "optional units," the level at which many crop insurance policies are insured, and "enterprise units," the level closest to farm-level risk. We subtracted from the basic premium rates the portions that were to cover prevented planting, replanting, and quality adjustments. The adjusted premium rates were used to calibrate an additive farm yield variability term for each county and crop.[3]

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

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

where

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

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

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

[1]We assume medium/short-grain rice is grown only in California and that all California rice is medium/short-grain.

[2]Although there is evidence to suggest that RMA rates, particularly in low-risk regions, are too high, quantifying yield variability in low-risk regions is quite difficult when one must deal with yield and variance trends.

[3]Another approach would be to use Actual Production History (APH) yield data from RMA. While actual losses fully reflect the underlying yield variability, APH is used by RMA only to estimate mean yield, the first moment of the distribution and not the higher moments. We did not use this approach largely because estimates of higher moments from a very small sample (10 or fewer observations) would be subject to large error.

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 base crop insurance rates.

Price variability was estimated from NASS national price data. National annual marketing-year average (MYA) prices for 1974 through 2009 for each of the seven 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 were placed in a matrix [P] that has T rows of annual prices. Yield data for each of the seven crops were placed in a matrix [Y] that contains county-, CRD-, 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 can be generated from 1,000 random 5-year time paths. In this report, however, the revenue variability and ACRE payment estimates 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. This approach is similar to that used by RMA to generate random yields to simulate insurance rates for its COMBO product.

Data on direct payments are from county summaries of Farm Service Agency records. Countercyclical payments and marketing loan payments are generated by model simulations. Producer-paid crop insurance premiums, which are included in farm benchmark revenue, are estimated from model simulations of a 70-percent revenue insurance policy.

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Appendix table 1
Prices and program parameters in the analysis

	Corn	Soybeans	Wheat	Cotton	Grain sorghum	Rice, long-grain	Rice, medium/ short-grain
	Dollars per bushel			*Dollars per pound*	*Dollars per bushel*	*Dollars per hundredweight*	
Scenario I	3.80	9.75	5.80	0.55	3.20	13.90	21.30
Scenario II	4.56	11.70	6.96	0.66	3.84	16.68	25.56
Scenario III	3.04	7.80	4.64	0.44	2.56	11.12	17.04
Scenario IV/ target price	2.63	6.00	4.17	0.71	2.63	10.50	10.50
Direct payment rate	0.28	0.44	0.52	0.0667	0.35	2.35	2.35
Marketing loan rate	1.95	5.00	2.94	0.52	1.95	6.50	6.50
Marketing loan rate with ACRE	1.37	3.50	2.06	0.364	1.37	4.35	4.35

Scenario I prices are approximate guarantee prices for ACRE in 2010. Scenario II prices are a 20-percent increase in prices. Scenario III prices are a 20-percent decrease in prices. Scenario IV guarantee prices are target prices. Simulations are based on expected market price equal to guarantee price, unless otherwise indicated.

Appendix table 2
Expected payments from revenue program triggered at different levels of aggregation

Scenario/level	Corn	Soybeans	Wheat	Cotton	Grain sorghum	Rice, long-grain	Rice, medium/ short-grain
	Dollars per acre						
Scenario I							
National	7.89	6.21	4.29	5.66	3.48	21.87	58.84
State	8.90	6.78	4.85	7.38	3.87	22.33	58.84
District	9.83	7.24	5.59	8.35	4.53	22.43	58.74
County	10.57	7.83	6.21	9.48	5.11	22.84	58.76
Scenario II							
National	9.47	7.45	5.15	6.80	4.17	26.25	70.61
State	10.68	8.14	5.83	8.86	4.64	26.80	70.61
District	11.80	8.68	6.71	10.02	5.43	26.92	70.49
County	12.69	9.39	7.45	11.38	6.13	27.41	70.51
Scenario III							
National	6.31	4.97	3.43	4.53	2.78	17.50	47.07
State	7.12	5.43	3.88	5.91	3.10	17.87	47.07
District	7.87	5.79	4.47	6.68	3.62	17.94	46.99
County	8.46	6.26	4.97	7.58	4.09	18.27	47.01
Scenario IV							
National	5.46	3.82	3.08	7.31	2.86	16.52	29.01
State	6.16	4.17	3.49	9.53	3.18	16.87	29.01
District	6.81	4.45	4.02	10.78	3.72	16.94	28.96
County	7.32	4.82	4.47	12.24	4.20	17.25	28.97

Averages weighted by acres harvested in 2010. Based on simulations of market price equal to guarantee price.

Appendix table 3
Risk reduction from revenue programs triggered at the different levels of aggregation

Level	Corn	Soybeans	Wheat	Cotton	Grain sorghum	Rice, long-grain	Rice, medium/ short-grain
	Percent						
Scenario I							
National	7.1	5.7	10.4	12.8	9.8	14.7	14.1
State	7.6	6.2	11.0	13.5	10.2	14.8	14.1
District	8.1	6.6	11.8	14.0	10.7	14.9	14.1
County	8.5	7.0	12.5	14.4	11.1	15.0	14.1
Scenario II							
National	6.6	5.5	9.4	11.3	8.8	13.4	13.3
State	7.1	6.0	10.0	12.1	9.2	13.5	13.3
District	7.6	6.3	10.9	12.6	9.7	13.5	13.3
County	8.0	6.8	11.5	13.0	10.1	13.6	13.3
Scenario III							
National	7.8	6.0	11.9	15.6	11.3	16.6	15.2
State	8.4	6.5	12.4	16.3	11.6	16.7	15.2
District	8.9	6.9	13.2	16.8	12.1	16.8	15.2
County	9.3	7.4	14.0	17.2	12.6	16.9	15.2
Scenario IV							
National	8.4	6.6	12.7	10.8	11.1	17.2	18.6
State	8.9	7.0	13.2	11.5	11.5	17.3	18.6
District	9.4	7.4	14.0	12.0	11.9	17.3	18.6
County	9.8	7.9	14.7	12.5	12.4	17.4	18.6

Risk reduction = Percent decrease in coefficient of variation of representative farm acre revenue due to revenue program. Averages weighted by acres harvested in 2010. District = Crop Reporting District. Based on simulations of revenue where expected market price equals revenue program guarantee price.

Appendix table 4a

Expected payments from revenue program triggered at different levels relative to payments forgone under ACRE, by State, guarantee price scenario I

State	Revenue program level			
	National	State	District	County
	Ratio			
Alabama	0.00	0.00	0.00	0.00
Arkansas	0.50	0.55	0.55	0.55
California	1.38	1.38	1.39	1.38
Colorado	0.76	1.06	1.16	1.29
Delaware	1.93	2.51	2.72	2.72
Florida	0.08	0.14	0.16	0.16
Georgia	0.40	0.53	0.59	0.68
Idaho	1.22	1.45	1.51	1.65
Illinois	1.82	1.71	1.95	2.12
Indiana	1.71	1.65	1.70	1.82
Iowa	1.89	2.13	2.37	2.50
Kansas	1.08	1.18	1.57	1.80
Kentucky	1.57	1.79	1.84	2.06
Louisiana	3.17	4.12	4.13	4.00
Maryland	1.52	1.99	2.09	2.18
Michigan	1.47	1.71	1.99	2.15
Minnesota	2.02	2.64	2.87	3.12
Mississippi	1.27	1.55	1.72	1.87
Missouri	1.15	1.43	1.62	1.71
Montana	0.72	0.88	1.22	1.42
Nebraska	1.36	1.47	1.53	1.66
New Jersey	1.65	2.09	2.18	2.34
New Mexico	0.06	0.08	0.09	0.11
New York	0.53	0.48	0.51	0.54
North Carolina	2.92	4.03	4.13	4.58
North Dakota	0.76	0.78	0.92	1.05
Ohio	1.57	1.55	1.69	1.84
Oklahoma	0.79	1.04	1.09	1.21
Oregon	1.15	1.82	2.19	2.25
Pennsylvania	2.63	3.20	3.30	3.90
South Carolina	0.97	1.44	1.43	1.63
South Dakota	1.75	2.10	2.25	2.51
Tennessee	1.53	1.76	1.85	2.06
Texas	0.21	0.24	0.26	0.32
Utah	0.38	0.40	0.46	0.46
Virginia	2.45	3.55	3.67	4.22
Washington	0.99	1.07	1.09	1.17
West Virginia	1.02	1.08	1.06	1.16
Wisconsin	1.12	1.38	1.44	1.53
Wyoming	0.39	0.37	0.38	0.44
U.S.	1.39	1.57	1.74	1.90

Appendix table 4b

Expected payments from revenue program triggered at different levels relative to payments forgone under ACRE, by State, guarantee price scenario II

State	Revenue program level			
	National	State	District	County
	Ratio			
Alabama	0.00	0.00	0.00	0.00
Arkansas	0.70	0.76	0.77	0.78
California	1.65	1.66	1.66	1.66
Colorado	0.92	1.27	1.40	1.55
Delaware	2.31	3.01	3.27	3.27
Florida	0.14	0.25	0.27	0.28
Georgia	0.54	0.74	0.82	0.95
Idaho	1.47	1.74	1.81	1.98
Illinois	2.19	2.05	2.34	2.55
Indiana	2.05	1.99	2.04	2.18
Iowa	2.27	2.56	2.85	3.00
Kansas	1.32	1.44	1.91	2.19
Kentucky	1.88	2.14	2.20	2.47
Louisiana	3.83	4.99	5.00	4.86
Maryland	1.82	2.38	2.51	2.61
Michigan	1.76	2.05	2.39	2.58
Minnesota	2.42	3.17	3.44	3.74
Mississippi	1.55	1.89	2.09	2.27
Missouri	1.41	1.74	1.97	2.08
Montana	0.87	1.05	1.46	1.71
Nebraska	1.64	1.78	1.85	2.00
New Jersey	1.98	2.51	2.61	2.81
New Mexico	0.09	0.12	0.13	0.16
New York	0.64	0.58	0.61	0.65
North Carolina	3.53	4.86	4.99	5.54
North Dakota	0.91	0.94	1.10	1.26
Ohio	1.89	1.86	2.03	2.21
Oklahoma	13.80	15.65	16.66	19.93
Oregon	1.38	2.19	2.63	2.70
Pennsylvania	3.15	3.84	3.96	4.68
South Carolina	1.19	1.79	1.77	2.01
South Dakota	2.10	2.53	2.70	3.02
Tennessee	1.89	2.18	2.29	2.54
Texas	0.29	0.34	0.38	0.46
Utah	0.45	0.48	0.56	0.55
Virginia	2.94	4.26	4.40	5.06
Washington	1.19	1.28	1.31	1.40
West Virginia	1.22	1.29	1.27	1.40
Wisconsin	1.35	1.65	1.73	1.84
Wyoming	0.46	0.44	0.46	0.52
U.S.	1.92	2.18	2.40	2.66

Appendix table 4c

Expected payments from revenue program triggered at different levels relative to payments forgone under ACRE, by State, guarantee price scenario III

State	Revenue program level			
	National	State	District	County
	Ratio			
Alabama	0.00	0.00	0.00	0.00
Arkansas	0.32	0.35	0.35	0.35
California	1.07	1.07	1.07	1.07
Colorado	0.42	0.59	0.64	0.71
Delaware	1.23	1.60	1.74	1.74
Florida	0.05	0.08	0.09	0.09
Georgia	0.25	0.32	0.36	0.42
Idaho	0.67	0.79	0.82	0.90
Illinois	1.18	1.11	1.27	1.38
Indiana	1.11	1.08	1.11	1.18
Iowa	1.24	1.40	1.55	1.64
Kansas	0.62	0.68	0.91	1.04
Kentucky	1.00	1.13	1.16	1.31
Louisiana	0.77	1.01	1.06	1.08
Maryland	0.96	1.25	1.31	1.37
Michigan	0.94	1.10	1.28	1.38
Minnesota	1.32	1.73	1.89	2.06
Mississippi	0.90	1.10	1.21	1.32
Missouri	0.71	0.88	1.00	1.06
Montana	0.39	0.48	0.66	0.77
Nebraska	0.85	0.93	0.96	1.04
New Jersey	1.06	1.35	1.40	1.51
New Mexico	0.03	0.04	0.04	0.05
New York	0.32	0.29	0.31	0.33
North Carolina	1.52	2.09	2.15	2.38
North Dakota	0.42	0.43	0.50	0.58
Ohio	1.01	1.00	1.09	1.19
Oklahoma	0.32	0.46	0.47	0.50
Oregon	0.63	0.99	1.19	1.22
Pennsylvania	1.61	1.96	2.02	2.39
South Carolina	0.65	0.95	0.94	1.08
South Dakota	1.08	1.30	1.39	1.55
Tennessee	1.04	1.20	1.26	1.40
Texas	0.11	0.12	0.14	0.17
Utah	0.21	0.22	0.26	0.25
Virginia	1.53	2.22	2.30	2.64
Washington	0.60	0.64	0.65	0.69
West Virginia	0.55	0.59	0.58	0.63
Wisconsin	0.73	0.89	0.93	0.99
Wyoming	0.22	0.21	0.21	0.24
U.S.	0.86	0.97	1.07	1.17

Appendix table 4d

Expected payments from revenue program triggered at different levels relative to payments forgone under ACRE, by State, guarantee price scenario IV

State	Revenue program level			
	National	State	District	County
	Ratio			
Alabama	0.00	0.00	0.00	0.00
Arkansas	0.28	0.30	0.30	0.31
California	0.47	0.47	0.47	0.47
Colorado	0.26	0.36	0.39	0.43
Delaware	0.52	0.68	0.74	0.74
Florida	0.15	0.29	0.30	0.28
Georgia	0.25	0.40	0.42	0.48
Idaho	0.41	0.48	0.50	0.55
Illinois	0.45	0.43	0.49	0.53
Indiana	0.42	0.40	0.42	0.44
Iowa	0.48	0.54	0.60	0.64
Kansas	0.30	0.31	0.42	0.48
Kentucky	0.39	0.45	0.46	0.52
Louisiana	0.24	0.30	0.32	0.33
Maryland	0.44	0.58	0.61	0.63
Michigan	0.37	0.43	0.49	0.54
Minnesota	0.43	0.55	0.58	0.62
Mississippi	0.19	0.22	0.24	0.25
Missouri	0.30	0.37	0.42	0.44
Montana	0.25	0.30	0.41	0.48
Nebraska	0.37	0.40	0.42	0.45
New Jersey	0.40	0.50	0.52	0.56
New Mexico	0.07	0.09	0.09	0.11
New York	0.18	0.16	0.17	0.18
North Carolina	0.39	0.54	0.56	0.61
North Dakota	0.24	0.25	0.29	0.34
Ohio	0.40	0.39	0.42	0.46
Oklahoma	0.17	0.23	0.24	0.27
Oregon	0.38	0.59	0.72	0.74
Pennsylvania	0.73	0.88	0.92	1.07
South Carolina	0.18	0.31	0.31	0.34
South Dakota	0.48	0.58	0.62	0.69
Tennessee	0.26	0.30	0.31	0.34
Texas	0.16	0.19	0.21	0.26
Utah	0.13	0.14	0.16	0.16
Virginia	0.48	0.70	0.73	0.84
Washington	0.32	0.35	0.35	0.38
West Virginia	0.35	0.37	0.36	0.39
Wisconsin	0.32	0.40	0.41	0.44
Wyoming	0.13	0.13	0.13	0.15
U.S.	0.36	0.40	0.44	0.49

Appendix table 5

Ratio of planted acres to base acres, selected States and U.S. average

Scenario/level	Corn	Soybeans	Wheat	Cotton	Grain sorghum	Rice, long-grain	Rice, medium/ short-grain
Arkansas	2.73	1.40	0.34	0.47	n/a	0.82	n/a
California	0.69	n/a	0.68	0.65	n/a	n/a	0.94
Colorado	n/a	n/a	0.82	n/a	n/a	n/a	n/a
Georgia	0.74	2.97	0.60	0.71	n/a	n/a	n/a
Illinois	0.98	1.12	0.69	n/a	0.42	n/a	n/a
Indiana	0.85	1.31	0.73	n/a	n/a	n/a	n/a
Iowa	0.93	1.26	n/a	n/a	n/a	n/a	n/a
Kansas	1.47	2.15	0.76	n/a	0.70	n/a	n/a
Kentucky	0.74	1.51	0.91	n/a	n/a	n/a	n/a
Louisiana	1.94	1.51	n/a	0.25	n/a	0.60	n/a
Minnesota	0.93	1.25	0.58	n/a	n/a	n/a	n/a
Mississippi	1.96	2.01	0.48	0.19	n/a	0.61	n/a
Montana	0.32	n/a	0.79	n/a	n/a	n/a	n/a
Nebraska	0.96	1.79	0.68	n/a	0.16	n/a	n/a
North Carolina	0.91	1.79	1.15	0.54	n/a	n/a	n/a
North Dakota	1.49	1.60	0.62	n/a	n/a	n/a	n/a
Ohio	0.82	1.30	0.91	n/a	n/a	n/a	n/a
Oklahoma	n/a	2.93	0.81	0.42	0.91	n/a	n/a
Oregon	0.71	n/a	0.80	n/a	n/a	n/a	n/a
Tennessee	0.95	n/a	0.89	0.39	n/a	n/a	n/a
Texas	1.14	2.66	1.11	0.69	0.98	0.30	n/a
Virginia	0.99	1.57	n/a	0.47	n/a	n/a	n/a
Washington	1.27	n/a	0.52	n/a	n/a	n/a	n/a
Wisconsin	0.74	1.64	2.00	n/a	n/a	n/a	n/a
U.S.	0.94	1.37	0.76	0.52	0.69	0.67	0.94

Planted acres in 2010.