Managing Yield Risk through a Cooperative

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Introduction

Recent legislative changes have increased the emphasis on agricultural risk management and new product development. The most recent legislation increased federal crop insurance subsidies to 59% for certain coverage levels. As a result of such subsidies, crop and revenue insurance use has increased dramatically in the past ten years. Some crops have participation that exceeds 80 percent of the eligible acres. The cost to the taxpayer for subsidized crop and revenue insurance has more than doubled in the past few years: from an expected cost of $1.5 billion in 1995 to over $3.0 billion today. Further, policymakers are now stating that every significant agriculture commodity will be eligible for some form of federally subsidized crop insurance in the near future. This will clearly neither be an easy nor low-cost objective to obtain.

Among the more salient challenges the federal crop insurance program faces is designing products that achieve equitable risk management for all producers at relatively low cost to the taxpayer. This issue is a particular problem for many of the specialty crops, as they are the most difficult to insure. For example, within this category of commodities, yield risk is often more related to management than to uncontrolled factors such as weather. Thus, the likelihood of moral hazard and adverse selection is greatly increased, creating conditions where the benefits of the insurance program could be greatly skewed toward growers who are poor managers. Controlling adverse selection and moral hazard requires substantial farm-level information and monitoring, which is often costly to obtain. Additionally, creating a new crop insurance program usually requires substantial farm-level historic yield data, which is often difficult and costly to obtain for specialty crops.

This paper investigates a new delivery mechanism for an alternative insurance product designed to manage vegetable yield risk. The combination should be more cost effective to both producers and taxpayers while also being more successful at managing yield risk. In particular, the use of an area yield insurance mechanism by a vegetable cooperative is analyzed. Hypothetically, this structure protects the throughput risk for the cooperative. It also creates a type of reinsurance that allows the cooperative to become a mutual insurer, offering farmers individual yield insurance.

Background on Crop Insurance

To understand why programs offering more efficient crop insurance are needed, it is necessary to discuss the inefficiencies of the current crop insurance program. Crop insurance is sold to individual farmers as protection against lower than average yields (farmers can of course also purchase catastrophic coverage to protect against damage from extreme weather events as hail and flood, but that type of protection is not the focus of this discussion). An average farm yield is calculated from the producer's Actual Production History (APH), 4 to 10 years of yield data. Yield levels can now be insured for up to 85 percent of that average. Further, farmers can obtain different crop insurance policies on the same crop by subdividing their farms into enterprise units. This offers opportunities to increase the whole farm coverage level.

Benefits for crop insurance have been skewed for some time. Glauber, Harwood, and Skees found that a small percentage of policies collect a significant portion of the losses. For example, only 1.4 percent of the soybean policies collected 41.3 percent of excess losses during the period 1983-90. Much of these inequities were a result of serious adverse selection and moral hazard during this time period. Farmers always know more about their yield potential and risk than anyone from the outside (either the government or a private insurer). Such asymmetric information creates the dual problems of adverse selection and moral hazard.

Adverse selection occurs when there are problems in classifying the risk of potential purchasers. In the federal crop insurance program, farmers are required to have records to back up their reported historic yields. It is not uncommon for them or the agents who sell to them to conveniently "lose" some historical yields to make the offer yield higher. Further, as few as four years of records can be used to set the average yield for the contract. Obviously, significant measurement error can exist with such a limited number of observations. Thus, the program creates an environment that fosters an unbiased selection of producers; producers with the highest risk will be the most motivated to purchase the insurance. Moral hazard arises when farmers who are insured change their behavior in ways that increase the chances of loss beyond the insurance contract terms. For example, farmers may provide their APH from acreage with good soil and then also plant more marginal acreage once they purchase insurance.

Because of rating reforms instituted in the early 1990s, such abuse is considerably less of a problem today. However, the unbalanced nature of the benefits remains a problem and some fraud also exists because it is not difficult to misrepresent realized yields. Adding subsidies may bring lower risk farmers into the risk pool and ease some of the actuarial problems. Yet, those who have been abusing the program will remain the primary beneficiaries of more subsidies. Controlling adverse selection and moral hazard requires more reliable farm-level information. Obtaining such information is costly, especially with commodities grown on small acreage (i.e., vegetables) or grown by a few farmers in a particular area. Information costs will also be greater when a new crop is being insured; one that does not have yield data previously collected and organized into databases.

The federal crop insurance program is a public-private partnership where private companies sell and service crop insurance and also share in the risk. Private companies are reimbursed for selling and servicing policies to farmers at 24.5 percent of unsubsidized premiums. In other words, for every $100 premium sold, the insurance company receives $24.50 from taxpayers to cover delivery expenses. The percentage is fixed by statute and bears little relationship to the actual costs faced by companies. While the aggregate national cost to crop insurance companies may be close to the fixed percentage, the costs of selling and servicing crop insurance vary greatly from one area of the country to the other. Some companies may be getting reimbursed for costs they have not actually borne. Further, the fixed percentage means that companies are often unwilling to bear the extra costs associated with obtaining sufficient farm-level information. Clearly there is an incentive for companies to minimize their expenses.

Using Agricultural Cooperatives to Deliver Federal Crop Insurance

The use of agricultural cooperatives, instead of private insurance companies, to deliver federal crop insurance could help diminish some of the inefficiencies discussed above. As outlined in Black, Barnett, and Hu, the cooperative could develop an index that reflects yield levels for the entire membership or an appropriate sub-group (distinguished by geography and/or commodity). The government could then sell the cooperative an area-yield insurance product structured like the Group Risk Plan (Skees, Black, and Barnett). However, rather than paying for yield losses triggered by county yield levels, the government would make payments for losses triggered by index yield levels. The index accounts for the systemic risk, leaving only the independent, basis risk of individual grower-members. The cooperative could thus act like a mutual insurer that handles basis risk and offer some wrap-around-insurance protection to individual members (Zeuli and Skees). The farmer-members would thus be completely covered: (1) the area yield insurance policy would cover systemic losses; and (2) tailored products offered by the co-op would cover any residual losses the individual may suffer independently of the group.

This scheme could offer several advantages over the current federal crop insurance program, especially for new specialty crops. First, it should increase the cost efficiency of crop insurance delivery. Since cooperatives typically keep yield records of their members, fairly reliable APH data should be easily (and at relatively no cost) obtained. Second, moral hazard and adverse selection should be diminished. Since the growers collectively own the cooperative, and share annual profits, they will have less incentive to abuse the insurance program. They will also have more incentive to monitor other members, to ensure others do not abuse the system.

An Empirical Example

To illustrate the concepts and potential benefits of this cooperative insurance scheme, data was gathered from a central Kentucky vegetable marketing cooperative. The cooperative, established in 1969, currently handles four types of vegetables: cabbage, tomatoes, green peppers and red peppers (it recently added pumpkins, but that represents a small percentage of revenues and thus will be ignored). It has 176 members growing products on a combined 493 acres in 10-15 counties. Most members, however, farm in one of four counties. The cooperative has two receiving and packing plants in Kentucky, representing two primary geographical areas. For simplicity, and anonymity, these two areas will be referred to as north and south. Yield, acreage, and revenue data (aggregate and split among the two plants) from 1974-2000 was obtained for the four commodities. Individual farm level data was obtained for the years 1990-2000.

Figures 1 and 2 illustrate trends in yield per acre for tomatoes and cabbage based on the aggregate cooperative data. Yields were detrended using the following formula:

(1.0) Detrended yield = (actual yield / trend yield) * 2000 trend yield

An area yield contract was constructed with a strike or trigger yield set at 90 percent of the expected trended yield. As explained in Skees, Black and Barnett, this type of contract pays on a proportional basis. The yield shortfall percentage is a straightforward calculation:

(2.0) Yield shortfall percentage = (trigger yield – actual yield) / trigger yield

If the actual, or realized yield, exceeds the trigger yield, no payment would be made to the farmer. The yield shortfall percentage series is presented in table 1. It is noteworthy that the vegetable yields are generally not correlated (a product of diverse agronomic needs). Nonetheless, a few years stand out as being poor for all crops. For example, in 1983, all vegetables had yields below the trigger yield. A similar pattern is reflected in 1988 and 1998; all three were drought years.

Premium rates can be calculated from the trended yield data by simply creating a series of trigger yields (given expected yields) and making the percentage calculations for each year in the series. The simple average of the series of yield shortfall percentages gives the pure premium rate for the time period:

(3.0) Pure premium rate = sum of yield shortfall percentages / number of years

Actual premiums paid would be determined by the cash value of the liability that is selected (Miranda; Skees, Black and Barnett):

(4.0) Premium payment = pure premium rate * liability

Indemnity payments are the product of liability and yield shortfall percentage:

(5.0) Indemnity payment = liability * yield shortfall percentage

Over recent years, the prices paid to cooperative members have been relatively stable. Thus, the price level for each commodity is a fixed average of the past three years, as reported in table 2. The acreage is also fixed using the average of the past three years. Yields in table 2 reflect the trended yields from 1974-2000. The relative share of the total cooperative's revenue each commodity holds is also presented in table 2. Tomatoes are the greatest revenue source, followed by red peppers, cabbage, and green peppers.

Using the detrended yields and fixed average acreage and price data (reported in table 2), a revenue series was calculated for 1974-2000. A comparison of the relative risk with an area yield insurance contract and without such a contract was then developed. A time series of revenue with insurance was calculated by taking the revenue without insurance, subtracting premium payments and then adding indemnity payments for each year. Since a pure premium rate is assumed, on average the revenue with and without insurance will be equal. The variance or standard deviation, however, will be lower with the insurance. To normalize the risk and allow one to make comparisons, the coefficient of variation is used.

As shown in table 3, the relative risk for tomatoes decreases from 18.3% without insurance to 11.1% with insurance, a 39% reduction. When the total crop mix is evaluated, the relative risk (15.3%) is much lower than any single crop's relative risk. If each of the commodities had area yield policy coverage, then the total crop mix relative risk drops to 9.8%. As shown in figure 3, revenue variance also clearly (although not substantially) decreases with area insurance.

If the co-op could obtain more disaggregate area yield insurance for sub groups of growers, for example for each group of members delivering to the two receiving plants (north and south), the relative risk decline with insurance would be even greater. It is a common statistical property that variance of yields will decline as yields are aggregated. Thus, disaggregating the groups of farmers will increase variance and relative yield risk. This also means higher premiums for the same coverage levels (90% coverage for our examples). Since premium subsidies are set as a percent of total premium, there are subsidy advantages to disaggregating the groups to the extent practical.

Conclusion

The results of this analysis suggest that producers of specialty crops could benefit from an insurance program that offers area-yield insurance through a farmer-owned cooperative. Taxpayers would also benefit from the lower cost. The insurance contract would be more transparent, more accessible, and less likely to be subject to moral hazard and adverse selection than traditional crop insurance programs. Clearly, however, more analysis needs to be done. The next step is to analyze farm-level yields and benefits from a slightly more complicated scheme that involves some additional wrap-around-insurance product delivered by the cooperative.

References

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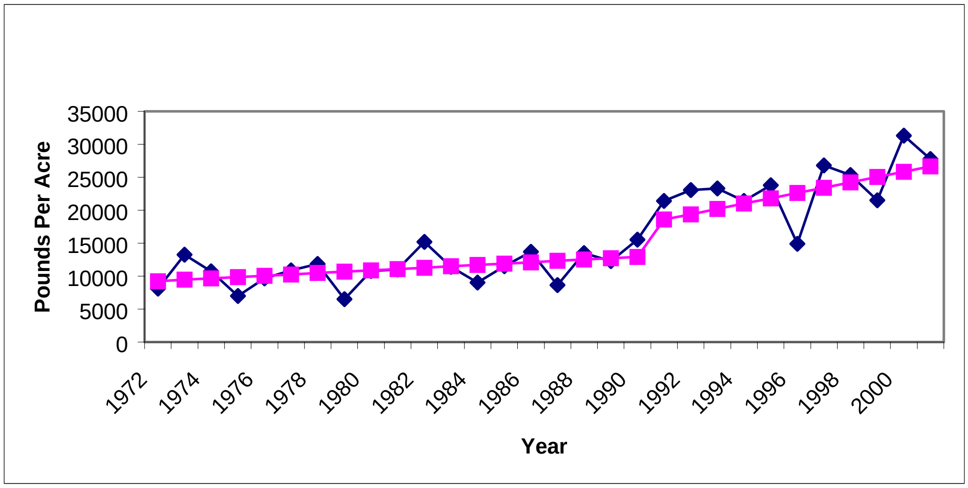

Figure 1. Tomato Yield Trends: 1971-2000

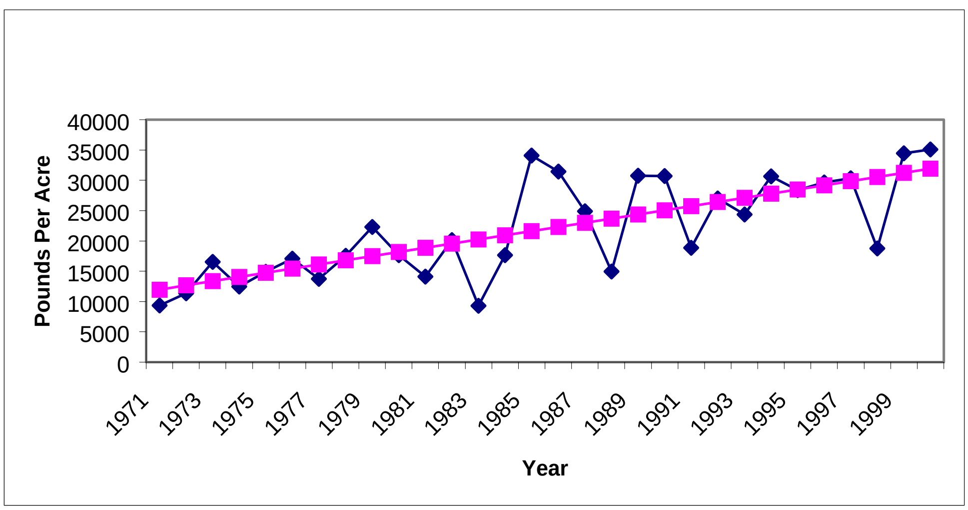

Figure 2. Cabbage Yield Trends: 1971-2000

Table 1. Cooperative Yield Shortfall Percentages by Year				
Year	Cabbage	Tomato	Green Peppers	Red Peppers
1974	1%	22%	1%	0%
1975	0%	0%	5%	0%
1976	0%	0%	0%	0%
1977	5%	0%	12%	31%
1978	0%	33%	0%	0%
1979	0%	0%	0%	0%
1980	0%	0%	38%	20%
1981	17%	0%	0%	6%
1982	0%	0%	0%	0%
1983	49%	15%	26%	26%
1984	6%	0%	0%	0%
1985	0%	0%	0%	0%
1986	0%	23%	0%	0%
1987	0%	0%	41%	51%
1988	30%	0%	71%	7%
1989	0%	0%	3%	19%
1990	0%	0%	1%	0%
1991	19%	0%	0%	0%
1992	0%	0%	10%	19%
1993	0%	0%	0%	21%
1994	0%	0%	0%	0%
1995	0%	27%	0%	35%
1996	0%	0%	36%	0%
1997	0%	0%	62%	0%
1998	32%	5%	0%	22%
1999	0%	0%	35%	14%
2000	0%	0%	0%	0%
Pure Premium	5.9%	4.6%	12.6%	10.0%

Table 2: Cooperative Commodity Portfolio					
	Acres	**Price**	**Yield**	**Revenue**	**Share**
Tomato	92	$ 0.234	26,640	$ 573,506	57%
Cabbage	77	$ 0.048	32,000	$ 118,272	12%
G. Pepper	36	$ 0.209	11,140	$ 83,817	8%
R. Pepper	151	$ 0.135	11,450	$ 233,408	23%

Table 3. Relative Risk by Crop					
	Revenue	**Standard Deviation (W/O)** [a]	**Coefficient of Variation (W/O)**[a]	**Standard Deviation (With)**[b]	**Coefficient of Variation (With)**[b]
Tomato	$577,343	$105,692	18.3%	$64,360	11.1%
Cabbage	$118,174	$28,647	24.2%	$19,589	16.6%
G. Pepper	$84,106	$34,289	40.8%	$23,159	27.5%
R. Pepper	$237,019	$82,139	34.7%	$60,269	25.4%
Total Mix	$1,016,642	$155,412	15.3%	$99,668	9.8%

a. "W/O" denotes without area-yield insurance.
b. "With" denotes with area-yield insurance.

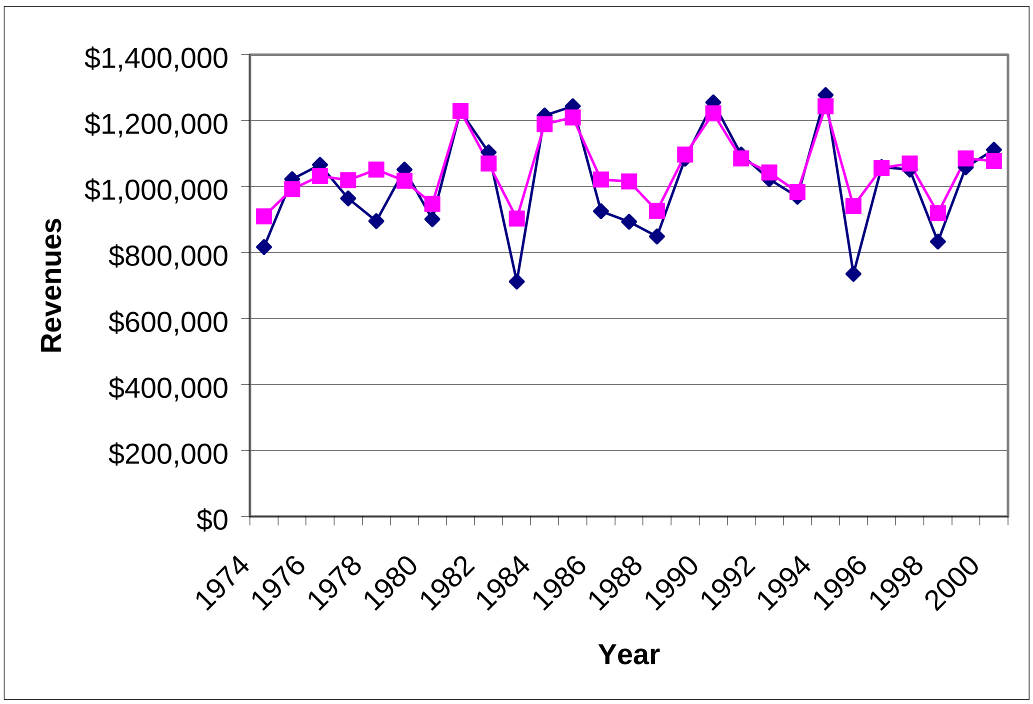

Figure 3. Revenues With and Without Area-Yield Insurance