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by

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How Important is the T-Yield? An Analysis of Reforms to Organic Crop Insurance

The federal crop insurance program has offered insurance products to producers of some organic crops since 2001. Initially, participation in the crop insurance program among this group was much lower than participation among conventional crop producers, and less than half of the organic crop acreage was insured prior to 2009 (Peterson et al., 2012; USDA – OIG, 2013). The low participation rates were driven by a perception in the organic community that the insurance products for organic growers were priced unfairly, did not offer enough protection, or were otherwise unattractive (Hanson et al., 2007; Singerman et al., 2010). Meanwhile, within the USDA's Risk Management Agency (RMA), there was concern that the organic insurance products were actually structured too generously, as loss ratios were consistently higher for organic crops than for conventional crops (USDA – RMA, 2010; USDA – OIG, 2013).

The primary cause of high loss ratios for organic crop insurance policies prior to 2014 was the use of conventional transitional yields (t-yields) to calculate expected yield outcomes for organic farms. Because organic crop yields are generally lower than conventional crop yields, the use of the conventional t-yield in organic insurance rating resulted in high yield guarantees and larger and more frequent indemnities paid to organic growers (USDA – OIG, 2013). In response to this problem and the persistent perception in the organic community that the program design was unfair to organic crop farmers, RMA made several significant changes to the organic crop insurance program for the 2014 crop year. The agency issued new organic specific t-yields that were up to 35% lower than the existing conventional t-yield; it offered organic price elections on an expanded set of crops[1]; and it removed an arbitrary 5% premium surcharge for

[1] Additional organic price elections have also been announced for the 2016 and 2017 crop years.

organic policies that was widely criticized within the organic community. This paper analyzes the impact of these changes to the organic crop insurance program on the expected insurance outcomes for organic corn and soybean growers.

Before crop insurance programs and products were adapted for use by organic producers, much of the research related to risk management on organic farms was focused on risk preferences and attitudes of organic farm managers. Most early studies concluded that organic crop producers were less risk averse than conventional producers, which is consistent with characteristics typically associated with early adoption of a new technology (Constance and Choi, 2010; Gardebroek, 2006; Läpple and Rensburg, 2011). As organic agricultural production expanded and crop insurance became the dominant agricultural support program in the United States, calls for improved insurance coverage grew, at least from organic grain and cotton producers who were familiar with the multi-peril crop insurance (MPCI) policies available to conventional growers (Hanson et al., 2007).

Multiple studies have conducted surveys of organic crop producers to elicit the reasons for participation and non-participation in the federal crop insurance program. Singerman et al. (2010) found that many organic farmers in Wisconsin, Minnesota, and Iowa that declined to purchase crop insurance did so because they believed coverage was either inadequate, too costly, or they simply preferred not to participate in federal programs. Glenn et al. (2014) found that many organic growers who did not participate in crop insurance programs opted out because they believed that their own risk management strategies (e.g. crop rotation, diversification) provided sufficient protection from crop-specific losses.

Insurance products for some organic crops were made much more attractive in 2011 when the first organic price elections were issued. A few major organic crops[2] could be insured at organic prices, dramatically increasing the revenue guarantees that growers of these crops could obtain and also increasing the value of insurance premium subsidies. While both qualitative and quantitative analyses showed that the addition of organic price elections made organic crop insurance more attractive and increased coverage (Singerman et al., 2012; Glenn et al., 2014), there were no studies that directly analyzed the farm-level outcomes of crop insurance participation among organic growers.

As with the issuance of organic price elections in 2011, the response within the organic community to the 2014 organic crop insurance reforms was largely positive. Organic farmers welcomed the reforms generally – in particular the removal of the 5% organic premium surcharge – though some were concerned about the impact that the newly issued t-yields might have on organic adoption (Behar, 2013; National Sustainable Agriculture Association, 2013; Glenn et al., 2014). Despite the enthusiasm, it is not clear whether the reforms to the organic crop insurance program have made participation more or less attractive for individual organic producers.

This study uses a unique set of organic corn and soybean yield data from growers in Minnesota to analyze the impact of organic crop insurance program rule changes put in place for the 2014 crop year. We pay close attention to the effect that the newly issued t-yields have on the expected indemnities for yield and revenue protection products and how this effect evolves as farms establish production records on organic acreage. Since area risk crop insurance products are also available to organic producers but do not rely on individual farm production histories,

[2] Organic price elections were issued in 2011 for corn, soybeans, cotton, and processing tomatoes. As of 2016 there are organic price elections for more than 50 crops.

they have been recommended to organic producers who feel that the new organic t-yields understate their true yield expectations. Our analysis also includes assessment of area yield and revenue protection products as a viable alternative for organic producers.

One challenge in analyzing crop insurance products for organic producers (and indeed a challenge that RMA faces in *rating* these products) is that little long-term farm level organic yield data exists. The organic yield data that RMA uses to estimate yield distributions and develop rating structures are representative only of farms that have chosen to participate in the federal crop insurance program. Given that organic participation in the crop insurance program has tended to be quite low, RMA has much less information regarding yield distributions for the full population of organic farms than it does for the distributions of conventional farms. A key strength of this paper is the use of a unique set of yield observations from Minnesota farms that have grown the same organic crop over a period of several years. These are farms that may or may not have purchased crop insurance, allowing us to avoid the pitfalls associated with data from farms that self-select into the crop insurance program.

Another key strength of this study is the use of actual premium rate calculations in the analysis of farm-level outcomes from insurance program participation. Because current crop insurance premium calculation methods are complex and require farm-level yield histories, many papers analyzing crop insurance choice assume actuarially fair premiums or otherwise simplified outcome calculation methods (e.g. Barnett et al., 2005; Deng et al., 2007; Woodard et al., 2012). However, it is well known that current crop insurance products and subsidy structures are not actuarially fair (Babcock et al., 2004; Woodard et al., 2011), and relying on this assumption for an analysis of farm-level net returns to insurance participation would not be appropriate. Moreover, because the relevant changes to the organic crop insurance program have to do with t-

yields and premium surcharges, accurate calculation of the Actual Production History (APH) and product premiums, with all of their complexities, is crucial in determining insurance product performance and the impact of recent reforms.

The next section of the paper outlines the 2014 organic crop insurance reforms with an explanation of how the t-yield is used in calculating insurance guarantees. The following section explains the method used to compare insurance product performance. We then describe and discuss the data and methods used in the empirical analysis. The results section follows with a presentation of the comparative performance of organic revenue and yield protection products before and after the 2014 rule changes as well as a comparison with area-risk protection products. We conclude with a discussion of this study's implications for future development of organic crop insurance products and rating.

Role of T-Yields in Yield and Revenue Protection Insurance

A farm's APH for a particular crop and production practice is meant to reflect that farm's yield expectation for that crop and is usually based on the yield outcomes previously observed on the farm. The t-yield is an expected county yield that, under some conditions, is used in the calculation of an APH value for the "unit" (i.e. crop, field, and production practice) that the farmer wishes to insure. The APH value leads directly to the yield or revenue guarantee provided by the selected insurance product, so the higher the farm's APH, the higher the farm's maximum yield or revenue guarantee. The relationship between the RMA issued t-yield and the producer's APH is of crucial importance in understanding the impact of the organic crop insurance reform on organic and transitioning crop producers. It is important to note that the t-yield is of greatest importance for farmers who are growing a new crop or are using a new production practice, such

as a farm growing a crop organically for the first time. A farm that grows a new crop or uses a new practice does not have a yield history for that crop or practice, so the assigned t-yield serves as a substitute for the actual yield history that has yet to be established. This analysis assumes that each farm has just achieved organic certification and has no insurance history on the organic crops in question[3].

In the most straightforward of cases for a farm with an established yield history, the APH for a particular insurance unit is the average yield that the producer has achieved in the most recent four to ten years. In many cases however, the calculation of the APH is much more complex. The method used by RMA to calculate the APH includes a yield substitution option and a system of "cups" and "floors" which keep a farm's APH from dropping too rapidly or falling below a minimum guarantee level (USDA – RMA, 2013b). Yield substitution allows a particularly low yield to be replaced in the APH calculation by 60% of the county t-yield, mitigating the impact of a catastrophic loss. The APH "cup" is a constraint that prevents the APH from declining by more than 10% in a single year. The APH "floor" allows the farm to replace the APH with 70-80% percentage of the county t-yield if the farm's APH drops below this level[4]. The effect of these features of the APH calculation is that a county t-yield that is much higher than the farm's true yield expectation may impact the APH for more than four years from the start of coverage, and in the case of a binding APH floor, may persist indefinitely.

[3] RMA allows producers to specify an insured crop as "transitional" if they are managing the crop organically but have not yet achieved organic certification. The yield experience of transitional crops can be used in the calculation of an organic APH once certification is achieved. In this analysis we assume that the farms have no transitional history and insure the crop for the first time in the year they achieve organic certification.

[4] If the farm has a single year of yield history, the floor is 70% of the t-yield. This percentage increases to 75% if the farm has two to four years of yield history, and increases to 80% if the farm has five or more years of yield history.

Formally, the APH in the first 5 years of coverage is calculated as follows:

$$
\begin{aligned}
&APH_1 = tyield_1 \\
&APH_2 = \max\left(\frac{3 * tyield_2 + yield_1}{4}, 0.9 * APH_1, 0.7 * tyield_2\right) \\
(1) \qquad &APH_3 = \max\left(\frac{2 * tyield_3 + yield_1 + yield_2}{4}, 0.9 * APH_2, 0.75 * tyield_3\right) \\
&APH_4 = \max\left(\frac{tyield_4 + yield_1 + yield_2 + yield_3}{4}, 0.9 * APH_3, 0.75 * tyield_4\right) \\
&APH_5 = \max\left(\frac{yield_1 + yield_2 + yield_3 + yield_4}{4}, 0.9 * APH_4, 0.75 * tyield_5\right)
\end{aligned}
$$

where the subscript denotes the year of coverage for a particular insurance unit and "$yield$" is the larger of the farm's observed yield and 60% of the county t-yield for that year, reflecting the yield substitution option[5]. In the first year of coverage, the APH is equal to the full t-yield in the grower's county for the relevant crop and production practice. In the second through fifth year of coverage, the farm's observed yields are incorporated gradually into the APH, subject to potential yield substitutions and the provisions that the APH cannot drop more than 10% in a year (i.e., yield cup), and that the APH cannot drop below 70-75% of relevant t-yield (i.e., yield floor).

The primary reform to the organic crop insurance program for crop year 2014 was the establishment of organic specific t-yields. Before the 2014 crop year, organic crop producers used the conventional t-yield to calculate the yield guarantee for their organic crop, which led to inappropriately high yield guarantees and high indemnity payments to organic producers. While using conventional t-yields in the calculation of an organic yield guarantee is clearly not ideal, a lack of organic yield data in early years of organic crop insurance availability made it impossible

[5] If a grower elects to make the yield substitution the yield cups are not applicable in subsequent crop years.

to accurately construct organic t-yields. The new organic t-yields issued for the 2014 crop year are set at a fixed factor, ranging from 0.65 to 1.0, of the conventional t-yields for each crop and county. In Minnesota, organic t-yields for corn, soybean, and wheat are set at 65% of the conventional yield for all counties, though t-yields for some other crops (canola, sunflowers, barely) have been reduced by a smaller amount.

The organic t-yields issued in 2014 also impact existing organic farms that have established organic APH values on existing organic acreage but wish to certify additional land as organic. Since the crops grown on this new organic land has not been insured under an organic practice, a separate APH must be established and the county t-yields will be used. A new APH must also be established if a new crop type is grown (e.g. blue corn rather than yellow corn) or if a new practice is used (e.g. irrigation installed on previously unirrigated land).

Loss ratios, Premium Wedges, and Subsidies

The loss ratio is the most commonly used measure of crop insurance performance. The loss ratio is typically defined simply as the indemnity paid by the insurer divided by the full premium paid in exchange for coverage. A total loss ratio (including premiums paid by the insured and applicable subsidies paid by the federal government) greater than 1.0 implies a net loss to the insurer for the product(s) in question. Although the system-wide loss ratios for the federal crop insurance program have fluctuated over time, since 2003 annual loss ratios for all products and crops have remained below 1.0, suggesting actuarial soundness of the crop insurance program (Glauber, 2013).

The premium wedge is another measure of insurance performance, defined as the difference between the insurance premium and the expected indemnity of the product in question (Deng et al., 2007; Wang et al., 2003). The wedge is useful for analysis of crop insurance products because, unlike the loss ratio, it provides information on the scale of premium and indemnity payments. An actuarially sound insurance product will have a positive wedge, indicating that the value of total premiums received by the insurer is higher than the indemnities paid to the insured. Note that a positive (negative) wedge will be observed for a particular risk pool and product that has a loss ratio less (greater) than 1.0.

The federal crop insurance program is heavily subsidized with subsidy levels rising in tandem with program participation through the 1990's and 2000's (Coble and Barnett, 2012; Glauber, 2013). Subsidies include payments to private insurance companies for administrative costs and a direct premium subsidy to reduce the premium payment due from the insured producer. The premium subsidy percentages increase as the chosen coverage level decreases, ranging from 38% to 67% for yield protection (YP) and revenue protection (RP) products and from 44% to 59% for area risk protection insurance (ARPI) products. Although RMA often reports the loss ratios calculated using the full premium (including subsidy) as a measure of program soundness, the loss ratios and wedges calculated using producer premiums, net of subsidies, are more relevant for analysis of farm-level insurance decisions. These measures are the focus of this analysis and we refer to them as the "producer loss ratio" and the "subsidized premium wedge"[6].

[6] While the total loss ratios for the federal crop insurance program, which include premium subsidies, have been below 1.0 since 2003, the portion of total premiums for which crop producers are responsible have been substantially less than indemnities paid during this time period, implying a producer loss ratio greater than 1.0.

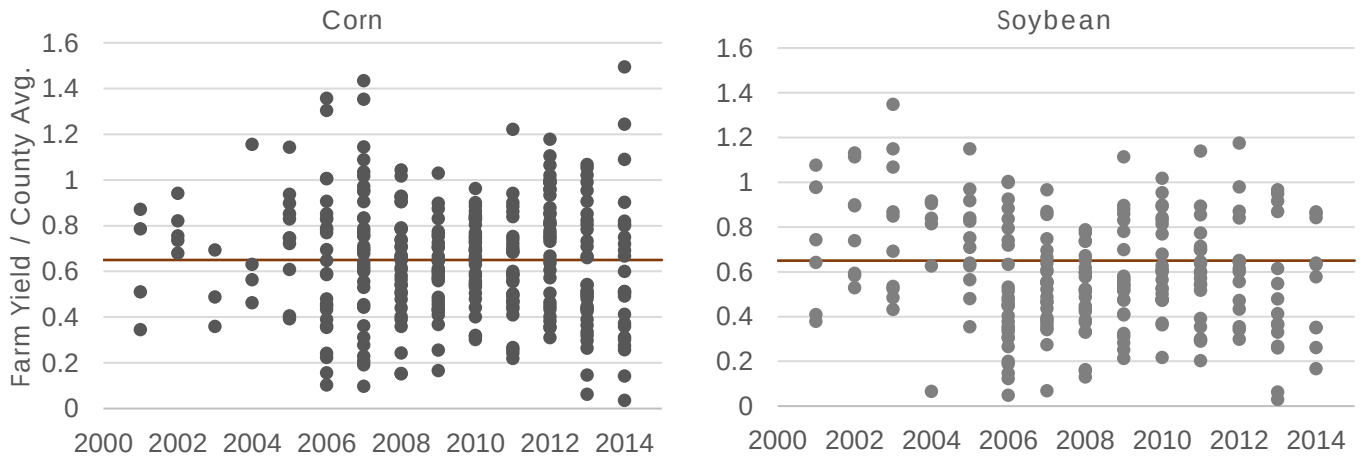
Empirical Analysis

To explore the effect of the organic crop insurance reforms put in place for the 2014 crop year and the issuance of a reduced t-yield for organic producers in particular, actual premium rates and indemnities are calculated using data on farm-level organic crop yields over time. Insurance outcomes for yield and revenue protection products are calculated and compared using the rating parameters, t-yields, and premium surcharge for organic crops during the 2013 crop year (before insurance reforms) and the same rating parameters along with the organic specific t-yields issued for the 2014 crop year. Premiums and indemnities for ARPI yield (AYP) and revenue (ARP) products are also calculated, using 2014 rating parameters and program design, to evaluate area protection as an alternative to multi-peril insurance products for organic farmers.

Data

We analyze outcomes of organic yield and revenue protection products using farm-level organic yield data collected by the Minnesota Farm Business Management (FBM) Program. The data include yield outcomes that were observed in years from 2000 to 2014 and come from fully or partially organic farms located throughout the state of Minnesota. If an included farm grew the same organic crop on multiple fields in the same county, the yield observations are aggregated to the enterprise level by calculating an acreage-weighted average yield. All organic corn and soybean yield observations are plotted in figure 1 as a percentage of the farm's county average conventional yield in the same year. A horizontal line at 0.65, representing the newly issued organic t-yields, is included in each panel for reference and appears to lie roughly at the center of the organic yield distributions.

Figure 1. Farm-level organic corn and soybean yields as a percentage of county average yields.



Given the temporal dynamics of the APH calculations, the full impact of a t-yield revision on a farm's yield guarantee and subsequent indemnity payments can only be seen when a multi-year sequence of yields is analyzed. With a long enough series of yield observations, the varying impact of the t-yield on new and established farmers can be identified. To this end, we include in the empirical analysis only those organic crop producers for whom we have at least five years of either organic corn or soybean yield observations. In the dataset provided by the Minnesota FBM program there are 24 farms with at least five years of corn yield observations and 15 farms with at least five years of soybean observations used in this analysis. If a farm has provided more than five years of yield observations, only the most recent five observations are used in the analysis to avoid weighting any individual farm's experience more heavily than another.

Although this set of organic yield data is small for actuarial purposes, it is similar in size to the data set that was used in a USDA audit of existing organic crop insurance policies which led to the 2014 reforms (USDA – OIG, 2013). The audit analyzed the performance of 76 crop insurance policies purchased by 33 organic farms nationwide and found that loss ratios were high

for organic farms because the conventional t-yields overstated their yield potential. The data used in this study, derived solely from Minnesota organic crop producers, provide a better representation of state-wide and within-farm yield distributions than the more diverse group of data used in the RMA audit. While the size and local scope of our data set limits our ability to make conclusions regarding the full impact of the organic insurance reforms across the country, it allows an analysis that can provide insights into the likely impact and potential pitfalls of the recently issued organic t-yields.

A key strength of this analysis is that since these farm records were collected by the Minnesota FBM program rather than by RMA, crop insurance participation is not a prerequisite for inclusion. Given the low participation rates in the organic crop insurance program, particularly in early years of program availability, a data set made up exclusively of insured farms (such as that used in the 2013 USDA audit) may be biased by adverse selection issues. This makes the set of farm-level organic yield outcomes used in this paper particularly valuable for analysis of insurance outcomes.

Yield Sequence and APH Calculation

The order in which yields are experienced can have a significant impact on the resulting APH and yield guarantee. The yield sequence is particularly important for new insurance units because the APH is an average of only four yield values for new growers. Producers with long yield histories have APH values that incorporate more annual yield observations into the average, making each individual observation and the sequence in which the yields were observed less impactful.

Table 1 illustrates the importance of yield sequence to the APH value using two scenarios with yield values that differ only in the order in which they are observed. Suppose that in year 1 the farm plants a new crop or practice for which it has no yield history. When a farm plants a crop for the first time they are able to use the full t-yield (160 bushels in this example) as the APH. In sequence 1, the farm achieves its lowest yield in the first year and the yield observation increases each year until a yield equal to the t-yield is observed in year four. The APH decreases each year but the downward adjustment is constrained in years two through five by either the yield cup or yield floor. In the second sequence, the yields are equal to those in the first sequence but the highest yield (160 bushels) is observed in the first year with yields decreasing each year. The differences in the APH values for these two scenarios are large, though mitigated to some degree by the yield cups and floors[7]. After the first year of coverage, in which the APH values are equal, the differences in APH range from 2 to 20 bushels per acre. At the 75% coverage level, this results in yield guarantee differences of 1 to 15 bushels per acre.

Table 1. Calculation of APH given different yield orderings.

		Sequence 1		Sequence 2	
Year	T-yield	APH	Yield	APH	Yield
1	160	160	70	160	160
2	160	144[c]	80	160	120
3	160	130[c]	120	150	80
4	160	120[f]	160	135[c]	70
5	160	120[f]	-	122[c]	-

[c]: binding “cup”
[f]: binding “floor”

Of course, each farm observes only a single sequence of annual crop yields. However, if we assume that the five annual yield observations for each farm in the dataset are independent

[7] The insured also has the option to substitute 60% of the t-yield for an observed yield. If a yield is substituted yield cups and floors can no longer be used in the APH calculation. The yield substation option is not beneficial in this example.

draws from that farm's underlying yield distribution, we can re-order the yields to generate additional yield sequences and insurance outcomes. Given that the sequence of a farm's yield observations affects the farm's APH and resulting premiums and indemnities payments, to analyze the insurance outcomes only from the observed sequence would be to discard data in an environment characterized by extreme data scarcity.

In the analysis of YP and RP product outcomes for organic growers, the five annual yield observations for each farm are permuted to obtain all possible yield sequences and the resulting APH values. In the first year of insurance participation, there is only one possible APH value for a given farm (i.e., the farm's county t-yield) and there are only five possible indemnity outcomes (i.e., one for each yield observation). In the second year of simulated insurance participation (i.e. after one year of yield experience) there are five possible APH values and 5 x 4 = 20 possible indemnity payments. When the farm has four years of yield experience and the t-yields are no longer used in the APH calculation, there are $5!/1! = 120$ possible yield sequences and thus 120 possible APH values for each farm. By scrambling the yield sequence in this way, and calculating premiums and indemnities for each possible outcome, we achieve a more accurate view of crop insurance performance distributions under each policy regime than we would if we analyzed observed indemnity and premium outcomes.

Since the yield and revenue guarantees for area risk insurance products do not rely on farm-level yield history, no such yield permutation method is used in the calculation of ARPI premium and indemnity calculations. Rather, the outcomes for the area-risk products are simply calculated for the counties and years in which the included farms had insurable organic corn and soybean production. County-level yield and price values used in the calculation of premiums and indemnities for the area-risk insurance products are taken from historical RMA data.

Premium and Indemnity Calculation

Crop insurance premium rating is complex, with different premium rates for each county, crop, production practice, and farm yield history. Because it is difficult and time consuming to calculate actual premiums for each farm-level insurance unit, many studies analyzing crop insurance outcomes rely on assumptions of actuarial fair premiums (e.g., Barnett et al., 2005) or simplified APH calculations (e.g., Deng et al., 2007). In this analysis we use the APH values calculated individually for each farm and yield sequence permutation, subject to all of the nuance associated with yield cups, floors, and substitutions, with the actual RMA rating parameters and formulas (USDA – RMA 2013a; USDA – RMA 2014) to calculate the premiums required to insure each crop under YP, RP, and ARPI products.

Since subsidy percentages and the resulting producer loss ratios and subsidized premium wedges differ by coverage level, we consider all possible coverage levels for each of the four insurance products (50%-85% for YP and RP; 70%-90% for AYP and ARP products). Depending on the structure, size, and location of a farm's land holdings, the insuring farm may have the choice to insure fields as basic, enterprise, or optional units (USDA – RMA, 2013b). This choice impacts both the premiums due for coverage as well as the probability that an indemnity is paid. This analysis assumes that all farms insure the acreage planted in a particular crop as a single basic insurance unit. Although some farms that are included in the dataset may have multiple fields and could potentially qualify for an enterprise unit premium discount, our data do not allow this level of detail.

Although crop insurance is a valuable tool for managing production and price risk, recent research shows that actual insurance purchasing behavior is often consistent with the

conceptualization of the crop insurance program as an investment in a lottery game (Babcock, 2015; Bocquého et al., 2014). That is, farm managers tend to focus on the net gains and losses to an insurance purchase, rather than on the smoothing effect that insurance participation has on farm income. Because the focus of this paper is on the impact of organic crop insurance reforms on the farm-level experience with the crop insurance program and the attractiveness of insurance products to organic producers, we focus our attention on the comparison of producer loss ratios and subsidized wedges that consider the subsidized premiums paid by crop producers. We acknowledge that risk averse growers would be willing to accept a net loss on the purchase of an insurance product in exchange for the risk reduction benefit that participation in the insurance program provides but we do not consider the impact of insurance coverage on the variability of farm income.

Results

When exploring the impact of the newly issued organic specific t-yields and the removal of the 5% premium surcharge on organic crop insurance products, it is instructive to examine the varying impact of the policy changes as farms accumulate organic production history. Since a farm's observed yields are incorporated gradually into the APH, replacing the t-yield in the calculation, the impact of the organic t-yields will diminish as farms continue with an organic system. Area-risk insurance does not rely on t-yields or farm-level yield histories, so the expected outcomes for ARPI products will be the same in a farm's first year of coverage as in their fifth.

Table 2 presents the producer loss ratios and subsidized premium wedges for YP and RP products for organic farms in their fifth year of organic production under the new organic t-yield regime. The loss ratios and wedges under the 2013 organic crop insurance rules are compared to those calculated using the same rating parameters but using the reduced organic t-yields issued in 2014 and with the 5% organic premium surcharge removed. Because these results represent farms in their fifth year of organic production, they represent insurance outcomes based on APH values that are impacted only slightly, if at all, by county t-yields.

The loss ratios under the new program rules are lower for both corn and soybean at every coverage level of YP and RP products than under the previous organic program rules. The loss ratio decline is greater for soybean coverage than for corn coverage, and tends to be greater for RP policies than for YP policies. The fact that loss ratios are lower under the new program rules, despite the removal of the 5% organic premium surcharge, demonstrates the persistent effect of the t-yields, even when four years of yield history are available. Not only do APH yield cups keep the APH from adjusting rapidly to new farm-level yield experience, but APH yield floors and substitutions can prop up APH values indefinitely when t-yields are much higher than the farm's true yield expectation. This effect is particularly pronounced with soybean coverage policies as organic soybean yields tend to be lower, relative to county average conventional yields, than organic corn yields (Figure 1; Delbridge and King, 2014).

It is noteworthy that under the new organic insurance policy regime the producer loss ratios for these farms with established yield histories are within the range of producer loss ratios observed for the crop insurance program as a whole over the past two decades, while the loss

Table 2. Producer loss ratios and subsidized wedges by coverage level for YP and RP products in the fifth year of the insured practice, before and after the 2014 policy change.

		Yield Protection				Revenue Protection			
Crop	Coverage Level	Producer Loss Ratio (Old)	Producer Loss Ratio (New)	Subsidized Wedge (Old)	Subsidized Wedge (New)	Loss Ratio (Old)	Loss Ratio (New)	Subsidized Wedge (Old)	Subsidized Wedge (New)
Corn	50%	2.44	1.79	-$6.35	-$2.85	3.59	2.60	-$13.96	-$7.10
	55%	2.61	2.03	-$10.21	-$5.38	3.69	2.66	-$21.13	-$10.72
	60%	2.84	2.23	-$15.17	-$8.38	3.91	2.83	-$30.40	-$15.77
	65%	2.80	2.13	-$21.83	-$11.29	3.62	2.64	-$41.33	-$21.36
	70%	3.05	2.27	-$32.03	-$16.34	3.59	2.69	-$54.03	-$29.22
	75%	2.89	2.15	-$41.57	-$20.77	3.20	2.47	-$65.78	-$36.54
	80%	2.52	1.91	-$49.15	-$24.18	2.70	2.13	-$75.79	-$41.95
	85%	2.03	1.55	-$51.36	-$22.58	2.17	1.72	-$80.33	-$41.07
Soybean	50%	4.22	2.76	-$11.28	-$4.61	4.63	2.85	-$15.12	-$5.79
	55%	4.03	2.49	-$15.29	-$5.62	4.43	2.63	-$20.82	-$7.42
	60%	3.99	2.45	-$20.06	-$7.30	4.35	2.74	-$27.18	-$10.62
	65%	3.46	2.10	-$25.20	-$8.42	3.68	2.39	-$33.26	-$13.02
	70%	3.23	1.99	-$31.01	-$10.34	3.46	2.33	-$41.08	-$16.82
	75%	2.68	1.71	-$35.05	-$11.12	2.91	2.06	-$46.86	-$19.60
	80%	2.10	1.41	-$35.81	-$10.06	2.31	1.68	-$49.35	-$19.40
	85%	1.57	1.08	-$30.18	-$3.36	1.73	1.26	-$44.27	-$12.16

ratios under the previous policy regime tend to be slightly higher (Glauber, 2013). The producer loss ratios are above one for all products and coverage levels under both sets of program rules, indicating that on average, participating farms receive more in indemnity payments than they pay in producer premiums. This has also been the case for the crop insurance program as a whole in every year since 1994 (Glauber, 2013).

In contrast to the outcomes for farms that have an established yield history, table 3 shows that producers who do not have a yield history, and thus use the county t-yield as their APH, experience dramatically higher loss ratios and larger wedges under the old program rules than under the new rules for YP and RP products. Since the APH in the first year of coverage of a new insurance unit (i.e. crop, field, and production practice) is simply set equal to the county issued t-yield, the issuance of the organic specific t-yields for these crops at 65% of the existing conventional t-yields greatly reduces the yield and revenue guarantees that are available. When new organic producers use conventional t-yields in the calculation of their APH values, producer loss ratios in the first year of participation exceed 10.0 up to the 75% coverage level for soybean YP and RP products and are above 4.0 at every coverage level for both products and both crops. The average subsidized wedge, representing the dollar amount that a grower could expect to gain by purchasing a particular crop insurance product, is strongly negative (< -$100 per acre) at high coverage levels for both YP and RP products for both crops. That is, the net return on crop insurance participation is over $100 per acre for some products under the 2013 program rules. This economic subsidy has been greatly reduced, and for some coverage levels, nearly eliminated by the issuance of organic specific t-yields.

Table 3. Producer loss ratios and subsidized wedges by coverage level for YP and RP products in the first year of the insured practice, before and after the 2014 policy change.

		Yield Protection				Revenue Protection			
Crop	Coverage Level	Producer Loss Ratio (Old)	Producer Loss Ratio (New)	Subsidized Wedge (Old)	Subsidized Wedge (New)	Loss Ratio (Old)	Loss Ratio (New)	Subsidized Wedge (Old)	Subsidized Wedge (New)
Corn	50%	7.98	1.16	-$26.86	-$0.58	11.08	2.09	-$46.60	-$4.34
	55%	8.34	1.38	-$40.53	-$1.93	10.64	2.24	-$65.62	-$7.20
	60%	9.04	1.65	-$57.83	-$4.23	10.80	2.46	-$89.54	-$11.30
	65%	8.37	1.61	-$77.46	-$5.83	9.34	2.25	-$117.05	-$14.72
	70%	8.34	1.68	-$99.60	-$8.38	8.75	2.24	-$147.29	-$19.56
	75%	7.40	1.59	-$122.52	-$10.31	7.38	2.04	-$176.91	-$23.79
	80%	6.28	1.41	-$148.32	-$10.62	5.92	1.72	-$206.40	-$24.81
	85%	4.97	1.18	-$172.12	-$7.02	4.54	1.38	-$231.08	-$20.11
Soybean	50%	16.57	3.82	-$32.92	-$6.32	17.36	4.22	-$42.15	-$8.14
	55%	15.42	3.52	-$43.97	-$8.17	15.53	3.92	-$55.18	-$10.82
	60%	15.02	3.57	-$56.98	-$11.10	14.79	4.10	-$71.30	-$15.52
	65%	12.64	3.05	-$72.24	-$13.53	11.92	3.45	-$88.82	-$19.15
	70%	11.56	2.83	-$89.32	-$16.47	10.75	3.13	-$109.12	-$22.82
	75%	9.56	2.40	-$108.64	-$18.94	8.82	2.59	-$130.58	-$25.57
	80%	7.40	1.88	-$126.99	-$18.69	6.79	2.02	-$149.51	-$25.53
	85%	5.30	1.37	-$140.28	-$13.00	4.92	1.48	-$162.69	-$19.48

Figure 2, which presents loss ratios at the 75% coverage level for RP, YP and ARPI products, shows graphically how the effect of the high conventional t-yields fades over time as organic farms incorporate their actual yield history into the APH calculation. It is noteworthy that the loss ratios for soybean coverage under the new organic program rules decrease slightly from the first year to the fifth year of coverage, falling below 2.0 the yield insurance product and to 2.06 for the revenue insurance product. The decrease in the loss ratio as yield experience is incorporated into the APH indicates that the new t-yields are set slightly higher than the true yield expectation for these organic soybean producers. As the farm's yields are observed, the yield guarantees and subsequent indemnity payments fall. In contrast, the loss ratios for RP and YP corn coverage under the new organic t-yields increase from the first to the fifth year of coverage. This suggests that the organic corn t-yields are too low and the true yield expectation of organic farms in Minnesota is likely greater than 65% of conventional t-yields.

It is often suggested that farmers who wish to purchase coverage on a new insurance unit but believe that the relevant t-yield is lower than their true yield expectation should insure using area-risk products rather than YP and RP products. This strategy allows the farm to establish a yield history on the unit in question and provides protection from risk of widespread losses that reduce the average yield at the county level. Figure 2 and table 4 show that the producer loss ratios these organic farms would have experienced if insured under AYP and ARP products are far lower than those for YP and RP products even under the new organic t-yield regime. Table 4 shows that the average subsidized wedges for these products are positive for all coverage levels for both crops, suggesting that the purchase of area-risk protection products is not likely to result in indemnity payments that exceed the producer premiums required for coverage. This result, which shows that the purchase of ARPI products is likely to be a relatively costly way to

establish production history for organic farms, is not surprising given the history of ARPI/GRP participation over the last 15 years. Table 5, which presents RMA data on historical outcomes for area-risk products, shows that only 83 area risk policies (including both yield and revenue protection) were purchased for corn and only 55 policies were purchased for soybean in the entire state of Minnesota during the 2014 crop year.

Figure 2. Loss ratios over time for farm-level and area-risk yield and revenue protection products.

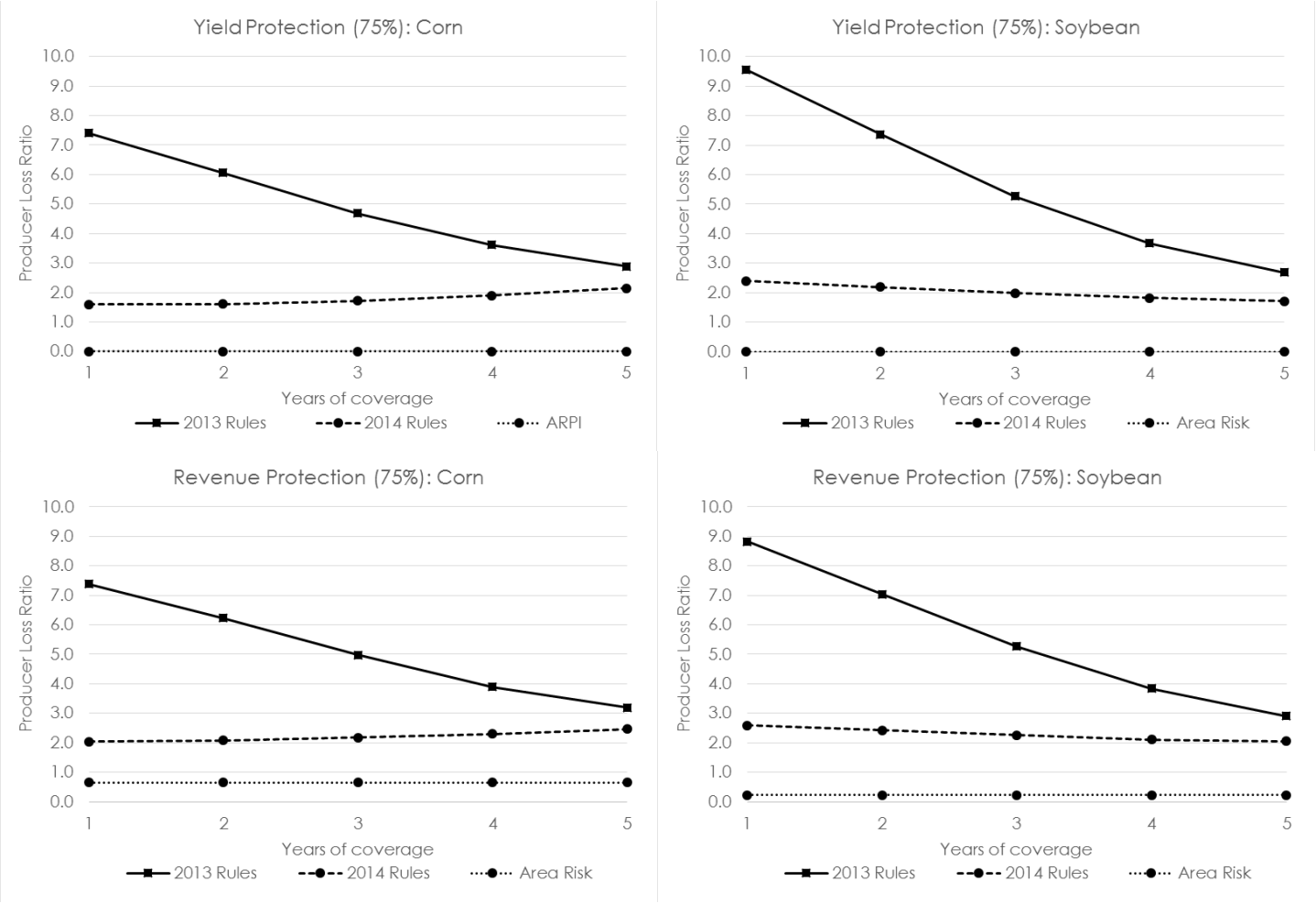


Table 4. Producer loss ratios and subsidized wedges by coverage level for area risk yield and revenue products.

		Area Yield Protection		Area Revenue Protection	
Crop	Coverage Level	Producer Loss Ratio	Subsidized Premium Wedge	Producer Loss Ratio	Subsidized Premium Wedge
Corn	0.70	0.00	$13.32	0.37	$20.70
	0.75	0.00	$16.45	0.66	$16.95
	0.80	0.00	$23.60	0.94	$4.22
	0.85	0.00	$30.57	0.96	$3.67
	0.90	0.16	$36.92	0.93	$9.75
Soybean	0.70	0.00	$3.40	0.05	$19.94
	0.75	0.00	$4.26	0.23	$23.82
	0.80	0.07	$5.54	0.44	$23.10
	0.85	0.41	$5.02	0.54	$28.34
	0.90	0.54	$6.40	0.63	$30.96

Table 5. Number of policies sold and producer loss ratios in Minnesota for corn and soybean area-risk protection products, 2000-2014.

	Corn		Soybean	
Year	Policies Sold	Producer Loss Ratio	Policies Sold	Producer Loss Ratio
2000	432	0.00	170	0.00
2001	365	0.61	130	0.56
2002	310	0.00	110	0.00
2003	262	0.52	96	24.68
2004	274	0.86	122	3.31
2005	330	0.03	135	0.00
2006	506	0.36	209	0.01
2007	444	3.69	193	0.61
2008	419	1.62	160	3.25
2009	265	0.00	128	0.03
2010	235	0.00	127	0.00
2011	164	0.03	97	0.60
2012	116	0.00	64	0.00
2013	115	3.89	62	2.04
2014	83	4.87	55	4.41

Although the results of the simulated premium and indemnity values for this set of organic farms under each set of program rules suggest that RMA largely succeeded in improving the soundness of crop insurance for organic producers, the likely impact of these changes on program participation rates among organic producers merits attention. It has been reported that crop insurance participation among organic crop producers in the Midwest was lower than among conventional crop producers before organic price elections were first issued in 2011 (Hanson et al., 2007; Singerman et al., 2010; Watts and Associates, Inc., 2009). While it appears that the percentage of organic corn and soybean acreage that has been insured in recent years is more in line with conventional insurance rates (USDA – RMA; USDA – NASS, 2014) it is not yet clear what impact the organic insurance reforms of 2014 will have on program participation. If the adoption of lower organic t-yields makes YP and RP policies less attractive for high performing or newly certified organic crop producers, adverse selection may threaten the future of the program and make it difficult for RMA to collect enough production data to further improve the rating of organic insurance products.

Figures 3 and 4 present producer loss ratios for revenue protection products at the 75% coverage level for farms grouped by realized farm-level yield relative to the county average yield. The top quartile of farms in these figures are those with the highest observed yields relative to the relevant county average yield over the five years of included production data. These farms achieve the highest yields relative to other farms in the county and receive the lowest crop insurance indemnities. Note that these results are for the first year of insurance coverage so all APH values are equal to the county t-yields and premium rates and yield guarantees do not yet reflect farm specific performance. Under the new organic t-yield regime, the top quartile of farms in this data set would receive slightly less in indemnities than they pay

Figure 3. Average farm-level loss ratios for organic corn crop during first year of revenue protection coverage, by quartile.

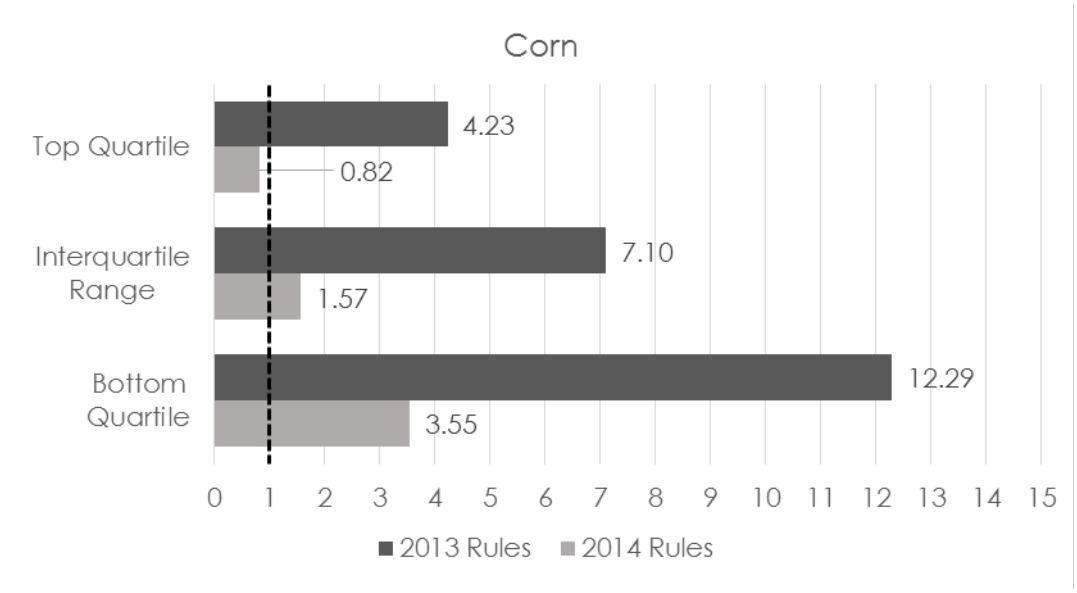
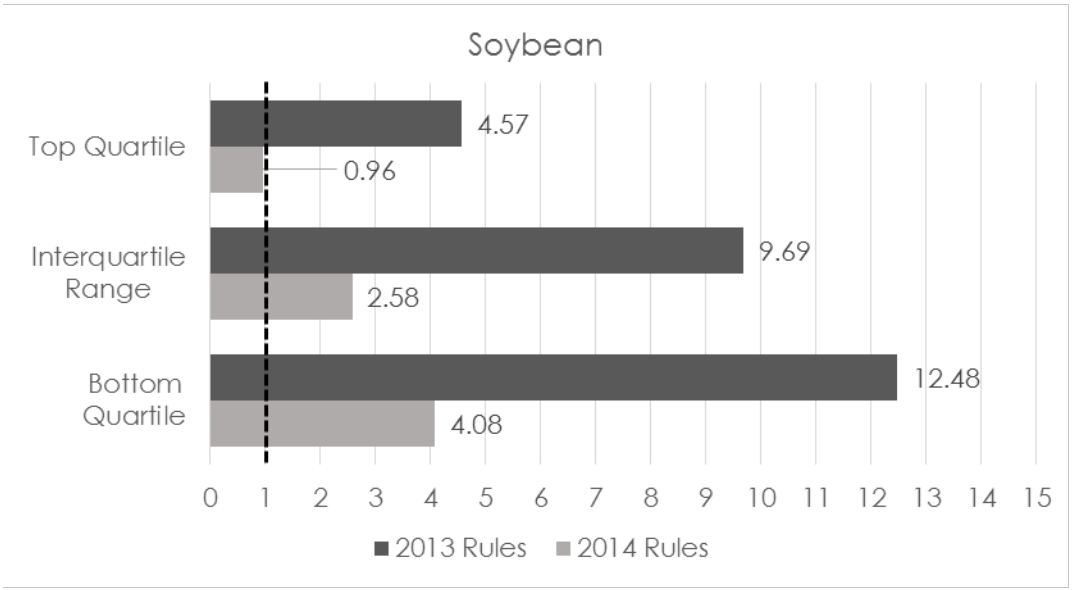


Figure 4. Average farm-level loss ratios for organic soybean crop during first year of revenue protection coverage, by quartile.



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in producer premiums, on average, resulting in a loss ratio of 0.82 for corn and 0.96 for soybean. Under the previous t-yield regime the top quartile of farms experienced loss ratios above 4.0 for both corn and soybean crops, indicating that they could expect to receive much more in indemnities than they paid in premiums. It appears likely that top performing farms, which would have found insurance coverage beneficial before the organic reforms, may be less likely to secure coverage under the new program rules.

Conclusion

Our analysis shows that the reforms made to the organic insurance program for the 2014 crop year significantly decrease the expected return from insurance purchase for newly certified organic farms and that this effect persists for several years. Loss ratios under the previous organic insurance rules, in which organic crops were insured using conventional t-yields, are shown to be much higher than those experienced for the crop insurance program as a whole. The newly implemented organic insurance regulations, which include the issuance of organic specific t-yields for the first time, result in loss ratios largely consistent with program-wide loss ratio averages.

It should be noted however, that the average loss ratios that we present for corn and soybean RP and YP products are based on assumed full participation of the farms in our sample. The size and sign of the average subsidized wedge varies by farm and there is a subset of relatively high yielding farms that would receive positive net indemnities under the previous program design and negative net indemnities under the new program design. If the changes to the crop insurance program result in increased adverse selection issues among organic crop producers, actual future loss ratios are likely to be higher than those predicted here.

Due to a change to the ARPI program in 2014, insured producers are now required to submit yield experience for their crops to RMA, even though the yield guarantees, premium rates, and indemnities depend only on the county expected and final yields, price elections, and the chosen coverage levels. This gives organic crop producers the opportunity to insure under a potentially less expensive area risk option while their yield history accumulates and eventually displaces low county t-yields in their APH calculation. However, we find that the producer's expected return to the purchase of ARPI products is often strongly negative and less attractive on average than the purchase of multi-peril products, even under the new organic t-yield regime. That is, farmers who believe that the organic t-yields are below their true yield expectation are unlikely to find ARPI products to be a good alternative.

The stated plan of RMA with respect to organic crop insurance is to continue to revise organic t-yields and price elections as additional data is gathered. While organic price data are likely to become more abundant and robust, making the improvement of price elections possible, there is a chance that adverse selection and falling participation rates will make the improvement of organic t-yields more difficult. Our analysis leads to three key recommendations for RMA as they seek to expand and improve risk management options for the growing number of organic crop producers.

First, an effort should be made by RMA to adjust the organic t-yields conservatively, keeping in mind the impact that such adjustments can have on program participation. Smith and Glauber (2012) point out that the federal crop insurance program achieved participation rates of roughly 80% not by creating smaller, homogenous risk pools as commercial insurers tend to do but rather by drawing low risk producers into the program with aggressive subsidies. Since high program participation helps to develop data resources and improve the rating of future products,

some value should be placed on program participation at the potential cost of higher indemnity payments. Future research should include a full actuarial analysis of the relative impacts of changes to premium subsidies and yield guarantees on participation in the organic insurance program. This would help determine the least cost method of expanding coverage and achieving sustainable risk pools.

Second, RMA should explore the prospect of using a farm's conventional APH in establishing their organic APH for the same crop. Although this would be a significant departure from current APH calculation methods it would allow the inclusion of much more information about a farm's true expected organic yield than is currently used to establish a new producer's organic APH yield. This concept, of using production history of a different crop or practice to establish an APH of a new crop, has been shown to improve crop insurance rating when the crop yields in question are correlated (Goodwin et al., 2002). There is also evidence that a farm's conventional yield experience is significantly correlated with organic yield outcomes (Delbridge and King, 2014), suggesting that organic crop insurance could be a good application of this novel APH calculation method.

Finally, RMA should re-examine rating procedures and subsidy levels for the ARPI products. These products, which are less costly to administer and are less prone to problems related to moral hazard and fraud should be priced to perform on a par with yield and revenue protection products in order to attract greater farmer participation. A common criticism of area-risk policies is that it is subject to basis risk, meaning that a farm might suffer a loss and not receive and indemnity. However, Barnett et al. (2005) found that for some crops and regions area risk products are at least as effective as risk reduction tools as MPCI products. It seems likely that the lack of popularity of area risk products has more to do with their low producer loss ratios

than with concerns regarding basis risk. Area risk products are particularly appealing for crops or production practices, such as organic production, for which data are scarce and sound rating and accurate t-yields are difficult to set.

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