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Rethinking Revenue: Policy Design Options for Farm Bill Commodity Programs

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Rethinking Revenue: Policy Design Options for Farm Bill Commodity Programs

Under pressure to reduce agricultural program expenditures, Congressional Agriculture Committees eliminated direct payment programs in the Agricultural Act of 2014.[1] A substantial dispute among regional and commodity interests produced options for farmers to choose among several new counter-cyclical payment programs for grain, oilseed, and dairy producers. The new commodity assistance programs include Price Loss Coverage (PLC), Agriculture Risk Coverage (ARC), and the Margin Protection Program for Dairy Producers (MPP).[2] In short, the programs are designed to make payments to producers when national marketing year average prices, county or farm revenue, or national dairy income-over-feed-cost margins (respectively) fall below certain thresholds (Newton et al. 2015; Newton and Coppess 2015; Coppess and Paulson 2014). Payment rates for PLC and MPP depend only on commodity prices while payments rates under ARC-CO depend on national average crop prices, county average crop yields, and five-year Olympic moving average (OMA) smoothing of these variables. For ARC-CO, the use of county average yields has gained attention due to the decline in crop prices experienced since 2012.

First, five-year OMA smoothing of prices and yields excludes the highest and lowest values, leaving an average of the remaining three price and yield variables. This helps remove the effect that abnormally high and low values can have on the sample average. This is different than using a long-run average (e.g. 10 years) but can be subject to two or more events that positively or negatively impact crop revenue in the five-year period. As an example, it is possible for the OMA crop yield to be below the 10-year long run average if multiple negative yield shocks are experienced during the five-year OMA observation period. Under such a scenario commodity support will be impacted by the negative yield shocks which can raise questions about whether they accurately reflect the risk environment in a particular county or for a particular crop. By oversampling of rare events (positive or negative) commodity program payments may over- or under-compensate revenue shortfalls relative to the long run risk environment. Over time the OMA smoothing will adjust the crop revenue to reflect updated production and marketing conditions.

Second, the use of national average prices with county-level yields as the payment trigger mechanism is a standard component for commodity policy and is used by both PLC and ARC, but it impacts the spatial distribution of program payments. Marketing year average prices and national price indices have been the primary trigger mechanisms in deficiency payment programs since 1973 (Mercier 2011). Revenue-based protection that combined national average prices with state and farm planted yields was first introduced in the 2008 Farm Bill through the Average Crop Revenue Election program. For ARC-CO and PLC, national average prices are weighted averages of regional prices, but these prices do not fully capture the regional yield-price relationships that impact crop revenues, i.e. the "natural hedge" (Harwood et al. 1999). Commodity price basis varies significantly across the U.S. yet it is not a direct factor in

[1] Hereafter the Agricultural Act of 2014 will be referred to as the 2014 Farm Bill.

[2] ARC is available as both ARC-Individual (ARC-IC) and ARC County (ARC-CO). ARC-IC makes use of multiple crop yields across the entire farm, while ARC-CO makes use of county average yields for individual crops. This research analyzes program payment implications for ARC-County.

determining farm-level program payments. Due to the design choice to use national average prices and county-level crop yields program payments may: (i) over or under compensate farmers relative to their revenue shortfall; and (ii) result in different payment rates across political boundaries. While ARC-CO is functioning as designed by Congress, disparities in program payments across political boundaries have contributed to recent interest in modifying the newly created revenue programs to make the distribution of program payments more uniform (Hoeven 2016; Grassley and Ernst, 2016; Barnaby 2016).

Commodity programs are subject to frequent modification. While retooling commodity support programs to address spatial differences in revenue or to recognize long-run productivity patterns may allow the programs to more accurately reflect the regional risk environment, these modifications are not without economic consequences. First, modifying ARC to use long run average or trend projections for crop yields (as opposed to OMA yields) specifically to increase the magnitude of program payments may mute market signals and make crop acreage decisions more inelastic in the short run. While program payments are decoupled from planting decisions, it is often argued that payments from commodity support programs allow high cost and inefficient farm operations to remain in business, thereby making supply more inelastic (D'Antoni and Mishra 2012). Second, price-yield correlations tend to be more negative inside the Corn Belt than outside the Corn Belt (Harwood et al. 1999). Modifying safety net programs to include regional basis or to reflect the natural hedge will change the revenue risk assumed by the farmer. Third, Newton and Balagtas (2015), Newton, Coppess, and Schnitkey (2015), and Schnitkey et al. (2015b) demonstrated that 2014 Farm Bill program participation decisions were highly conditional on expected program returns.[3] Future modifications to the expected benefit framework may increase uncertainty in the payment probability and thus change program participation incentives or base acre re-allocations during subsequent enrollment periods. Fourth, a general conclusion that can be drawn from the empirical evidence on crop insurance programs is that moral hazard can cause insurance markets to fail (Coble et al. 1997). While ARC-CO is decoupled from actual plantings, modifications to farm safety net programs designed to increase or reallocate program payments may strengthen the conditional relationship between program payments and farm-level production decisions and may provide an opportunity for farmers to engage in riskier behavior.

Positioning for the 2018 Farm Bill has already begun. Members of Congress are on the record identifying the need to reconsider the effectiveness of commodity support programs (Hoeven 2016; Grassley and Ernst, 2016; and Gibson, Courtney, and Welch 2016). Given the desire to reevaluate the 2014 Farm Bill programs, this article is among the first to put forward an analysis of alternative policy design options for ARC-CO.[4] Specifically, we evaluate four counterfactual policy design options, then using farm-level data for the 2014-2015 marketing year obtained from USDA we re-estimate total program payments for corn, soybeans, and wheat under the counterfactual design options. The counterfactual policy options include: on a county-by-county basis resampling crop yields over a 10-year period to replace the OMA yield when multi-year yield declines are observed; modifying ARC-CO to include regional revenue-based protection; and then evaluating ARC-CO using a uniform payment trigger mechanism based on

[3] Newton, Thraen, and Stephenson (2015) found similar participation patterns for the Milk Income Loss Contract program (repealed in the 2014 Farm Bill).

[4] Newton, Thraen, and Bozic (2015) analyzed counterfactual policy design options for the 2014 Farm Bill's margin protection program for dairy producers.

national average prices and yields. The article proceeds with a discussion of ARC-CO including a review of the policy trigger mechanism and the distribution of actual program outlays for the 2014-2015 marketing year.[5] In the following section farm-level USDA program participation data is used to evaluate the spatial distribution of ARC-CO payments under the actual and counterfactual policy design frameworks.[6] The article concludes by reviewing the proposed policy modifications and budget implications.

Agriculture Risk Coverage in the 2014 Farm Bill

Since 1973, U.S. federal farm supports have been designed to directly or indirectly enhance farmer income. These programs have included counter-cyclical payment programs, price support programs, marketing assistance loans, export incentive programs, ad hoc disaster payments, and direct payment programs (Price 2004; Bryant, Outlaw, and Anderson 2007; Schnepf 2012). The 2014 Farm Bill provided the most significant policy reform in decades. It repealed counter-cyclical and direct payment programs in favor of target price, revenue guarantees, or insurance-style margin based programs. These programs are Price Loss Coverage (PLC), Agriculture Risk Coverage (ARC), and the Margin Protection Program (MPP) for Dairy Producers, respectively.[7] Based on USDA farm program participation data, 91 percent of corn farms, 96 percent of soybean farms, and 66 percent of wheat farms elected ARC-CO nationwide. Additionally, 76 percent of all base acres were enrolled in ARC-County (USDA FSA 2016).

Agriculture Risk Coverage, County Option (ARC-CO), is a commodity-by-commodity revenue-based assistance program using county average yields and national average prices as the payment trigger mechanism. The revenue guarantee is set at 86 percent of the benchmark revenue. The benchmark revenue guarantee is specific to each county and commodity and is given by: $B_{ij} = \bar{y}_{ij} \times \bar{p}_i$, where B_{ij} is defined as the benchmark revenue for commodity i and county j and is the product of the five-year OMA U.S. marketing year average price, $\bar{p}_i$, for commodity i, and the OMA yield, $\bar{y}_{ij}$, for commodity i and county j. Prices in the benchmark revenue calculation may not fall below the PLC reference price (plug price) and county yields may not fall below 70 percent of the county transitional yield. PLC reference prices for corn, soybeans, and wheat are \$3.70, \$8.40, and \$5.50 per bushel, respectively.

ARC-CO makes payments when the actual revenue, defined as the county-level yield multiplied by the U.S. marketing year average price, falls below 86 percent of the benchmark revenue guarantee, $\max\left(0.86 \times B_{ij} - y_{ij} \times p_i, 0\right)$, where y_{ij} and p_i are the actual yields and prices for commodity i and county j, respectively.[8] Per acre payments from ARC-CO are capped such that the payment rate, ρ_{ij}, from ARC-CO may not exceed 10 percent of the benchmark revenue guarantee:

[5] Farm program participation data for PLC was unavailable at the time of this analysis. The marketing year for corn and soybeans begins September 1 and ends on August 31 of the following year.
[6] Data obtained from USDA Farm Service Agency through a Freedom of Information Act request.
[7] Price Loss Coverage provides program payments to producers when the marketing average price of a commodity falls below a specified reference price. Payment amounts are equal to the shortfall in the marketing year price multiplied by 85 percent of the farm's base acres and farm's program yields.
[8] The county yields are reported by USDA Farm Service Agency (FSA) and the marketing year average prices are reported by USDA National Agricultural Statistics Service (NASS).

$$\rho_{ij} = \min\begin{cases} 0.10 \times B_{ij} \\ \max\left(0.86 \times B_{ij} - y_{ij} \times p_i, 0\right) \end{cases}.$$

Finally, program payments are made on 85 percent of the base acres for the crop, and the farm-level benefit of ARC-CO is given by the product of: 85 percent of farm *k*'s assigned base acres, A_{ijk}, of commodity i in county j and the ARC-CO payment rate: $\omega_{ijk} = 0.85 \times A_{ijk} \times \rho_{ij}$. As demonstrated in the conceptual framework for ARC-CO, only the county yield captures the regional variations in crop revenue.

Program Participation

Estimates by USDA FSA indicate that nearly 242 million acres were enrolled in ARC-CO, ARC-IC or PLC. Of the acres enrolled, 76 percent were enrolled in ARC-CO, 23 percent in PLC, and 1 percent in ARC-IC (USDA 2015).[9] As demonstrated by Schnitkey et al. (2015b) the program participation decisions were impacted by farmer expectations for program payments during the five-year duration of the Farm Bill. Under ARC-CO, the benchmark price used with county yields to determine program payments on corn acres was $5.29 per bushel for both the 2014-2015 and 2015-2016 marketing years, meanwhile the reference price used to trigger a PLC payment for corn is set at $3.70 per bushel. Figure 1 identifies the actual and projected marketing year average prices and OMA prices for corn, soybeans, and wheat.[10] During the enrollment period for ARC and PLC, marketing year average price projections from USDA's March 2015 World Agricultural Supply and Demand Estimates indicated that PLC payments for corn were unlikely. As a result, ARC-CO presented the potential for higher program payments in nearby years and subsequently 93 percent of corn base acres enrolled in ARC-CO (USDA 2015; Paulson et al. 2015).[11] Similar pricing and participation patterns were observed for soybeans leading to 97 percent of base soybean acres being enrolled in ARC-CO.

Farmer's strategic use of the program contributed to higher participation rates and higher total outlays relative to 2015 Congressional Budget Office projections for $3.7 billion dollars and 60 percent enrollment in ARC when the bill was initially developed (CBO 2014; CBO 2015). Total program payments for all 2014-15 Farm Bill Title I commodity programs reached $5.2 billion dollars for the 2014-2015 marketing year. More specifically, ARC-CO made payments totaling $4.4 billion dollars for the 2014-2015 marketing year and PLC made payments totaling $776 million dollars, Table 1. Approximately $3.7 billion of ARC-CO payments were paid for corn base acres, followed by $349 million for wheat base acres and $317 million for soybean base acres.

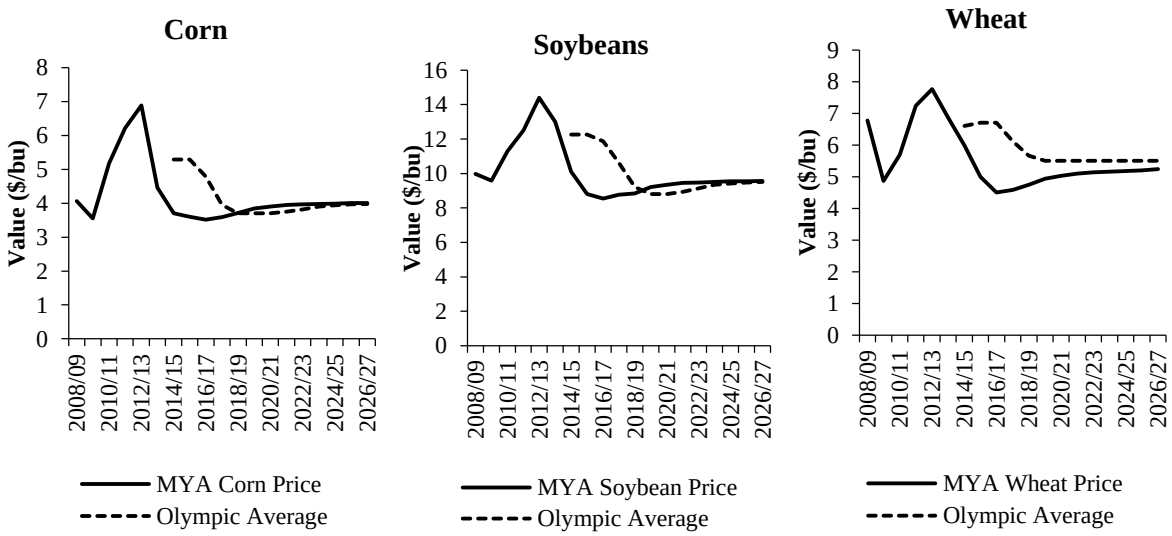
[9] Causes for the minimal participation in ARC-IC include a base revenue adjustment for 0.65 versus 0.86 for ARC-CO as well as a significant increase in program complexity and paperwork requirements.
[10] Projections for 2016 to 2026 are based on Congressional Budget Office March 2016 forecasts (CBO 2016).
[11] ARC and PLC enrollment period closed in April of 2015. Farmers had a one-time choice among ARC-CO, PLC, and ARC-IC.

Table 1. Program payments under ARC-CO and PLC for the 2014/15 marketing year

	PLC	% of Total	ARC-CO	% of Total	Total
Corn	$0	0%	$3,712	84%	$3,711
Wheat	$0	0%	$349	8%	$349
Soybeans	$0	0%	$317	7%	$317
Long Grain Rice	$399	51%	>$0	0%	$399
Peanuts	$321	41%	$0	0%	$321
All Other Crops	$55	7%	$58	1%	$113
Total	$776		$4,436		$5,212

Prices used in the ARC-CO benefit framework are uniform across the U.S. for each crop. Variations in yield above or below the OMA used in the revenue guarantee determine the magnitude of ARC-CO program payments. Due to differences in area productivity, the distribution of program payments is not expected to be uniform across the U.S. Of the states receiving ARC-CO benefits for corn, 53 percent of the payments went to Iowa, Minnesota and Nebraska farmers combined. These states accounted for 36 percent of the U.S. corn production during 2014. Illinois, which accounted for approximately 17 percent of the corn produced in the U.S. during 2014, received approximately 6 percent of ARC-CO corn payments.

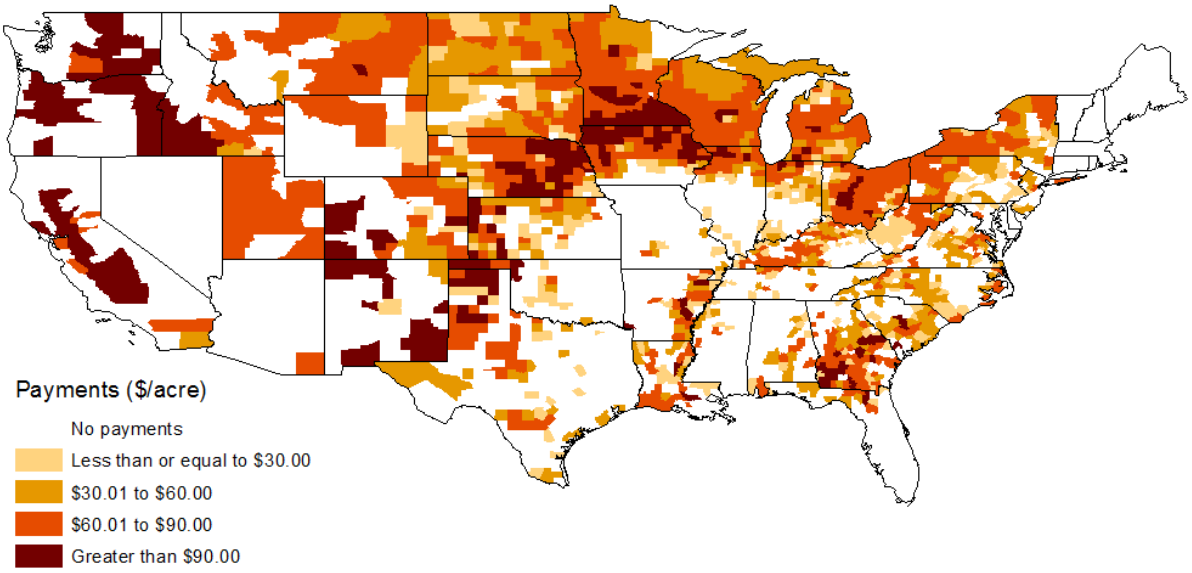
Figure 1. Marketing year average prices and Olympic average prices for corn, soybeans, and wheat 2008/09 to 2027/27



For the 2014-15 marketing year crop areas that experienced high yields had revenues high enough, despite lower crop prices, to reduce payments or prevent them from triggering. For corn, these areas include parts of Southern Iowa, Central Illinois and the Eastern Corn Belt. Areas with below average corn yields, such as Northern Iowa, Minnesota or Nebraska experienced lower revenues due to lower yields, and as a result received higher ARC-CO

benefits relative to their share of U.S. corn production.[12] Figure 2 identifies the spatial distribution of ARC-CO payments on corn base acres. These results are in line with the design of ARC-CO because the revenue calculations make use of county average yields in conjunction with national average prices such that: $\partial\pi/\partial y < 0$.[13]

Figure 2. Actual program payments under ARC-CO for corn base acres for 2014/15 marketing year



Oversampling of Rare Events

Crop yields are conditional on a number of random variables. For example, Westcott and Jewison (2013) use planting date, July temperatures, July precipitation, and shortfalls in precipitation as conditioning information for determining U.S. corn yields. At the farm-level crop yields vary substantially due to these and other random variables. While Congress designed the program to be based on county yield information in an attempt to deal with moral hazard concerns, the availability and consistency of county-level data – or lack thereof – has raised concerns. Even so, the legislation allowed USDA to consider multiple data sets when estimating county crop yields. USDA data sources for county-level crop yields may include estimates from National Agricultural Statistics Services (NASS), Farm Service Agency (FSA), and the Risk Management Agency (RMA). These crop yields may not always align. Under certain circumstances, and depending on which yield value is used, five-year OMA smoothing of prices and yields can result in different estimates of the actual and benchmark revenue. Additionally, when a county experiences two or more events that adversely impact crop revenue over a five-year period then the OMA revenue calculation may be lower relative to a longer sample period or trend line projections. Barnaby (2016) raised these issues with ARC-CO as the explanations for the disparity in program payments across political boundaries.

[12] Title I commodity program payments were subject to an automatic budget sequestration of 7.3 percent during 2015.
[13] Notation does not include yield-price correlation.

Of the 2,719 counties eligible for ARC-CO payments on corn base acres more than 900 counties had OMA yields below the 10-year average. For example, the county average corn yield in Calhoun County, Iowa was 132 and 130 bushels per acre in 2012 and 2013, respectively. These values were approximately 40 bushels per acre below the 10-year average crop yield for the county. However, only one of the multi-year yield declines was dropped from the OMA calculation resulting in a yield guarantee of 158 bushels per acre for the county. This OMA yield was 12 bushels below the 10-year average and 21 bushels per acre below as OMA calculated using 2008 to 2012 county yields from NASS. These multi-year losses cause the benchmark revenue guarantee to be below the long run average crop revenue in the county.

In the same way, oversampling may also result in higher estimates of crop revenue such that program payments are made even when revenue is in line with the long run average or trend projections. For example, ARC-CO samples from the period of record high grain prices observed during 2010 to 2012, Figure 1. As a result, the benchmark revenue uses crop prices of $5.29, $12.27, and $6.60 for corn, soybeans, and wheat, respectively. These prices correspond to 192 percent, 177 percent, and 159 percent (respectively) of the 10-year average commodity prices observed prior to 2010. Over time OMA smoothing is designed to adjust the crop revenue to reflect updated production and marketing conditions. But it does take time for this to adjust. In the case of ARC-CO OMA yields, and not considering price effects, the revenue guarantee in counties with multi-year losses experienced during 2012 or 2013 will not improve until 2017 - one year before the Farm Bill is set to expire. This circumstance may be what has led some policy to suggest that ARC-CO should reassess county yields to reflect a longer sample period of crop yields or to reassess the cascade of sources for which FSA evaluates county-level crop yields.

The Natural Hedge

While ARC-CO utilizes both price and yields to estimate program payments, the use of national average prices and county-level yields overlooks the regional price effects associated with the natural hedge, Figure 3. The natural hedge is described as the regional yield-price relationship that works to offset yield losses with higher prices thereby helping to smooth farm revenue across marketing years. However, the effectiveness of the natural hedge depends on the strength of the yield-price correlation. In areas where the natural hedge is stronger, low prices are consistently offset by high yields. These strong inverse correlations reduce the variability of crop revenue and provide a natural hedging instrument to farmers. In areas where the correlation is weaker, low prices and low yields or high prices and high yields occur simultaneously with greater frequency.[14]

Consistent with Harwood et al. (1999), the natural hedge is stronger in the Corn Belt and becomes weaker in areas outside the Corn Belt. In areas with weak correlations the variability in crop revenues is higher. For example, the variability in revenue for Castro County, Texas (weak natural hedge) is nearly twice as high as revenue levels observed in Champaign County, Illinois (strong natural hedge). Similar patterns are observed across the U.S. It follows then that the variability of revenue is greater outside the Corn Belt and is negatively correlated with the

[14] Similar to ARC, PLC also uses the marketing year average prices to trigger program payments and does not consider commodity price basis when determining the reference price of the actual crop price. A modification to PLC to address regional commodity price basis may include using state level prices to trigger program payments.

strength of the natural hedge, Figure 4. Over time this variability in farm revenue will increase the variability of safety net support for revenue-based programs even in the presence of OMA smoothing.[15]

Figure 3. Corn yield-price correlation at the county-level

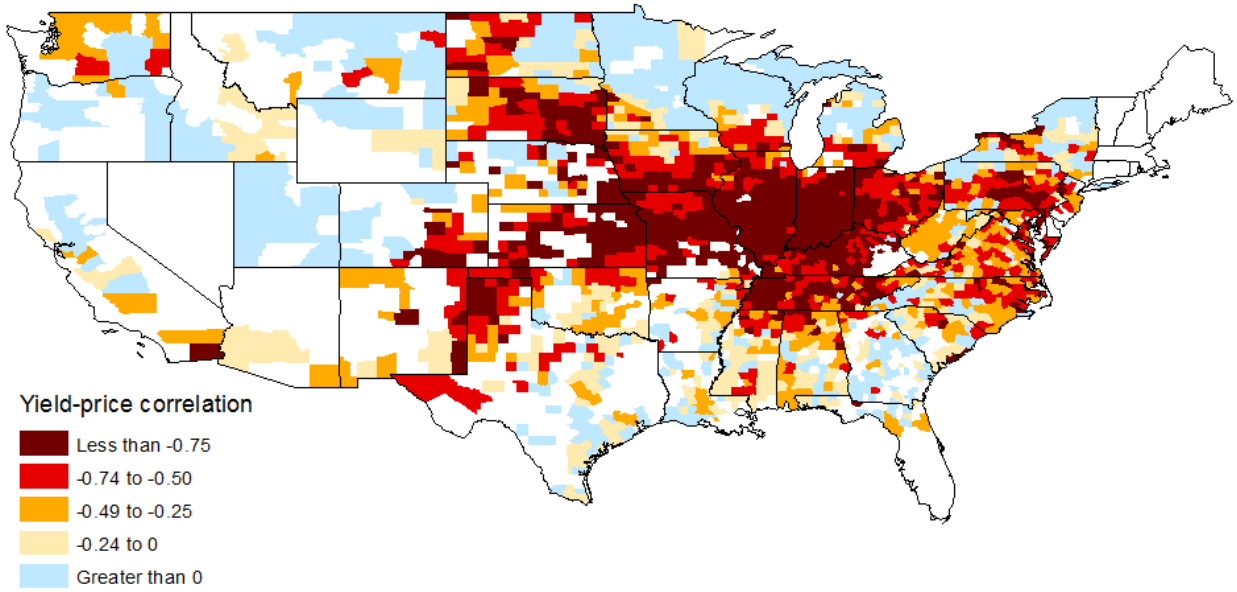
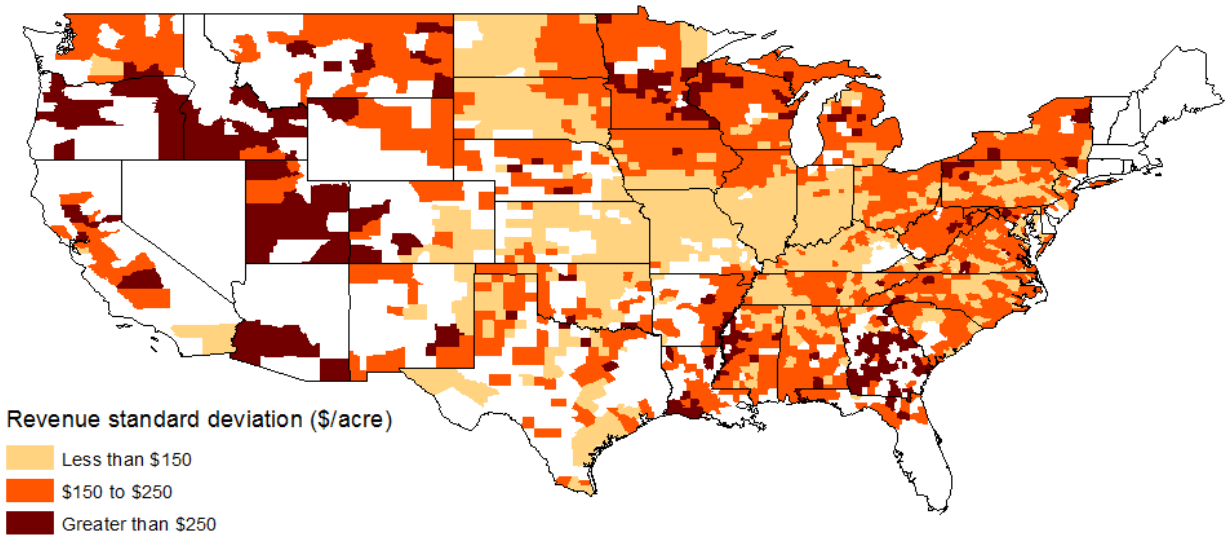


Figure 4. County-level standard deviation in corn revenue



[15] The natural hedge tends to smooth revenue. In areas where the natural hedge is stronger low prices are offset by high yields and income risk is lower.

Without price-yield correlations, the county yield reflects regional crop revenues and program payments may over or under compensate farmers relative to their actual farm revenue. As an example, the marketing year average corn price during 2014-2015 ranged from a low of $3.34 per bushel in South Dakota to a high of $5.36 per bushel in Arizona, a difference of $2.02 per bushel. Despite these differences, program payments under ARC-CO were based on the U.S. average price of $3.60 per bushel and provided large program payments in areas of the country where prices had already adjusted to new market clearing levels.

Policy Options Reconsidered

By delivering billions of dollars in Federal assistance, farm program payments have economic implications. More than 80 years of debate has focused on the appropriate mechanism to determine how much and when farm income support should be provided. The 2014 Farm Bill made substantial changes to farm income support programs. Instead of direct payments each crop year, as was the case since 1996, ARC-CO payments to farmers are contingent on estimated crop revenue falling below certain thresholds.[16] While ARC-CO is functioning as designed by Congressional Agriculture Committees, questions and concerns about the program are indicators that it could be revised in the next farm bill. The spatial differences in program payments will likely be the driving factor. The program lends itself to several possible policy modifications. Options include revising the payment trigger mechanisms to be based on a combination of regional and/or national prices and yields. In order to account for the impact of spatial differences in crop revenue and to potentially make the distribution of ARC-CO program payments more uniform several counterfactual policy design options are considered in the following section.

The potential modifications to ARC-CO include:

(1) *ARC-Max* makes a simple modification to the benchmark revenue calculation to use the higher-of the five-year OMA county yield or the 10-year long run average county yield.
(2) *ARC-Regional* modifies the existing ARC-CO framework to substitute state-level five-year OMA commodity prices in the actual and benchmark revenue calculations (no changes are made to yield data);
(3) *ARC-State* utilizes state-level commodity prices and yields in the actual and benchmark revenue calculations to capture the nature hedge associated with prices and yields; and
(4) *ARC-National* is a more broad payment trigger mechanism that uses U.S. average commodity prices and yields in the actual and benchmark revenue calculations.

ARC-Max

Under this policy design scenario ARC-CO was modified such that the benchmark yield was the higher-of the OMA county yield or the 10-year long run average NASS county yield. This modification reduces the impact of multi-loss years on the benchmark revenue guarantee.

[16] The 2008 Farm Bill made direct payments each crop year for a covered commodity based on payment acres and payment yields.

The benchmark revenue guarantee under this counterfactual policy design is given by $B_{ij} = \max(\bar{y}_{ij}, \hat{y}_{ij}) \times \bar{p}_i$, where $\hat{y}_{ij}$ represents the 10-year average NASS county crop yield.

Since the benchmark revenue guarantee will only increase, this modification to the ARC-CO framework will increase program payments. In order to estimate the impact of this alternative framework on program payments and total Government outlays ARC-CO participation data was obtained from USDA. This data included total program payments by farm for each state and county.[17] In order to estimate total base acres for each commodity, program payment rates published by FSA for each state and county by crop were used to derive implied base acreage.[18] Using the implied base acreage by state, county, and crop, total outlays under the actual and counterfactual policy design option were estimated and compared.

Results of the ARC-Max counterfactual policy design reveal that using the higher-of the OMA yield or the 10-year average crop yield would have increased program payments during the 2014-15 marketing year compared to the actual policy design. Under the actual policy design, program payments on corn, soybeans, and wheat acres totaled $4.31 billion dollars while under the ARC-Max scenario program payments increased by 13 percent, or $448 million dollars, to $4.76 billion. Results differed by commodity. For corn, the counterfactual policy design increased government outlays by $330 million dollars, approximately 9 percent, to $3.96 billion dollars. For wheat, program payments increased by $51 million dollars to $341 million dollars, an increase of 15 percent. Soybean payments increased by $67 million dollars to $381 million, an increase of 22 percent over actual outlays. Table 2 identifies program payments by crop for the actual and counterfactual policy design scenarios.

Table 2. Actual and counterfactual program payments for select commodities, 2014-2015 marketing year in millions of dollars

	Actual Program Payments 1/	ARC-Max	ARC-Regional	ARC-State	ARC-National
Corn	$3,655	$3,986	$3,556	$3,485	$3,890
		(+9%)	(-3%)	(-5%)	(+6%)
Wheat	$341	$392	$366	$329	$0
		(+15%)	(+10%)	(-3%)	(-100%)
Soybeans	$314	$382	$345	$241	$0
		(+22%)	(+7%)	(-23%)	(-100%)
Total	$4,310	$4,758	$4,267	$4,056	$3,890
Corn, Soybeans, Wheat		(+13%)	(-1%)	(-6%)	(-10%)

1/ Based on data obtained from USDA Freedom of Information Act, data does not add to totals released by FSA. Note: Change from actual FOIA totals in parenthesis.

By using the higher-of OMA or 10-year average commodity yields, the impact of multi-year yield declines had a smaller impact on the benchmark revenue guarantee. The net effect

[17] Data obtained from USDA did not include base acreage by county.

[18] For areas without an ARC-CO payment, base acres were implied using actual planted acres and multiplied by the ratio of base acres to actual acres for each commodity for which data was reported. Ratios used were: 0.77 for corn, 0.41 for soybeans, and 0.63 for wheat.

would increase commodity program payments for counties that experience multi-year yield declines over the 2009 to 2013 sample period. As an example, under the actual policy design Calhoun County, Iowa had an OMA yield of 158 bushel per acre, 10 bushels per acres below the 10-year average, and received an ARC-CO payment of $23 dollars per base acre. Once the higher-of component was factored into the revenue guarantee ARC-Max would have provided a program payment of $69 dollars per base acre, an increase of $46 dollars. At the county-level, ARC-Max would have increased program payments from $3.4 million dollars to more than $10 million dollars. Figure 5 shows the distribution of ARC-Max payment rates and counties where ARC-Max resulted in additional or no change in program payments for corn base acres.

Including the higher-of yield into the ARC-CO program payment calculations partially addresses the substantial disparities in benefits across county political boundaries. Of the 2719 counties receiving an ARC-CO payment for Corn, 631 counties would have their program payments increased under ARC-Max. Under ARC-Max all participants end up either better off or with no changes in program payments. However, while ARC-Max addresses recent concerns over disparities in crop yields, it fails to recognize the impact of yield-price correlations across the Corn Belt. Additional design options explored in the following sections address these correlations.

ARC-Regional

Under this policy design scenario ARC-CO was modified to include the State-level five-year OMA price into the calculation of the benchmark and actual revenue. These new prices replace the U.S. prices in the current ARC-CO policy design. This modification should better capture the regional variation in commodity prices and the impact of these prices on farm revenue. Under this alternative framework the benchmark revenue and actual revenue is the product of the State-level price and the county-level yield. Program payments under this counterfactual policy design are given by:

$$p_{ij} = \min \begin{cases} 0.10 \times \left(\bar{y}_{ij} \times \bar{p}_{il} \right) \\ \max \left(0.86 \times \left(\bar{y}_{ij} \times \bar{p}_{il} \right) - y_{ij} \times p_{il}, 0 \right) \end{cases}.$$

where $\bar{p}_{il}$ and p_{il} represent state *l*'s OMA and actual crop price, respectively.

Using the implied base acreage by state, county, and crop, total outlays under the actual and counterfactual policy design option were compared. Results of the ARC-Regional counterfactual policy design reveal that revenue estimates derived using state-level prices and county-level yields may have slightly reduced total program payments during the 2014-15 marketing year compared to the actual policy design. Under the actual policy design, program payments on corn, soybeans, and wheat acres totaled $4.31 billion dollars while under the ARC-Regional scenario program payments decreased by 1 percent, or $43 million dollars, to $4.26 billion. Results differed by commodity. For corn, the counterfactual policy design reduced government outlays by $99 million dollars, approximately 3 percent, to $3.55 billion dollars. However, for wheat and soybeans, program payments actually increased. Soybean payments increased by $31 million dollars to $345 million dollars, an increase of 10 percent. Wheat

payments increased by $25 million dollars to $366 million, an increase of 7 percent over actual outlays.

By using state-level commodity prices, program payments were directed toward areas where the state-level revenue was below the state-level benchmark revenue guarantee. As an example, under the actual policy design Cochise County, Arizona received an ARC-CO payment of $85 dollars per base acre. Once the five-year OMA Arizona corn price of $6.16 per bushel and the 2014-15 marketing year average price of $5.36 per bushel were considered, the ARC-Regional payment rate fell to $0 per base acre. Instead of going to Cochise County, Arizona these funds were redirected to other U.S. counties. Figure 6 shows the distribution of ARC-Regional payment rates and counties where ARC-Regional resulted in additional, fewer, or no change in program payments for corn base acres.

Including the state-level prices into the ARC-CO program payment calculations does not resolve the substantial disparities in benefits across county political boundaries. For example, under the counterfactual benefit framework producers in Calhoun County, Iowa received $3.5 million on 171 thousand corn base acres while producers in Pocahontas County, Iowa (directly to the north) received $14 million dollars on a similar volume of corn base acres. This disparity in program payments is directly attributable to the variation in county-level crop yields and the impact of these yields on the benchmark and actual revenue. Additional design options explored in the following section may better address this disparity by making program payments uniform across the State.

ARC-State

In an effort to make ARC payments more uniform across a State ARC-CO was modified to use State-level five-year OMA prices and yields in the calculation of the benchmark and actual revenues. These new prices and yields replace the national average prices and the county-level yields currently used in ARC-CO. This modification will better capture the regional variation in commodity prices, but will capture in less detail the variation in crop yields across a State. The result of this modification is that all base acres in a particular State will receive the same program payment on a commodity-by-commodity basis. Program payments under this counterfactual policy design are given by:

$$p_{il} = \min \begin{cases} 0.10 \times \left(\bar{y}_{il} \times \bar{p}_{il} \right) \\ \max \left(0.86 \times \left(\bar{y}_{il} \times \bar{p}_{il} \right) - y_{il} \times p_{il}, 0 \right) \end{cases}.$$

where $\bar{p}_{il}$ and p_{il} represent state *l*'s OMA and actual crop price, respectively; and where $\bar{y}_{il}$ and y_{il} represent state *l*'s OMA and actual crop yield, respectively

Using the implied base acreage by state, county, and crop, total outlays under the actual and counterfactual policy design option were compared. Results of the ARC-State counterfactual policy design reveal that revenue estimates derived using state-level prices and yields would reduce total program payments during the 2014-15 marketing year compared to the actual policy design. Under the ARC-State scenario total program payments decreased for all corn, soybeans, and wheat by $254 million dollars, a reduction of approximately 6 percent relative to actual outlays. For corn, the counterfactual policy design reduced government outlays by $170 million

dollars, approximately 5 percent, to $3.49 billion dollars. Wheat payments decreased by $12 million dollars to $329 million, a reduction of 3 percent. Finally, under the alternative framework soybean program payments were reduced by $73 million dollars, approximately 23 percent, to $241 million dollars.

By utilizing state-level price and yields program payments were uniform across the state. Under this policy design the previous disparity between Calhoun County and Pocahontas Counties in Iowa was alleviated as both counties received program payments of $88 per base acre and received approximately $13 million in safety net support. There will, however, be issues under such a policy modification. Payments would be uniform across a state, but some farms in a state would have received lower program payments compared to the current policy design. For example, portions of Northern Illinois that experienced lower crop yields in the 2014-15 marketing year would have had their payments reduced. The lower yields in Northern Illinois would have been offset by higher yielding counties in Central and Southern Illinois that represents a proportionally larger share of the state's corn production. Figure 7 shows the distribution of ARC-State payment rates and counties where ARC-State resulted in additional, fewer, or no change in program payments for corn base acres.

In both of the previous counterfactual scenarios the price-yield relationship is better represented such that the commodity program payments better capture the market clearing price conditions in each State. This type of targeted revenue support provides protection to farmers in areas as needed based on adverse price changes and weather-related productivity shortfalls (based on regional price and or yield estimates). However, while ARC-Regional and ARC-State both provide more targeted price-based commodity support, disparities due to political boundaries would remain.

In the case of ARC-State, state-level data is subject to political boundaries that may not necessarily reflect the risk to farm revenue. Farms on each side of a state line could get very different treatment, and within a state, yield and prices often vary significantly from one part of the state compared to another. These spatial variations would make for new disparities in treatment. As an example, under the counterfactual scenario farms on the border of Illinois and Iowa would have received substantially different ARC-State payment rates of $5.03 per acre in Illinois and $88.68 per acre in Iowa.[19] This disparity in program payments is a function of the yield and price differences observed across state boundaries or within a particular state. A final design option, explored in the next section, would address this disparity by making program payments uniform across the U.S. for each commodity.

ARC-National

[19] In Illinois, a 200-bushel per acre yield combined with a state average price of $3.71 to produce actual revenue of $742 dollars per acre, and was only slightly lower than the benchmark guarantee of $747 per acre. In Iowa, a 178-bushel per acre yield combined with a state average price of $3.71 to produce actual revenue of $660 dollars per acre, and was substantially lower than the benchmark guarantee of $732 per acre.

It may be possible to address the disparities observed across political boundaries by making program payments uniform across the U.S. Such a modification would remove the county yields from the policy design framework and instead use national average prices and yields to trigger program payments. Under this proposed framework program payments for commodity i at the U.S. level are given by:

$$p_{iUS} = \min \begin{cases} 0.10 \times \left(\bar{y}_{iUS} \times \bar{p}_{iUS} \right) \\ \max \left(0.86 \times \left(\bar{y}_{iUS} \times \bar{p}_{iUS} \right) - y_{iUS} \times p_{iUS}, 0 \right) \end{cases}.$$

where $\bar{p}_{iUS}$ and p_{iUS} represent the U.S. OMA and actual crop price, respectively; and where $\bar{y}_{iUS}$ and y_{iUS} represent the U.S. OMA and actual crop yield, respectively. Under this framework, program payments would be triggered when the national average crop revenue fell below the benchmark revenue guarantee. This modification would effectively make ARC-National function similar to PLC in that program payments would be uniform across the U.S. for each commodity. The only difference between the programs would be that PLC provides target price support and ARC-National would provide target revenue support.

Results of the ARC-National counterfactual policy design reveal that revenue estimates derived using National average prices and yields would reduce program payments during the 2014-15 marketing year by nearly half a billion dollars compared to the actual policy design. For corn, the ARC-National policy design expanded government outlays by $235 million dollars, approximately 6 percent, to $3.89 billion dollars. However, program payments were eliminated for both soybeans and wheat. The combined reduction in program payments for soybeans and wheat totaled $655 million dollars. Such a significant reduction in commodity program payments would alter the distribution of benefits among commodities and may have unanticipated economic and political consequences. By utilizing national average price and yields program payments for corn were uniform across the country at $61 per base acre. This resulted in significantly higher program payments in some states and lower payments in other states. Importantly, under the ARC-National framework the distribution of benefits closely followed the distribution of corn production. Figure 8 shows counties eligible for an ARC-National payment and counties where ARC-National resulted in additional, fewer, or no change in program payments for corn base acres.

Figure 5. Estimated program payments and change from ARC-CO for corn base acres using long run average yields, 2014-2015 marketing year (ARC-Max)

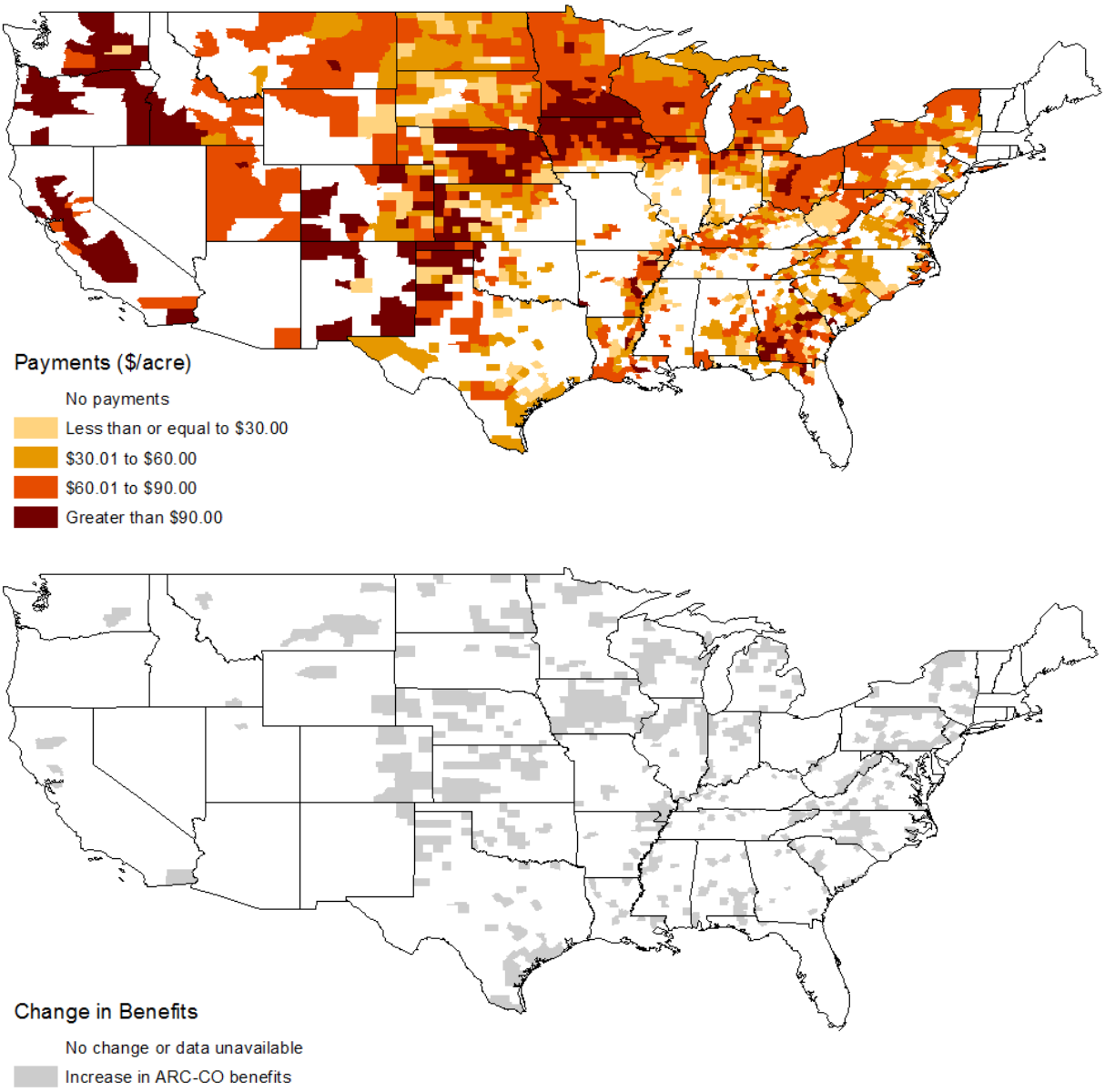


Figure 6. Estimated program payments and change from ARC-CO for corn base acres using state prices and county yields, 2014-2015 marketing year (ARC-Regional)

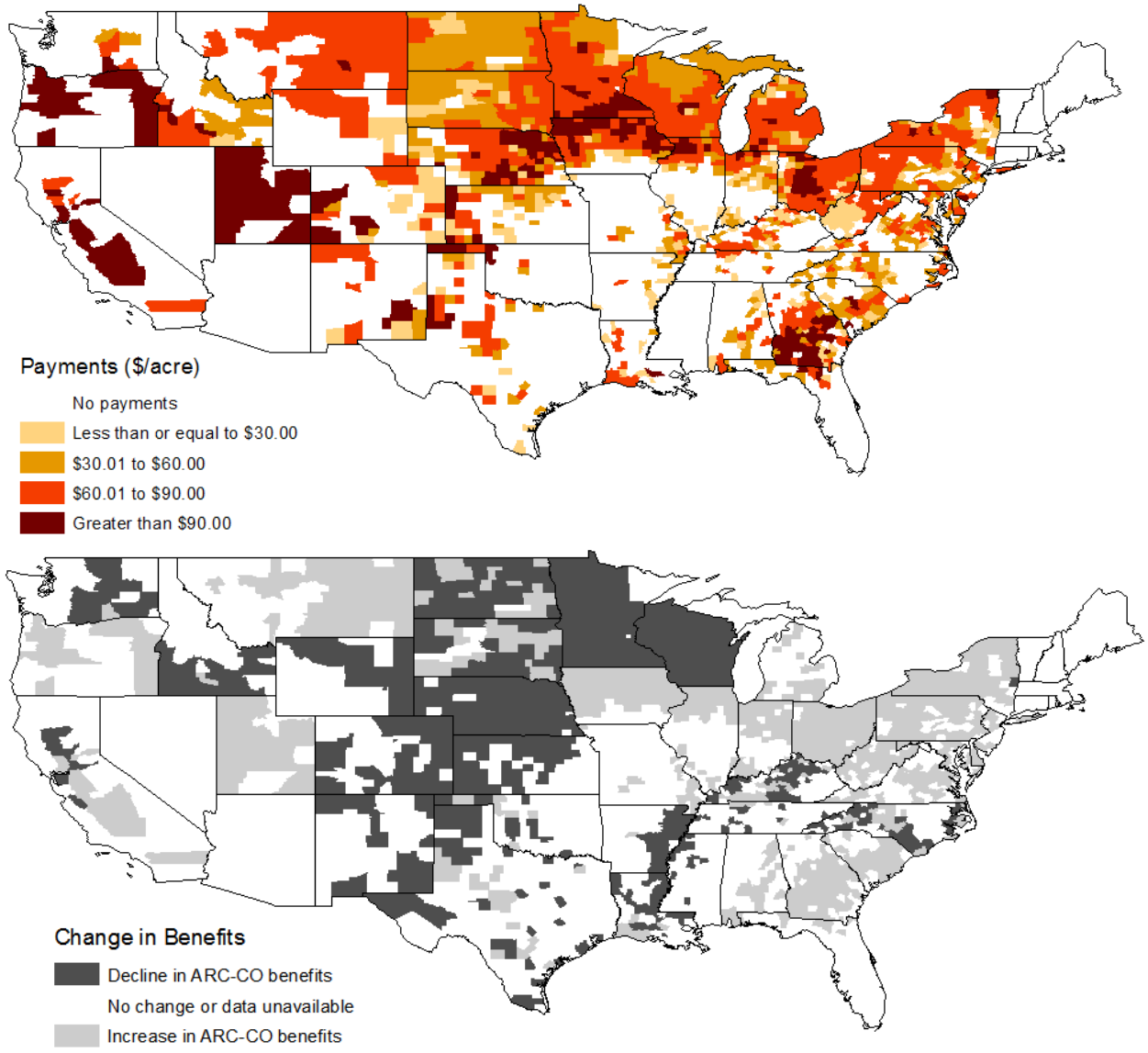


Figure 7. Estimated program payments and change from ARC-CO for corn base acres using state prices and state yields, 2014-2015 marketing year (ARC-State)

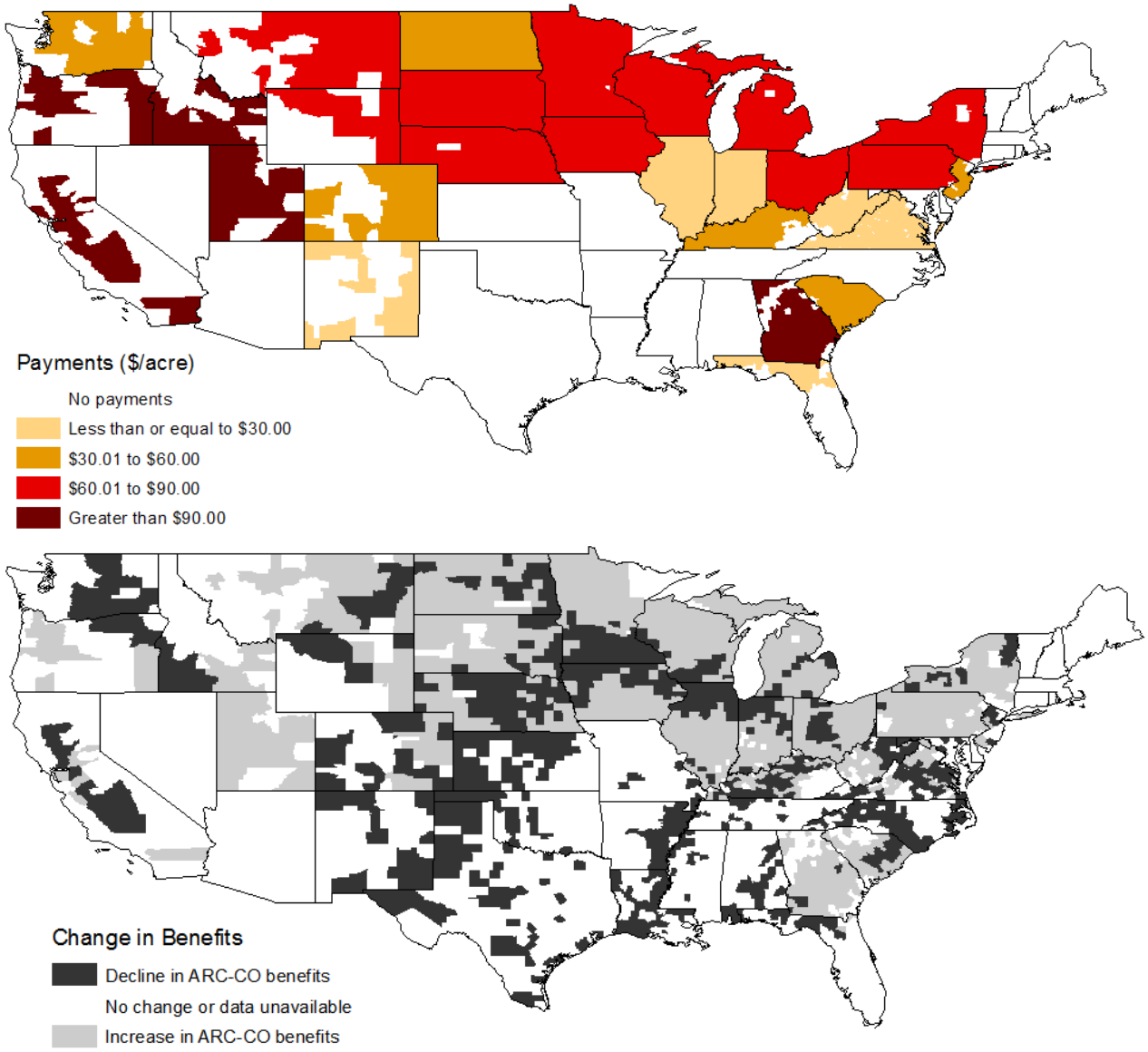
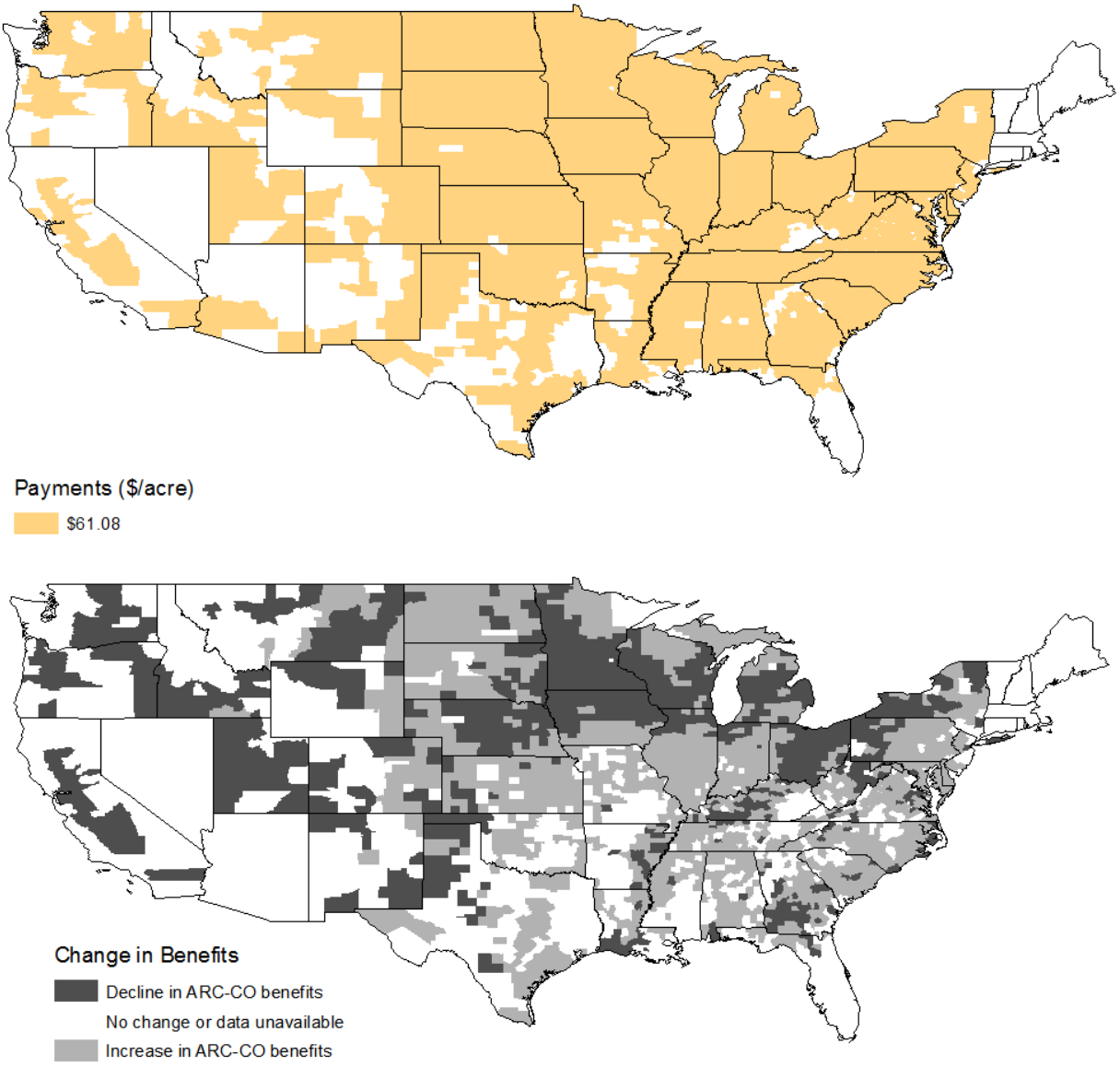


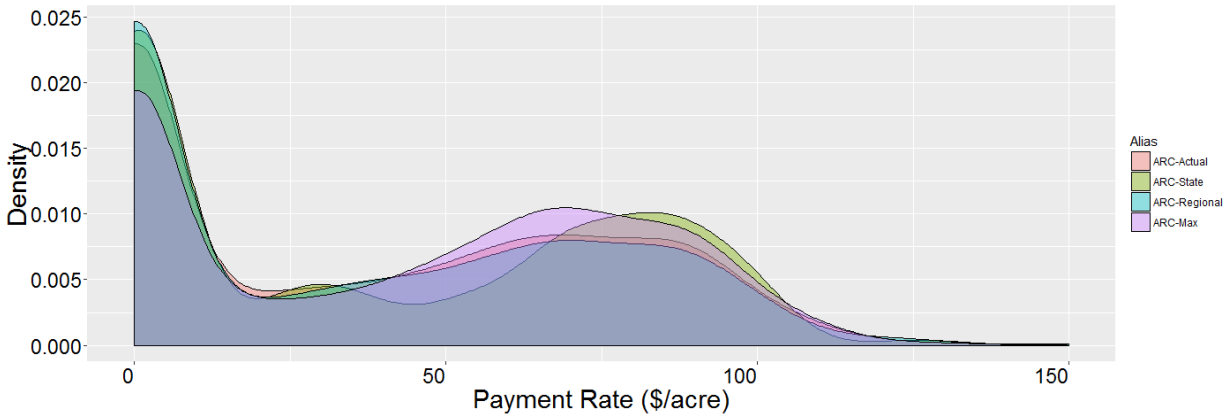
Figure 8. Estimated program payments and change from ARC-CO for corn base acres using U.S. prices and U.S. yields, 2014-2015 marketing year (ARC-National)



Summary

ARC-CO is functioning as designed by Congress in that county-level yields impact crop revenues and thus are determinants of commodity program payments. However, concerns over yield estimates and spatial differences in program payments across political boundaries have contributed to recent interest in modifying the newly created revenue programs to improve program performance (Barnaby 2016; Hoeven 2016; Grassley and Ernst, 2016). In this article we have analyzed four policy design options to modify the ARC-CO framework. These modifications would be expected to address spatial differences in program payments and may better recognize the impact of the natural hedge on crop revenues.

Figure 9. Density functions of actual and counterfactual ARC program payments for corn base acres, 2014/15 marketing year



These modifications would be expected to alter the spatial distribution of program payments. Total program outlays change by ±10 to 13 percent and there is the potential for program payments to be redistributed across commodities. However, as demonstrated in Figure 9, for a particular commodity these alterations in the distribution of benefits do not substantially change the overall distribution of program payment rates at the farm-level. The payment rate distributions under each of the counterfactual policy options are bi-modal or multi-modal with high concentrations near $75 per base acre and $0 per base acre. Similar distributions are observed for soybeans and wheat payment rates.[20]

However, the challenge with ARC-CO is that political boundaries do not always align with the risks and revenue associated with crop production. Farms within a county are subject to the yield performance of farms also in the same county, and farms may receive different program payments than neighboring farms across the county line. ARC-CO is also a product of using national average prices and county-level yields. These benchmark and actual revenues ignore the yield-price correlations and are surveying from two different spatial measures. The most basic options to revise ARC-CO include changing these relationships in the conceptual framework. Using a higher-of yield calculation in the benchmark revenue guarantee will absorb the impact of multi-year losses but ignores the long-run commodity prices that are analogous to yields and overlooks the natural hedge. State price and county yields provide better recognition of the yield-price correlations but do not capture the spatial price differences within a State or the impact of multi-year losses. For example, county-level cash prices for corn vary significantly from Northern to Southern Illinois. The use of state-level price and yields makes program payments uniform across the state but fails to address the spatial disparities that may occur across state boundaries. Finally, national average prices and yields result in uniform program payments across the U.S. Some combination of long run yield and price smoothing with a regional or national revenue trigger may improve the performance of ARC-CO relative to the existing framework, but is likely to increase outlays.

The reality is that ARC-CO payment trigger mechanisms are useful in delivering program payments to farmers based on approximations of risk and were designed to supplement crop

[20] ARC-National program payments are not included in the density function as all program payments are uniform for all corn base acres.

insurance programs. The question then becomes, at what geographic level should program payments be triggered and should a systemic risk program be triggered at the local, state, or national level? These are questions policy makers will address as the 2018 Farm Bill debate develops. As demonstrated, modifications to the existing commodity programs will alter the spatial distribution of program payments. Additionally, modifying ARC-CO does not guarantee that total Government outlays will be lower under any of the counterfactual scenarios. This analysis has been focused on policy trigger mechanisms, however, much of the debate as negotiations advance will depend on CBO estimates of program outlays and baseline restrictions.

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