Module 11

Assessing Alternative Yield and Price Risk Management Tools For Corn and Soybeans

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Topics

Introduction

One fascinating aspect of recent years was the way the futures markets for corn and soybeans responded to weather patterns throughout the Corn Belt. On days when drought concerns reduced expected yields by a half percent, the futures markets would rally by 10 cents or more. When the rains came, the futures prices would fall. On most days and for most producers, there was good news AND bad news, seldom did the farmer get rain AND see the futures market rise.

The degree to which prices and yields are related is usually measured by the correlation coefficient. A correlation coefficient of –1.0 means that if yield turns out to be less than expected, price will ALWAYS be greater than expected. Conversely, a correlation coefficient of 0.0 means that if yields are greater than expected, then there is a 50% chance that prices will be greater than expected and a 50% chance that prices will be less than expected. That is, there is no relationship between yields and prices.

Areas where a large share of total production of a crop is grown will typically have stronger correlations than areas where a small share of production is grown. Correlation coefficients are as high as -0.7 for some counties in Iowa and Central Illinois. This high degree of correlation means that there is about an 80% chance that prices will be greater than predicted at planting time. Or when yields are good, there is an 80% chance that prices will be low.

A strongly negative yield-price relationship is beneficial to farmers because it tends to lower their income risk. Higher than expected prices tend to offset lower than expected yields, and lower than expected prices are typically offset by high yields. A strongly negative relationship between prices and yields is also important because it makes forward sales a very risky proposition. Suppose for example, you forward contract 100% of expected production and then suffer a yield shortfall. Not only will you have to buy grain to meet your contractual commitments, but you can be pretty sure that the grain you have to buy is expensive.

In an earlier lesson (**Module 5**) **Hilker**, **Baldwin**, and **Black** introduced the concept of a revenue distribution. Here we expand on this discussion by incorporating a negative price yield correlation and then use the resulting distribution to compare alternative risk management tools.

The ideal risk management tool would cost a small amount, reduce the chances of low net returns, and not sacrifice upside potential. But, of course, farmers often have to make tradeoffs between these characteristics. Some tools cost very little, but offer little downside protection when crop yields or prices are low. Others may offer downside protection, but they limit upside gains, and they may cost a lot. How can a farmer determine which tool is best suited for his or her farm operation?

One way to compare risk management tools is to answer a lot of "what if" questions. What if we get the low yields AND low prices? What if we get good yields and low prices? etc. The problem with the "what if" method is that some scenarios are much more likely than others. For example, Iowa soybean producers seldom see high prices and high yields, or low prices and LOW yields.

In this lesson we assign realistic probabilities to a set of price yield outcomes for a soybean farmer in Hamilton County. To do this we used the CBOT estimate of the distribution of prices, and USDA data to calculate the likely yield distribution. Then we combined the price and yield distributions so that prices and yields interact as they have in recent years (i.e., we impose a negative correlation).

To understand what comes next, recall the movie "Groundhog Day" in which an unfortunate individual was forced to relive the same day over and over again. What we have done is to assume that this producer lives through the 1997 crop year 5,000 times but with a different price and weather pattern each time. Now that we know what happened to yields and prices we can see how the various risk management tools perform for each of the 5,000 replications. This producer is most interested in per acre revenue (which must be more than $220 per acre if he is to remain in business) so we have shown how the strategies influence revenue. We used an expected local soybean price of $6.75 and an expected yield (APH yield) of 44 bu. per acre to center our distributions. The $6.75 was the November futures price of soybeans in March of 1997, adjusted for local basis.

Figure 1 shows what revenues look like if no risk management tool is used. In most of the applications the price and yield we picked caused revenues to be between $250 and $350 per acre. However, there are times when either price, or yields (or both) are low enough to cause revenues to dip below $220. This happened about 15% of the time, which means that there is a 15% chance that this producer will have a very bad year per acre. Notice also that there is a small (about 5%) chance that revenues will be below $150. Offsetting these low risk scenarios are the 5% or so of years when revenues will be greater than $450. These great years occur when this producer has a good yield - say 50 bu. per acre, and when local prices exceed $9.00 per acre.

Now let's assume that the farmer buys crop insurance (**Figure 2**). This means that when yields are below the deductible, the farmer is compensated via insurance premiums. The effect of this insurance is to greatly reduce the chances of a very bad year; therefore, crop insurance works to stabilize revenues. However, there are years when prices are low, and yields are also low, but not so low as to trigger crop insurance payments. Thus in about 5%

of the draws, revenues are less than $220. Therefore crop insurance does not provide all of the desired protection, because it does nothing to protect against low prices.

Figure 3 shows how using the futures market to establish a short hedge influences the revenue distribution. Curiously this tool is of little use to this producer because much of the producer's risk comes from yield changes. Also the futures hedge actually increases risk. This occurs because when yields are low, and he has contracted to deliver more soybeans than he actually owns, prices are usually high. In these years, the losses on the futures market will be greater than any benefits he secures from high cash prices.

One sure way of reducing risk is to buy crop insurance and put options. **Figure 4** shows how successful this strategy can be. There are no observations below $220. However, this strategy is also very expensive and would cost more than $20/per acre (a cost that is not reflected in the histogram). One reason that the put option/yield insurance strategy is so expensive is that there can be years when prices fall and yields are good and vice versa. In these years the put option or yield insurance will pay off - even though revenues are at or above the target level. This is known as over-insurance.

Recently two new instruments became available that have reduced risk as well as the put option/crop insurance strategy but which eliminate the over-insurance. One of these is called Crop Revenue Coverage (CRC) which is now available throughout the Corn Belt and the other is Revenue Assurance (RA) which should be available in much of Corn Belt in 1999. These have an almost identical effect on the shape of the distribution as the put option/crop insurance scenario, but they cost much less (See **Figure 5** and **Figure 6**). CRC guarantees revenue and in addition makes payments if yields are low and prices are high. This latter option is useful for producers who like to sell their crop in advance, via futures, or forward markets because the lost bushels are replaced at their harvest time value. RA does not have this latter property and is less expensive for most producers. For this Hamilton County producer CRC would cost $8-$10 per acre while RA would cost about $6.

For this producer the choice boils down to the last three strategies because all three guarantee that revenues will remain above the critical $220 level. So long as all three are actuarially fair, the choice will depend on the specific attributes of the policy. Producers who would like to receive payouts from their risk management tool even though revenue may not be low, will use the put option/crop insurance tool. Producers who like to use the futures market to price grain before planting will be drawn to CRC; producers who want the maximum risk protection at the lowest price will use RA.

The effects on the distribution of gross soybean revenue of the different risk management tools for Illinois and Indiana soybeans are similar to those shown here. The degree to which prices and yields are negatively correlated in other producing states is likely lower than that assumed in this analysis.

These findings also apply, in general, to corn producers throughout the Corn Belt. **Figures 7**, **8**, **9**, **10**, and **11** show the distribution of per-acre corn revenue under no tool and four alternative risk management tools for a corn producer in Hamilton County, Iowa. These histograms account for the cost of the alternative tools.

Figure 7 shows that revenue on this farm can fall to as low as $50/acre and be as high as

$600 per acre, which when compared to **Figure 1**, shows that corn producers typically face more revenue risk than do soybean producers. Suppose this farmer wants to guarantee that he will receive at least $240 in gross revenue per acre from his corn crop. As shown in **Figure 8**, crop insurance reduces the chances of falling below this level, but does not eliminate it, because it does nothing about price risk. The cost of crop insurance for this farmer would be about $7/acre after accounting for the federal subsidy available to producers who buy crop insurance. **Figure 9** shows that buying an at-the-money put option actually increases the risk of gross revenue falling below this level, in part because of the high cost ($21/acre in this example) of put options. **Figure 10** shows that combining crop insurance and put options successfully guarantees the farmer about $212/acre. This is the target revenue level of $240/acre less the option and crop insurance premia. Revenue Assurance guarantees this farmer $240/acre less the insurance premium, which amounts to about $6/acre. This corn example illustrates that insuring revenue is the most efficient way of managing risk.

This lesson shows how farmers can analyze the effects of various risk management strategies on revenue risk. While some general conclusions can be drawn from this lesson, the histograms presented here do not apply to all soybean production regions because yield risk varies dramatically across regions. Furthermore, price levels and price variability vary from year to year depending on market conditions. For example, in years of high springtime price, the chances that prices will fall are increased because farmers (if weather allows) may respond to the high prices with a bumper crop. If the high springtime price is due to short carry-out from the previous year, then the chances of a very high price are also increased due to the non-trivial chance of two short crops in a row. The expected price in springtime just balances these two forces. The cost of a put option in this year will tend to be quite high, to reflect the increased chance of a large (up or down) price movement. Farmers need to, look at both the futures and options markets in the springtime as well as a farm's own yield potential and variability to understand the degree of incomes risk at planting.

Decision aids are being developed that will allow any farmer with a computer to customize the histograms presented here for his or her own farm conditions and a particular year's price conditions. Interested farmers should look into acquiring such a decision aid before choosing a particular risk management strategy.

Price probability histograms for selected contracts are available on the Michigan State University Agricultural Economics webpage. The address is **http://www.msu.edu/user/hilker/**. Yield and price probability histograms can be generated from the **AgRisk** software. AgRisk is a user-friendly, Windows 95 program designed to assist corn, soybean, and wheat farmers to manage harvest-time revenue risk. AgRisk was developed by Gary Schnitkey, MarioMiranda, and Patrick Moran of the Ohio State University and Scott Irwin of the University of Illinois with funding provided by The Risk Management Agency, U.S. Department of Agriculture.

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