Decision Time on Farm Programs:
A Closing Perspective on ARC-CO vs. PLC

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As the clock ticks swiftly to the March 31 deadline, farmers now have at their disposal all of the information they are going to have to make the farm program decision. Recently, price forecasts have been updated and the National Agricultural Statistics Service (NASS) published their estimate for the 2014 crop year county average yields. With that in mind, this article seeks to provide a closing perspective on the ARC-CO and PLC decision for corn and soybeans by considering the magnitude of risk in forward markets and the implications for program payments.

Background

Agriculture Risk Coverage, County Option (ARC-CO) is a revenue-based assistance program using county average yields and national average prices. The guarantee is set at 86 percent of the benchmark (5-year Olympic average) prices and yields, with a maximum payment equal to 10 percent of the benchmark revenue and payments made on 85 percent of the base acres for the crop.

Price Loss Coverage (PLC) is a fixed-price program triggered when national average prices fall below a reference price ($3.70 for corn, $8.40 for soybeans), paying on the difference multiplied by the program yield and also made on 85 percent of the crop's base acres.

Price Expectations and Probability of Payments

Given that farmers know as much as they are going to know before this program decision is made, we begin this discussion with a review. As has been discussed at length (*farmdoc daily* March 11, 2015), price expectations are the most significant driver for the ARC-CO/PLC decision. High prices in recent years have been followed by two years with back-to-back big crops that have reduced expected prices for new-crop corn and soybeans. Additional big crops in future years would likely increase grain stocks and result in prices further below current expectations; unforeseen declines in demand would have a similar impact. Alternatively, poorer yields or increases in demand could lead to higher prices.

Price Expectations

USDA, the Congressional Budget Office (CBO) and the University of Missouri's Food and Agricultural Policy Research Institute (FAPRI), have provided and updated their baseline forecasts for the coming five marketing year average (MYA) prices and they are included in Figure 1. The Agriculture Policy Analysis System (APAS) has recently added a price series that makes use of Chicago Board of Trade futures prices. As discussed in recent articles (*farmdoc daily* February 4, 2015 and *farmdoc daily* February 12, 2015), however, five-year baseline price projections and futures are equally inaccurate when it comes to making long-term price projections (i.e. average percentage errors of 20 to 26 percent). We all understand and acknowledge that no one knows what the MYA prices will be for these farm programs; our goal is not one of picking the best estimate but rather we seek to help address risk, particularly from the market. Today's article uses information implied from futures and options markets to provide a perspective on MYA prices and price risk for both corn and soybeans through the 2018-19 marketing year.

Figure 1. Baseline Mid-Point Price Projections, 2014-15 to 2018-19 Marketing Years
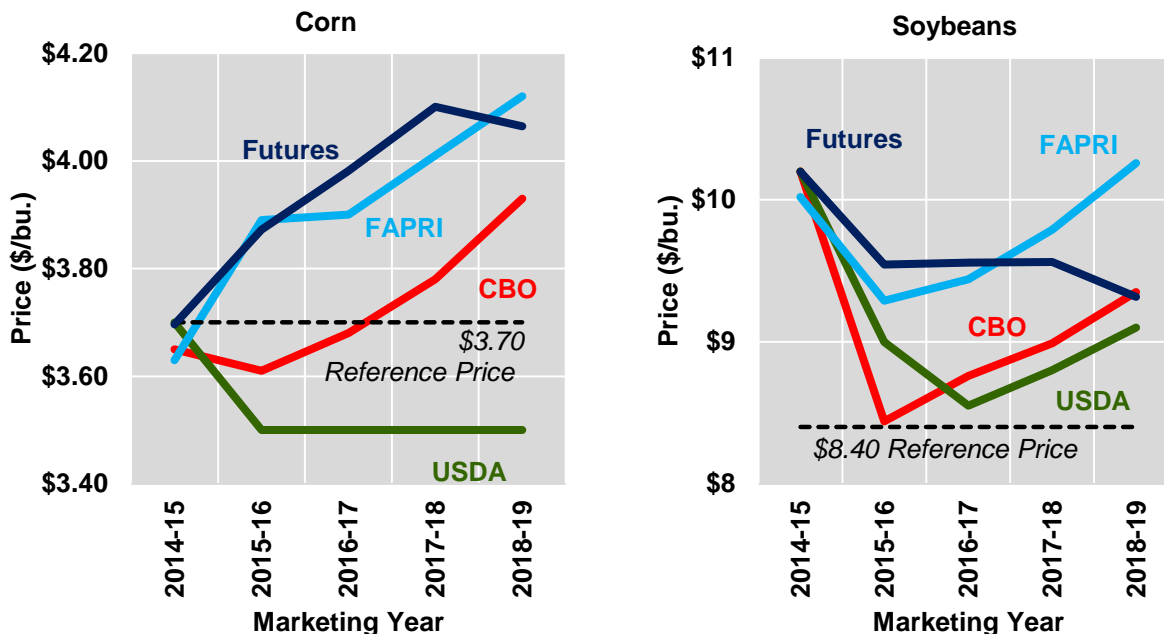
Futures contract prices have been shown to be an unbiased indicator of prices in the future. Moreover, implied volatility estimates from options prices are unbiased estimates of risk to the futures prices. Additionally, at least in nearby months, detailed structural models do not succeed in outperforming futures prices as a short-term forecasting tool. But we do not pretend that using futures can provide any more certainty or accuracy; every price forecast is expected to be wrong (*farmdoc daily* February 4, 2015).

Instead, we are thinking in terms of risk and, more importantly, acknowledging that price risk is higher as we project further into the future. To infer on potential long-term risk in corn and soybean markets we turn toward recent futures and options prices for both corn and soybeans through 2018. We are assuming that the price distributions are log-normal, with the mean and variance of expected prices obtained from futures prices and at-the-money option premiums. This method is used to generate price expectations for the 2015-16 through 2018-19 marketing years. To derive expectations for the current marketing year we simulate prices based on USDA's March 10 WASDE price projections for corn and soybeans (mid-points are $3.70 per bushel corn and $10.20 per bushel soybeans). Figure 2 shows the MYA price expectations, with a 50 percent confidence interval, for corn and soybeans through the 2018-19 marketing year. As can be seen in Figure 2, prices can fall in a wide range in out years.

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Figure 2. Expected Marketing Year Average Price, 50% Confidence Interval, and PLC Reference Price
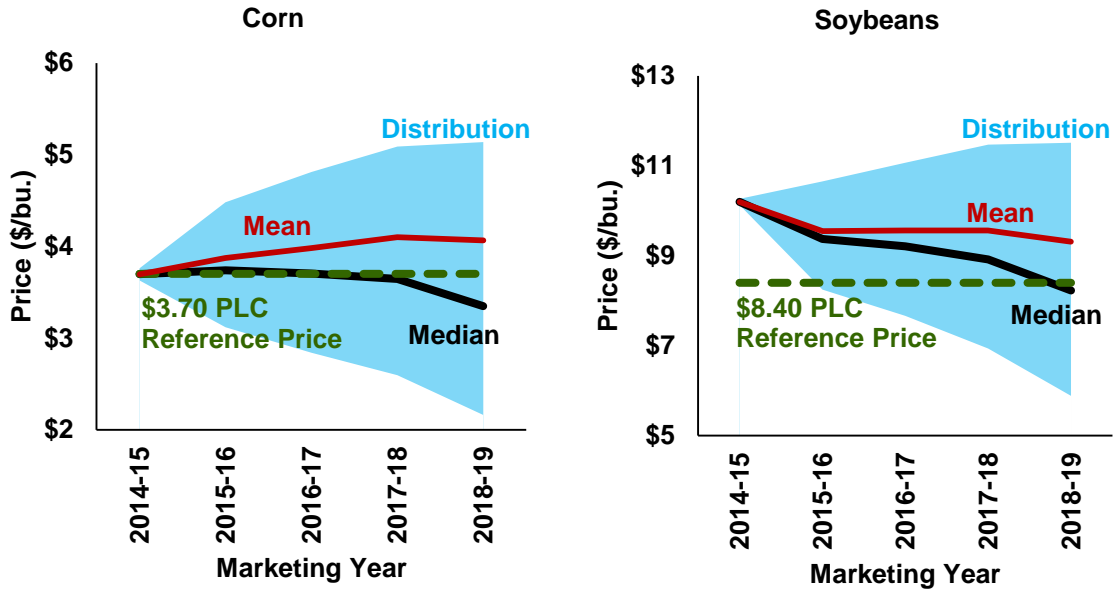
Notably, the mean of these market expectations effectively represents a "normal" supply and demand environment characterized by current stock levels, planting expectations, average weather, trend yield, and expected changes in consumption. With respect to price risk, uncertainty about future prices is greater at more distant forecasting horizons (higher levels of uncertainty result in larger confidence intervals). The increase in uncertainty is on account of the higher option premiums, and reflects a variety of potential supply and consumption conditions which could emerge in the coming years (i.e. adverse weather, increase in export volumes, etc.). As an example, a dry year in 2015 would likely reduce grain stocks and result in prices above current market expectations, and is captured in the upper portion of the confidence interval.

These price projections and confidence intervals can also be used to approximate benchmark Olympic moving average (OMA) price distributions. Given the market implied MYA prices, distributions for ARC-CO benchmark prices are given in Figure 3.

Figure 3. Median of Marketing Year Average Price and Distribution of Benchmark Olympic Moving Average Price
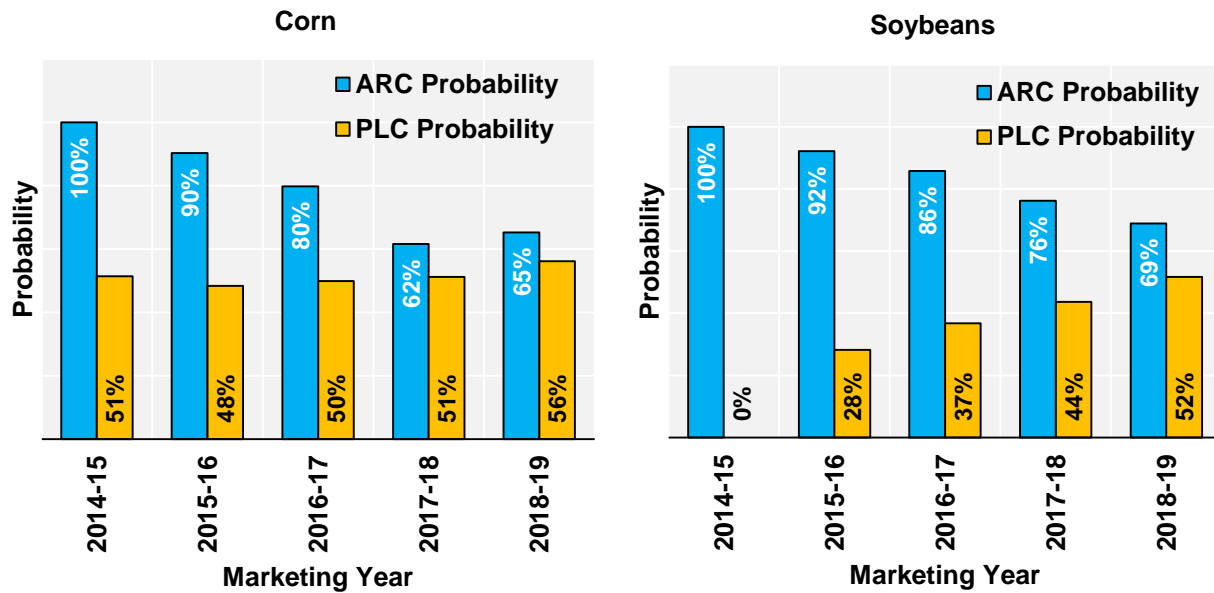
Corn

Soybeans
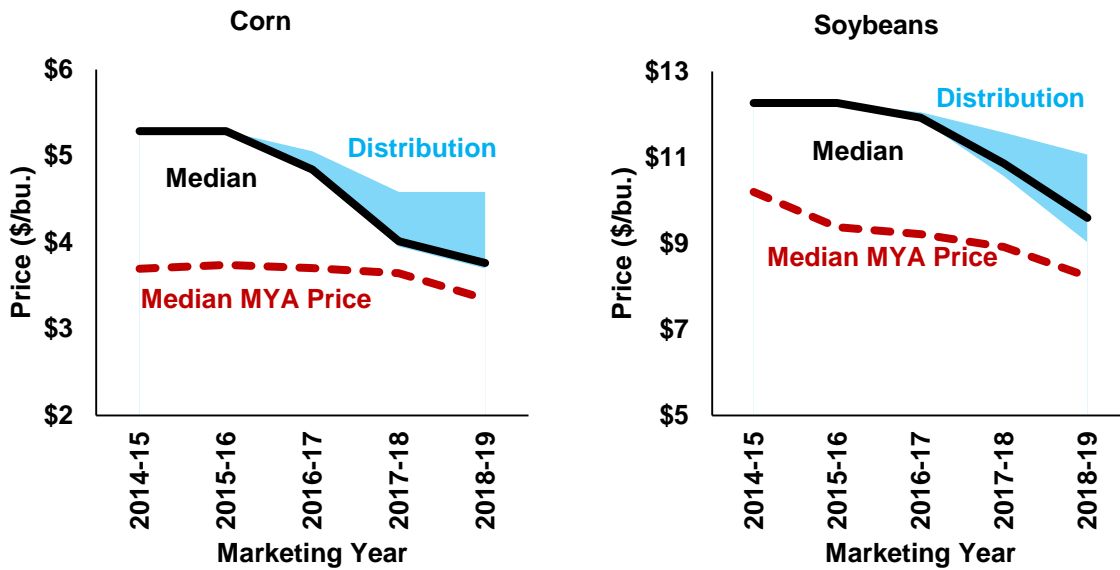
The distribution of benchmark OMA prices is considerably different than the distribution of MYA prices, and is highly skewed in the direction of lower commodity prices as evidenced by the median values of the distribution. This is due to specific design features of ARC. First, prices below the PLC reference prices are replaced, or "plugged", in the calculation of the OMA price such that the OMA price will never fall below the reference price. Second, in each five-year sample used to estimate the OMA price, the maximum and minimum values are removed from the sample. For example, the current USDA corn price projection of $3.50 to $3.90 per bushel is not high enough to factor into the benchmark revenue guarantee for 2015-16. As a result, for the first two years of the program the ARC OMA price is $5.29 per bushel corn. Similar price relationships result in a $12.27 per bushel soybeans OMA price guarantee for both the 2014-15 and 2015-16 marketing years. In the following years, the distribution of ARC-CO prices is much tighter relative to the distribution of MYA prices due to the nature of the Olympic average price calculation described above.

Probability of Payments

For corn and soybeans, market expectations on price and risk indicate a higher likelihood of ARC-CO payments relative to PLC. The potential for higher payments from ARC-CO in nearby years confirms recent CBO expectations of higher outlays and enrollment rates for ARC than for PLC for both corn and soybeans. With respect to ARC-CO, the high commodity prices experienced during the 2010-11 to 2012-13 marketing years provide added revenue support relative to the current risk environment. This is demonstrated by the large difference between the median OMA price and the median MYA price in Figure 3. The larger the difference, the less likely a high yield will reduce or eliminate ARC-CO payments. Figure 4 details the probability that the OMA price will be greater than the MYA price, one indicator of potential ARC-CO benefits.

Figure 4. Probability of Meeting ARC-CO or PLC Price Thresholds

Corn

Soybeans

For both corn and soybeans, the probability that MYA prices are below the benchmark is greatest in nearby years. For soybeans, the probability ranges from 100 percent in 2014-15 down to 69 percent in 2018-19. Similarly, for corn the probability ranges from 100 percent in 2014-15 down to 65 percent in 2018-19.

The price distributions can also be used to estimate the probability of PLC payments by comparing the median of the MYA price distribution to the reference price.[1] For example, with respect to soybeans, there is less than a 52 percent probability that the MYA price will fall below the $8.40 reference price in the final scheduled year of the Farm Bill. This is also the highest probability for a soybean PLC payment (Figure 4). The probability ranges from 0 percent in the 2014-15 marketing year to as high as 52 percent by 2018-19. On the other hand, the probability of PLC payments for corn is generally around 50 percent, and is the highest in 2018-19 at 56 percent. The higher probability of PLC payments for corn is attributable to back-to-back big crops and the subsequent multi-year price erosion experienced in the corn market (e.g. December corn futures have declined by nearly 45 percent since 2012).

Finally, comparing Figures 2 through 4 with respect to price expectations and probabilities we see that for PLC, so long as the median of the price distribution is greater than the PLC reference price, the probability of PLC making payments is less than 50 percent. Likewise, for ARC-CO, as long as the median of the OMA price distribution is greater than the median of the MYA price, the probability of meeting ARC-CO price thresholds remains above 50 percent (Figures 3 and 4). For nearby years, and based on price expectations alone, there is a higher likelihood of ARC-CO making payments compared to PLC. Importantly, for ARC-CO, the price probabilities do not fully represent the likelihood of making payments because yield uncertainty is not included.

PLC Payment Magnitude

Using the probability of PLC payments given in Figure 3, we calculate the estimated benefits by taking the difference, if positive, between the reference price and the maximum of the simulated marketing year price and the loan rate ($1.95 per bushel for corn and $5.00 per bushel for soybeans). The maximum possible PLC payment rates are $1.75 per bushel corn and $3.40 per bushel soybeans. Figure 5 shows expected (or average) PLC payment rates per bushel through the 2018-19 marketing year based on futures market price projections.

**Figure 5. Difference Between ARC-CO OMA Price and MYA Price,
and PLC Payment Rate Per Bushel**
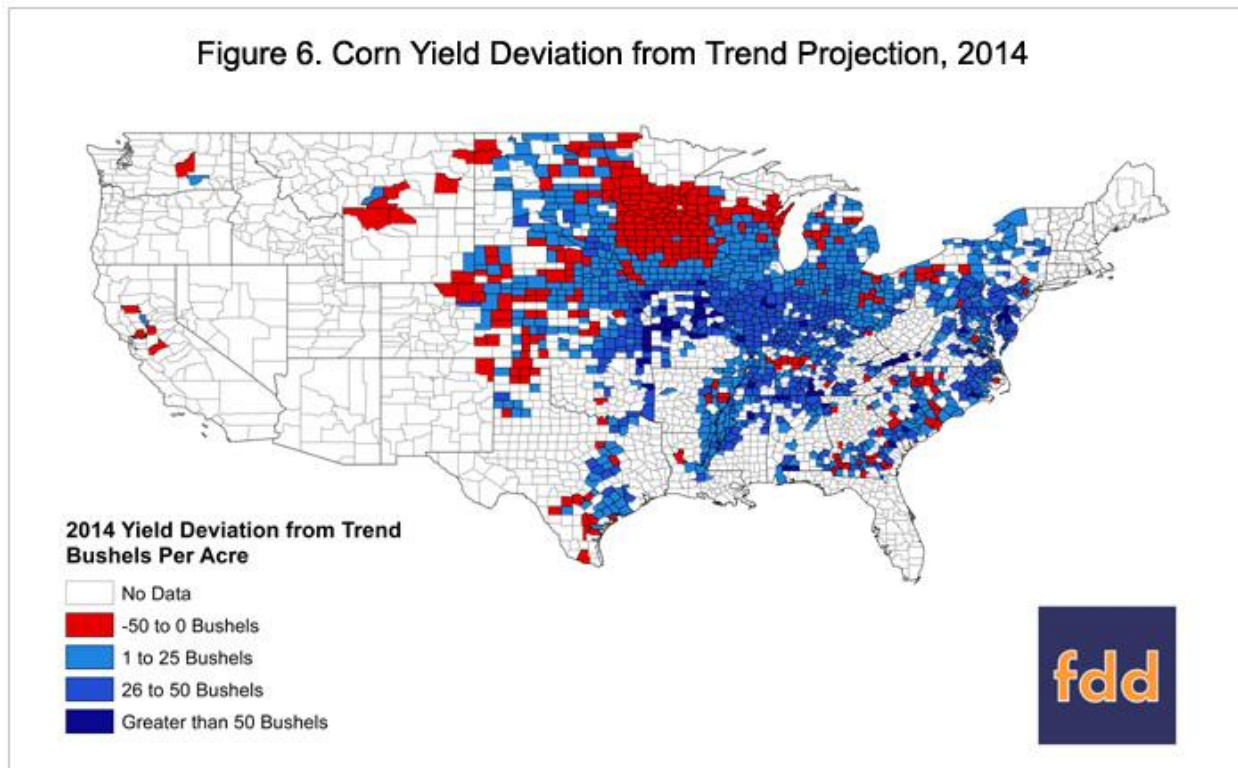
Corn

Soybeans
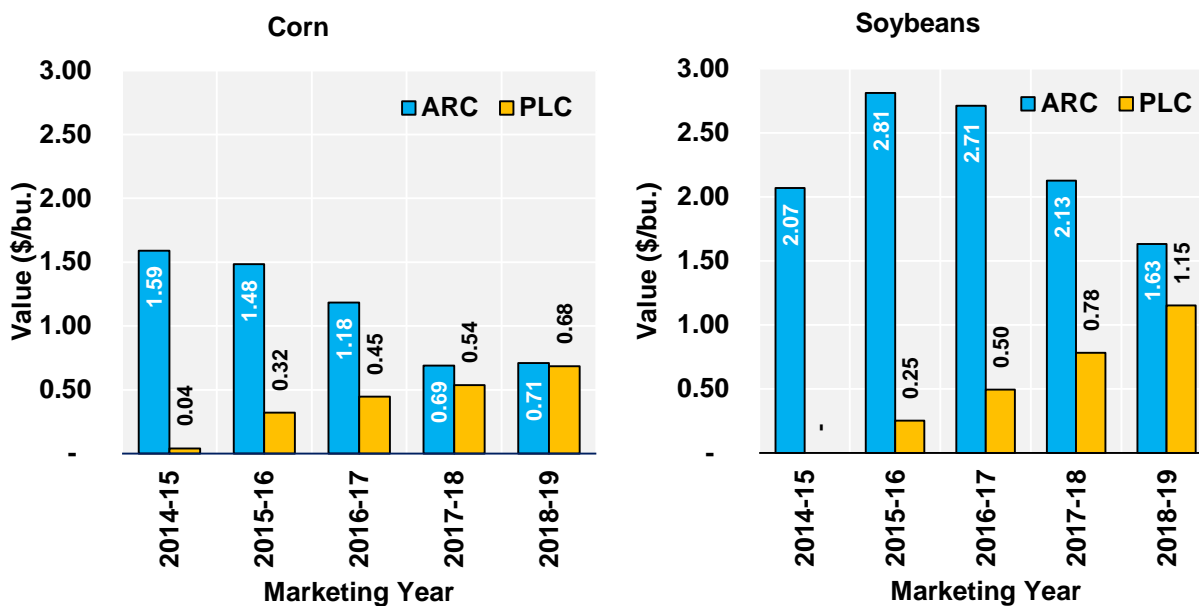
PLC payment rates increase at longer time horizons in large part because market expectations for risk also increase. For example, during the 2018-19 marketing year, the 50 percent confidence interval for corn shows a price range between $2.16 per bushel and $5.14 per bushel. Furthermore, for corn, 56 percent of the simulated MYA prices in 2018-19 are below the $3.70 reference price. Given these probabilities, the expected payment is $0.68 per bushel corn.[2] Soybeans provide a similar situation with higher uncertainty on price in 2018-19 driving a large potential PLC payment ($1.15 per bushel).[3] Aside from the uncertainty for potential PLC payments the other relevant component for considering PLC benefits is that payments are likely several marketing years away.

Evaluating the Impact of Yields on ARC-CO Benefits

While price expectations are the driving factor in the program decision, the 2014 crop year provides a pointed example of the importance of yields in this decision. PLC does not provide any assistance for yield risk. To get additional protection on yield risk farmers could purchase the county-trigger based coverage from the Supplemental Coverage Program, which was not available for the 2014 crop year. ARC-CO provides some assistance for area wide yield risks but large county average yields can impact the size of payments or even if payments are triggered. Most yield forecasts project forward the county-level trend increase in yields into future years, which assumes average weather.

When including the 2014 crop yield into the revenue guarantee, expectations for ARC-CO change considerably. For example, in 2014, due to high yields in some regions of the Corn Belt there is a low probability of ARC-CO payments (for both corn and soybeans) based on 2014-15 expected prices and projections for county yield (*farmdoc daily February 24, 2015*). Figure 6 maps the deviation from trend for 2014 corn yields. The low probability of ARC-CO payments is due to the record crop yields experienced in many corn- or soybean-producing counties. High yields reduce the difference between the ARC-CO benchmark revenue guarantee and actual revenue resulting in low or zero payments.

Figure 6. Corn Yield Deviation from Trend Projection, 2014

2014 Yield Deviation from Trend Bushels Per Acre

- No Data
- -50 to 0 Bushels
- 1 to 25 Bushels
- 26 to 50 Bushels
- Greater than 50 Bushels

Two counties in Illinois further illustrate this example. NASS average corn yield for McLean County was 217 bushels per acre. With a $3.65 MYA price, ARC-CO would not trigger a payment in McLean. By comparison, the NASS average corn yield for DeKalb County was 192 bushels per acre. With the same $3.65 MYA, ARC-CO would be expected to make a $79 per base acre payment for 2014 (factored by 0.85). PLC in both cases (using a 165 bushel per acre program yield) would be expected to make a $7 per acre payment (factored by 0.85).

However, by the 2015-16 marketing year, the probability for ARC-CO payments increases. Trend yield projections combined with current expectations of commodity prices result in a lower forecast of actual revenue relative to the benchmark, thereby increasing the probability and magnitude of ARC-CO payments. Current expectations, however, are a moving target and the actual revenue in 2015 will be subject to changes in market expectations of price and yield. For example, lower yields may be offset by higher commodity prices and could reduce or eliminate expected ARC-CO payments in 2015. Similarly, higher yields in 2015 could further reduce commodity prices and lead to PLC outperforming ARC-CO in nearby years. Price and risk expectations change constantly, and any number of random events can modify the expected path of forward grain prices and thus the expectation of returns from ARC-CO or PLC.

Conclusion

In general, we look to price expectations as the key component for the ARC-CO and PLC decision for corn and soybean base. However, price expectations and expected payment rates do not reveal the magnitude of risk in corn and soybean markets. Today's article has demonstrated that information implied from futures and options markets can be used to infer on risk in forward markets and may be used to make more informed risk management and program choice decisions. Additionally, considering yield uncertainty is a priority for ARC-CO as the county average yields will impact the probability and size of a payment.

The farm program decision comes down to protecting against extremely low prices (PLC) or revenue-based assistance against low prices and/or potentially low area yields (ARC-CO). Forward price uncertainty can be considered when making this decision. Based on current futures market price and risk expectations ARC-CO is expected to outperform PLC in nearby years for corn and soybeans, but actual payments are highly dependent on county yields. Farmers are encouraged to use the tools provided to make the program decision by the March 31, 2015 deadline.

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[1] The median is not equal to the mean of the price distribution. Due to the skewed nature of both the MYA price and the OMA price the median is less than or equal to the mean. In the case of the OMA price the median is closer to the lower tail as plug prices result in a highly skewed distribution.
[2] The median of the PLC payment rate for corn in 2018-19 is $0.35 per bushel.
[3] The median of the PLC payment rates for soybeans in 2018-19 is $0.17 per bushel.