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Why Do Producers Choose Individual or Area Insurance Protection?

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The Federal Crop Insurance (CI) program has grown to become the centerpiece of the agricultural safety net for crops and currently protects nearly \$80 billion worth of liability. Government spending on crop insurance is now projected to exceed spending on farm commodity programs in future years (Shields, Monke and Schnepf, 2010) (Figure 1). With all farm support programs expected to face tight budget constraints in the upcoming Farm Bill, alternative programs are under examination to reduce spending, simplify programs, and eliminate redundancy. Therefore, it is imperative to examine the interaction of crop insurance and other farm support programs and assess how producers may be affected by emerging Farm Bill proposals for alternative farm support structures.

A key development in the last Farm Bill was the move toward revenue protection as an objective of traditional farm programs. Early proposals for the next Farm Bill have included variations on the role of revenue protection in farm programs, with an emphasis on improved area revenue protection. However, most crop insurance policies sold today provide revenue protection on either a county or individual basis. This situation is raising fundamental questions about the effectiveness for producers of area versus individual revenue protection plans, with such plans used either separately or in combination with one another. Consequently, the focus of this article is on the connection between

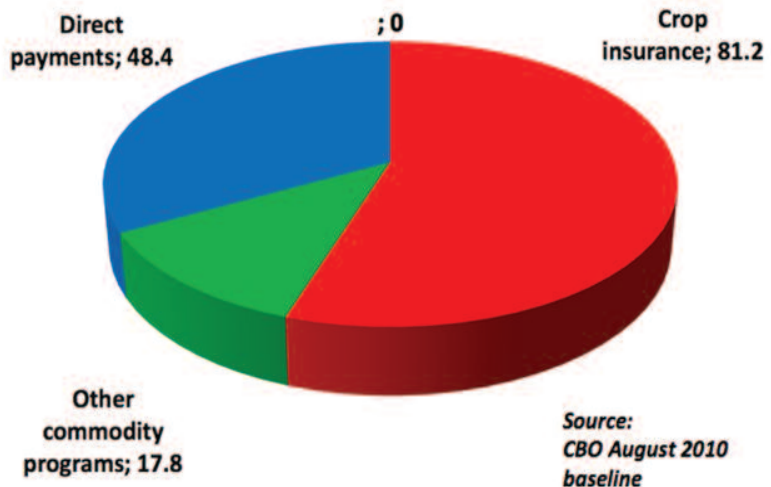
individual and area plans of crop insurance in relation to current and proposed area revenue plans under farm programs. We address this issue by deriving the producer's preference for coverage between area and individual plans using an economic model of producer choice. Related economic literature is first summarized, and then conclusions from the model are presented.

The Evolution of Revenue Protection

One aspect of the ongoing Farm Bill discussion is the relative roles of crop insurance and area revenue programs.

Since the 1990s, farmers have had both individual farm and county-based Revenue Insurance Plans available within the CI program, which protect against revenue shortfalls. The revenue plans currently constitute nearly the 80 percent of total premium (Figure 2). The Food, Conservation, and Energy Act of 2008 (2008 Farm Bill) authorized additional farm programs to protect revenue. One plan, the Supplemental Revenue Assistance Payments Program (SURE), is a whole farm program that supplements CI and the Noninsured Crop Disaster Assistance Program. Payments under SURE are based on individual producer losses spread over

Figure 1. FY2011-2020: Projected Program Costs, \$Bil.



an entire farm. However, the other new plan, Average Crop Revenue Election (ACRE), protects against revenue shortfalls at the state level. Some concerns on possible overlap and duplication of coverages between ACRE and CI have been raised (Zulauf, Schnitkey and Langemier, 2010; Barnaby, 2010).

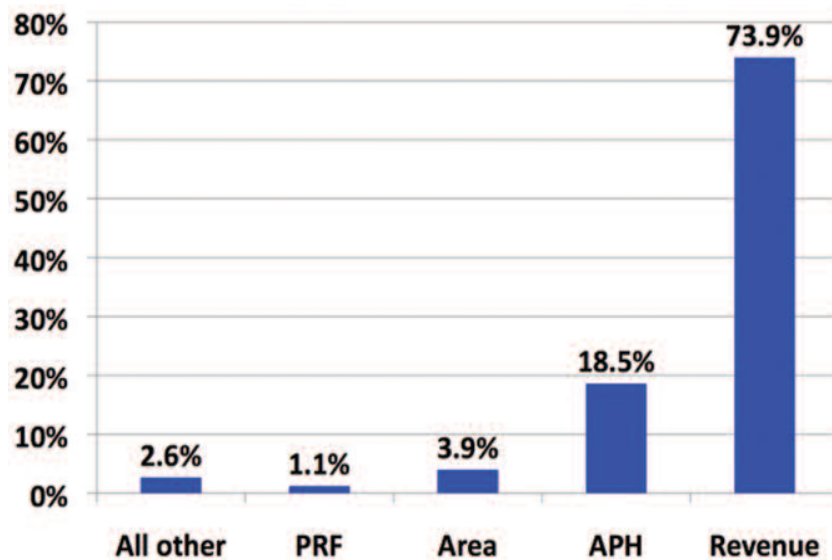
There are also proposals emerging for changing ACRE into a county-level area plan and integrating that with crop insurance (Babcock, 2010). Integrated programs are also known as “wrapped insurance,” where individual insurance works as if “wrapped” around the area program losses. Individual crop insurance would pay the residual amount of farmer’s loss once area payments are netted out (Coble and Barnett, 2008). Similarly, Cooper (2010) includes ACRE payments in the harvest-time premium calculation for CI.

A solid understanding of the interaction of CI with area insurance and related revenue programs and how these options address the risk management needs of producers and affect their participation decisions is essential for a healthy public policy discussion. However, the literature developing the factors behind a producer’s choice of area insurance, such as Miranda (1991) and Mahul (1999), has not taken into account the availability of multiple insurance or farm program alternatives in the analytical modeling.

Developing a Model to Better Understand Producer Choice among Insurance Plans

In order to extend past research on producer choice to better incorporate policy choices that might be considered for the upcoming Farm Bill discussions, we developed a stylized analytical model to assess farmers’ choice of coverage levels from individual and alternative area plans of insurance. The model is flexible to accommodate existing (such as the yield-based Group Risk Plan (GRP) or the revenue-based Group Risk Income Protection (GRIP)) or proposed area plans of insurance (such as county-based ACRE) and farm revenue protection programs (such as ACRE). We combined the two-point distri-

Figure 2. Plans of Insurance: 2010 Premium Share



bution approach (i.e., the farmer faces the prospect a loss with probability P or no loss with probability $(1-P)$) used in the Duncan and Myers (2000) insurance model with the correlation modeling approach (i.e., the individual farm and area losses may be correlated to varying degrees) used in Bulut and Moschini (2006). As in Duncan and Myers, we specify that the farmer’s preference is based on expected income, expected losses and the variance (a measure of variation) of losses (i.e., the farmer has a “mean-variance utility function”) and the farmer pays a premium and chooses coverage levels. To that framework, we introduce area insurance plans and define the joint distribution of individual and area losses where the losses are imperfectly and positively correlated. We then solve a risk-averse farmer’s optimization problem under various insurance plan options.¹ (A copy of the paper describing the model and the study results in detail is available in the AgEcon Search Website: <http://ageconsearch.umn.edu/handle/96307>. Alternatively, it can be requested from the authors.)

We identify the main factors determining the farmer’s coverage demands as: the premium rates, expected farmer’s and area losses, standard deviations of farmer’s and area losses, the correlation between farmer’s and area losses, and the farmer’s degree of risk aversion. Overall, the findings indicate a strong case for individual insurance vis-à-vis area insurance when the premium rates for area and individual plans are actuarially fair (equal to expected indemnities).

The root of the findings is the following: it is known that if insurance is actuarially fair, a risk averse producer will fully insure (100 percent of loss) (Mas-Colell, Whinston, and Green, 1995). Particularly, consider the situation where the farmer will hold coverage from either individual or area insurance (such as the APH yield plan versus the county level GRP yield plan) but not both. Under actuarially fair premium rates for either insurance plan, the farmer’s expected income is initial income minus the expected loss. The farmer can minimize the variance of income to zero by choosing full coverage

¹ For instance, a producer i is assumed to have a preference function for individual and area coverage specified as $U_i = M - \pi_x x - \pi_y y - \hat{l}_i - 0.5\lambda\hat{\sigma}_i^2$ where U_i denotes utility or satisfaction level, M : the farmer’s initial income, π_x : premium per unit of individual insurance coverage level, x : individual coverage level, π_y : premium per unit of area insurance coverage level, y : area coverage level, \hat{l}_i : the farmer’s expected loss with coverage, λ : risk aversion parameter, $\hat{\sigma}_i^2$: variance of the farmer’s expected loss with coverage.

Then, the farmer’s problem is to find the utility maximizing levels of coverage demands with individual and area plans given premium rates and other parameters such as probability of individual loss, probability of area loss, and correlation level.

Table 1. Possible Payment Outcomes for Individual and Area Insurance

	Area With a Loss	Area Without a Loss
Farmer With a Loss	Farmer is Paid	Farmer is Not Paid
Farmer Without a Loss	Farmer is Paid	Farmer is Not Paid

with individual insurance. On the other hand, the farmer cannot minimize the variance of income to zero with area insurance, unless the producer's loss and area loss are perfectly correlated as demonstrated in Table 1.

The table indicates that the farmer will be paid whenever area has a loss. But, the probability that the area will have a loss may not be necessarily equal the probabili-

ty that the producer will have a loss, unless the losses are perfectly correlated, which is highly unlikely. Therefore, an area plan is a more risky choice relative to an individual plan, and the risk averse farmer would prefer individual insurance.

The analysis may help evaluate the effectiveness of proposed county-level area revenue plans from a pure risk management perspective. The findings also help

explain the generally low level of participation in the ACRE program (see Figure 3) and in county-level insurance plans, such as GRP or GRIP (see Figure 4). Before presenting some of our initial conclusions on our modeling approach, it is instructive to examine recent economic research on the relative effectiveness of individual and area coverage.

Recent Research Findings on Farmers' Preference for Area Insurance

A number of recent studies have analyzed the existing and proposed area plans of insurance and their interaction with crop insurance.

Regarding GRP or GRIP, Barnett, Black and Skees (2005) find that GRP can be viable alternative to MPCY yield plan at least in some crops and regions despite the basis risk inherent in GRP. Basis risk refers to the possibility that a producer would not be indemnified for the producer's actual loss. Based on an analysis for cotton and soybean production in Georgia and South Carolina, Deng, Barnett, and Vedenov (2007) find that GRP yield insurance may be a viable alternative to MPCY yield insurance (even in heterogeneous regions) if the rates for farm-level insurance are overpriced, therefore not fair, while the GRP rates are fair. More recently Chaffin (2009) examined the farmer's choice between insurance plans that trigger at the farm or county level in a simulation study, which included GRP, GRIP, GRIP with Harvest Price Option (HPO) along with the APH individual yield plan and the individual revenue plans, Revenue Assurance (RA) and RA with HPO. The study identifies the factors determining optimal insurance plan choice as the correlation between county yield and farm yield and whether the farm is spatially diverse in a given county. Unless the correlation coefficient is above 0.9 and the farm is spatially diverse, the study recommends serious caution in choosing a county plan.

Regarding ACRE, Zulauf, Dicks, and Vitale (2008); Zulauf (2009); Zulauf, Schnitkey and Langemier (2010); Paulson, Schnitkey and Zulauf (2009); Schnitkey and

Figure 3. 2009 ACRE Enrolled Base Acres as a % of Total Base

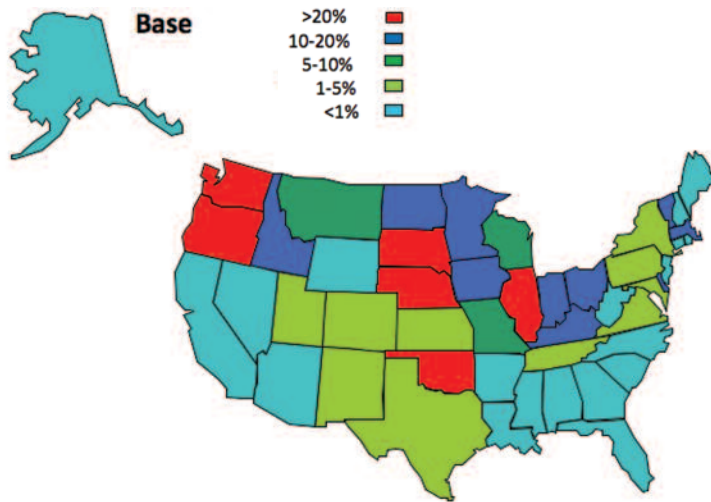
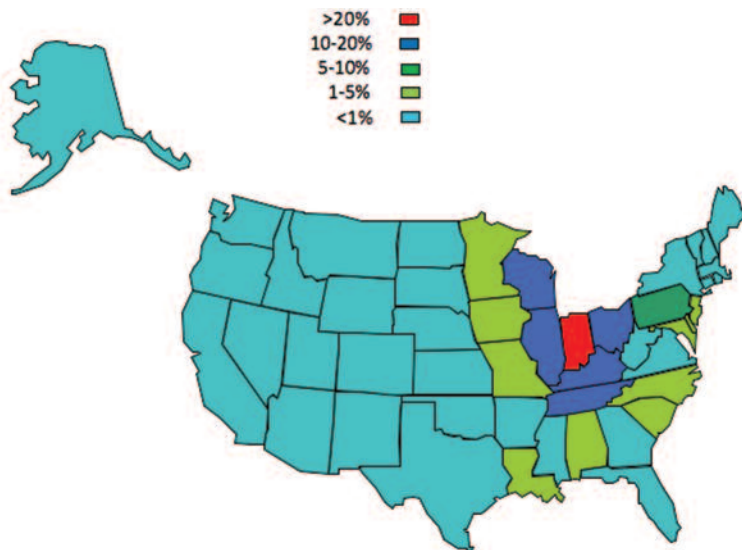


Figure 4. 2009 GRIP/GRP: Insured Acres as a % of Total Insured Acres





Paulson (2009) and Paulson (2009) tend to view ACRE and Revenue CI working more as complements rather than substitutes and recommend that farmers participate in ACRE and purchase CI. The crop insurance premium paid by the producer is added to the farm-level ACRE guarantee, increasing the probability of a payment and giving an extra incentive for farmers to sign up. However, ACRE may provide incentives to reduce CI coverage levels and use yield insurance rather than revenue insurance (Paulson, Schnitkey and Zulauf, 2009).

Zulauf, Dicks, and Vitale (2008) and Zulauf, Schnitkey and Langemier (2010) argue that ACRE would allow farmers to better adjust to possible declining prices and would be effective for large declines in prices that last longer than one year. ACRE may address price risk across years via the 10 percent cap and cup on the state guarantee and also by the use of the moving average of past prices, whereas CI protects against price risks only up to the harvest time in the current production year. Under the assumption of a stable demand for a commodity, if productivity gains are higher than input cost increases, commodity production would expand and equilibrium

prices would fall, which would lead to lower base prices and lower guarantees. However, a lower guarantee might not cover the increase in production cost, which has tended to increase in recent years.

The preceding argument in Zulauf, Dicks, and Vitale (2008) and Zulauf, Schnitkey and Langemier (2010) has the following limitations. The stable demand assumption in these studies can be called into question. Rising global food and fiber demand, the recent approval of higher ethanol blend levels in the U.S. and recent supply shortages in the world market seem to indicate that stocks may remain tight for major crops, which would tend to limit price declines. It is also not clear why productivity gains may increase faster than input cost increases during the life of the next Farm Bill. Furthermore, if prices were to increase sharply over time, CI revenue plans would respond more quickly and appropriately than ACRE. Based on a historical analysis covering 31 years from 1977 to 2007, Schnitkey and Paulson (2009) report that 18 out of 31 times the year-over-year increase in the state guarantee is capped at 10 percent.

They do not report on the frequency of which the state guarantee is capped. Given the rising prices and increasing volatility in the last decade, it seems reasonable to think that the state guarantee would be capped at least as often in the future as in the past.

Somewhat contrary to the aforementioned studies, Hong, Power and Vedenov (2009) find that a representative farmer in representative counties in Midwestern and Southern regions prefers Crop Revenue Coverage (CRC) revenue insurance over the combination of ACRE and CRC. This preference is more pronounced for cotton production in Hockley County (irrigated) and Hale County (non-irrigated) in Texas (where yield risk is high and yield and price are not highly correlated) relative to corn production in Piatt County in Illinois. In the latter county, the CRC option is only slightly preferred to the ACRE and CRC option.

Even though ACRE is optional for all eligible farmers and farmers do not directly pay for ACRE, selection of ACRE has an implicit premium as farmers must give up 20 percent of their direct payment and their entire price-based countercyclical payment, along with a 30 percent reduction to their marketing loan rate. This implicit premium does not change with the risk associated with ACRE, and is not based on actuarial or underwriting considerations (Barnaby, 2010). If the implicit premium may be mispriced, this may encourage or discourage participation in ACRE depending on the producer's risk of loss. In addition, the multiyear commitment for participation in ACRE and the program complexity may have curtailed participation levels. Overall, participation in ACRE has been low and rather selective by crop and region (Barnett, 2010). Specifically, nearly 13 percent of all eligible acres nationwide enrolled in ACRE in 2009; corn and soybeans have about 15 percent enrolled; wheat is 13 percent; rice and cotton are zero percent. About 25 percent of corn acres in Illinois, Nebraska, and South Dakota corn are enrolled in ACRE, while Iowa and Indiana are about 16 percent. (see also Figure 3). Barnaby

Table 2. The Producer's Coverage Choices for Individual and Area Insurance

Coverage Choice: Individual and Area Coverage are separate plans (Producer may buy one or both)
 (Assumes losses under individual and area plans are less than perfectly correlated)

Premium Rate Level	Individual Coverage Choice	Area Coverage Choice	Combined Individual and Area Coverage Choice
Individual = Fair Area = Fair	100%	0%	Individual = 100%
Individual = Fair Area = Free	<100%	>0%	Individual + Area may >100%

Coverage Choice: Individual and Area Coverage are Intergrated
 (Individual Plan pays the remainder of loss after the Area Plan pays)
 (Assumes losses under Individual and Area Plans are less than perfectly correlated)

Premium Rate Level	Individual Coverage Choice	Area Coverage Choice	Combined Individual and Area Coverage Choice
Individual = Fair Area = Fair	100%	0%	Individual = 100%
Individual = Fair Area = Free	>100%	>0%	Individual + Area >100%

(2010) points out that risk management was probably not the main reason for wheat (especially winter wheat) producers selecting ACRE as they had the information to adversely select on ACRE. Unlike the CI guarantee based on futures prices, the ACRE guarantee is calculated based on a moving average of past prices, which may not reflect current market conditions, and may distort farmers' planting decisions (Babcock, 2009).

Simulation studies such as Dismukes, Arriola, and Coble (2010) and Cooper (2010) find that ACRE tends to pay more in areas with high expected yield and low yield variability. ACRE is also ineffective in covering a farm's idiosyncratic risk-those uncorrelated with widespread losses.

Findings from Our Analysis

Using our stylized model of coverage level choice with area and individual insurance, we do not find any support for the purchase of area plans when the premium rates for area and individual plans are fair and the producer has to choose between individual and area plans (such as the APH individual yield plan versus the county-level GRP yield plan). Instead, the farmer would fully insure with individual insurance. The findings on the coverage choices (conditional on the premium rates) with area and individual plans when

these plans are separate (yet the farmer can hold coverage from both individual and area insurance) or integrated are summarized in Table 2.

We also looked at a situation in which the producer could insure using both an individual and an area plan, similar to a producer being able to participate in a plan such as ACRE. If the individual and area losses are positively but not perfectly correlated and premium rates are fair, our model indicates the farmer will fully insure with individual insurance and demand no area coverage. However, if the premium rate on the area plan is not fair (under-priced), then individual insurance and the area plan are substitutes, and the demand for area insurance will be influenced by the correlation level between the individual and area losses. For example, if area insurance is free and the individual plans are charged at the fair rate, the farmer has an increasing incentive to substitute more area insurance for individual insurance as the correlation increases. Our analysis suggests the farmer may even want to over-insure given the availability of free area insurance and the flexibility of being able to choose coverage levels with the area plan. (Note that the coverage level, or state revenue guarantee, with ACRE is set at the 90 percent of the state benchmark revenue. Farmers cannot choose their

coverage with ACRE as they do with individual crop insurance where the maximum coverage level is 85 percent.)

Appeal and Potential Role of Area Plans

GRP and GRIP will likely continue to serve as useful insurance products for a limited area of the country where farms are more homogeneous in their response to natural disasters. However, the increased farm premium subsidies for enterprise units appear to be cutting into the market share for these products. Proposals such as moving ACRE closer to the farm-level coverage in the form of a county-level revenue guarantee presumably hope to gain from higher correlation levels of losses between the county and the average farm relative to those between the state and the average farm. Regarding the actual levels of the correlation by county, we are unaware of comprehensive U.S. estimates of farm and county yield, loss, or revenue correlations based on individual farm data.

Coble, Dismukes, and Thomas (2007) report simulated national average yield correlations between county and farm of 0.89 for corn, 0.87 for soybeans, and 0.89 for cotton, high enough to suggest some potential attractiveness for county plans. However, caution is warranted with these numbers as the national average revenue correlations between farm and state report-

ed in the same study, which are 0.74 for corn, 0.72 for soybeans and 0.746 for cotton, are higher than those recently reported in Dismukes, Arriola, and Coble (2010). The latter study reports that the U.S. average farm-state revenue correlations are 0.55 for corn, 0.54 for soybeans and 0.39 for cotton.

Barnett, Black and Skees (2005) report estimated average correlations between farm and county yields for corn in 10 states using individual farm data on nearly 67,000 farms during 1985-1994. Their correlations varied widely; they were generally high in the heart of the corn belt, ranging from 0.71 in Ohio to 0.82 in Illinois, but fell to 0.49 in Texas and 0.36 in Michigan. These wide correlation differences across regions suggest that county area plans are likely to be of widely differing risk reduction value to producers in various regions. Large divergences in value complicate the determination of an appropriate implicit premium for any foregone farm program payments if the current ACRE program is shifted to a county revenue guarantee.

Furthermore, a county-based ACRE program would face significant operational hurdles. There are already separate county CI programs with explicit premiums, such as GRP and GRIP. The experience with these programs has pointed out significant problems with the availability of reliable county yield estimates from the National Agricultural Statistics Service (NASS), which RMA uses as a basis for the GRP and GRIP programs. RMA discontinued GRP/GRIP programs in 1,062 counties in 2010, which included counties producing corn, soybeans, grain sorghum, and peanuts, because the revised standards introduced by NASS resulted in fewer but more reliable county estimates. Moreover, the Farm Service Agency and NASS would face substantial additional workloads if ACRE were to be restructured to operate on county-level data, and both agencies already operate under limited funding and staff.

County-based ACRE proposals seem to overlook the fact that farmers have had little demand for GRP and GRIP in many regions of the country, as these plans accounted for less than four percent of the total MPCPI program premium in 2010. This is consistent with our finding of a strong preference to hold individual insurance and fully insure

when rates are fair. Integrating a county-based ACRE plan with crop insurance can lead to program savings through elimination of duplication of payments. Nevertheless, our findings further indicate that the county-based plan integrated with an individual policy, such as a county ACRE plan, will be desired by the farmer only if it is underpriced and the farmer can over insure, that is, the farmer would want to hold more coverage in total than what is necessary to pay the farmer's entire loss.

Conclusion

Our findings confirm that crop insurance is best suited for providing individual risk protection tailored to the risks and characteristics of individual farmers' operations. We conclude that farm programs

should not be redesigned to function as area plans which would be intended to overlap or substitute for crop insurance. Farm programs can be compatible with crop insurance—they can do what crop insurance does not, such as enhancing income, if that is the policy choice, or partially compensating for crop insurance deductibles. However, it does not seem prudent to try to displace crop insurance with a low cost or free farm program with limited coverage options and, presumably, payment limitations. Instead, crop insurance, as a dynamic, self-correcting, and evolving program of individual risk protection that is partly funded through producer-paid premiums, should be strengthened to enhance its position as the key long-term tool for agricultural risk management.

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