Long-Term Corn, Soybeans, and Wheat Price Forecasts and the Farm Bill Program Choice

Scott Irwin and **Darrel Good**

Department of Agricultural and Consumer Economics
University of Illinois

As indicated in the *farmdoc daily* article on January 14, 2015, many crop producers are in the process of making the farm program participation decision for the five years beginning with the 2014 crop. Price expectations for this five-year period play a central role in the decision. Several *farmdoc daily* articles (e.g., October 14, 2014; December 18, 2014; January 27, 2015) illustrate the sensitivity of expected program payments to alternative price projections for 2014/15. Long-term price projections for some crops are available from several sources, including the USDA's 10-year baseline projections, the Congressional Budget Office (CBO) 10-year baseline projections, and 10-year projections provided by The Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri. While USDA, CBO, and FAPRI baseline price projections may not be considered forecasts in the strictest sense because they are developed for policy analysis, they are generally referenced as sources for forming price expectations by producers enrolling in the farm program. Given the importance of the program participation decision, the accuracy of these long-term projections is of obvious relevance. The January 14 article examined the historical accuracy of two sources of long-term forecasts for corn: i) the USDA's 10-year baseline projections; and ii) the corn futures market. Here we examine the accuracy of these two sources of forecasts for soybean and wheat prices and repeat the examination for corn in order to provide a comprehensive analysis in one location.

Background

It is generally believed that most Midwest farms will be enrolled in either the Price Loss Coverage (PLC) or the Agricultural Risk Coverage (ARC) County option. Regardless of the program choice, annual marketing year average prices are part of the formula that determines the magnitude of annual program payments. For producers enrolled in the PLC program, annual payments will be made if the marketing year average farm price for corn, soybeans, and wheat is less than the trigger price of $3.70, $8.40, and $5.50 per bushel, respectively, and no payment will be made if the marketing year average price is above the trigger price. If the average price is below the trigger price, the magnitude of payments is determined by the larger of the marketing year average farm price and the CCC loan rate and the farm payment bushels, which are a function of base farm yields and base farm acres. For the ARC County program, an annual payment will be

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made if the county revenue (marketing year average price times the county average yield) is less than 86 percent of the benchmark revenue. The benchmark county revenue in any given year is the five-year Olympic average of county yields times the five-year Olympic average of U.S. marketing year prices. The magnitude of payment for an individual farm will be determined by the shortfall in county revenue, if any, and the number of payment acres. Payments per acre in any year are capped at 10 percent of the benchmark revenue.

While price is central to the magnitude of annual program payments, a given price in any year may have different implications for PLC and ARC payments since the formula for determining payments are not the same for both programs. The Farm Bill Toolbox at the *farmdoc* website has a suite of decision tools to help producers evaluate the program alternatives and select the appropriate alternative for their farms. The tools allow for the evaluation of alternative price scenarios over the five-year duration of the program. An important question for producers using these tools is the appropriate price scenarios to consider. In a *farmdoc daily* article on March 13, 2014, Carl Zulauf and Gary Schnitkey examined the implications of using alternative historical corn price patterns to forecast the price pattern for the 2014-15 through 2018-19 marketing years. In addition, long-term price forecasts that could be used in the program choice evaluation are available from a number of sources. The USDA, for example, makes 10-year price projections in their annual baseline projections released in February each year. An early release of the February 2015 projections can be found here. In addition, the Congressional Budget Office (CBO) makes long-term baseline price projections for agricultural commodities. See the CBO's January 2015 Baseline for Farm Programs for an example. The Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri also provides long-term baseline price projections for agricultural commodities. Projections made in January 2015 can be found here. Finally, soybean and wheat futures prices provide a forecast of prices for some duration. Selected hard red winter futures contracts, for example, are currently listed through July 2017 and selected soybean futures contracts are listed though November 2018, although contracts were not listed that far in the future in previous years.

Analysis

We examine the historical accuracy of two sources of long-term corn, soybean, and wheat price forecasts: i) the USDA's 10-year baseline forecasts; and ii) the futures market. The history of USDA's 10-year forecasts is depicted by the blue lines in Figures 1, 2 and 3. Each blue line represents a 10-year period that starts with the marketing year on the horizontal axis. The first forecast, made in February 1997, was for the 1996/97 through the 2005/06 marketing years. The second forecast, made in February 1998, was for the 1997/98 through the 2007/08 marketing years, and so on. The final forecast, depicted by the magenta line, is for the 2014/15 through the 2024/25 marketing years. The red line in each Figure   depicts the actual marketing year average price from 1996/97 through 2014/15, with the 2014/15 average price reflecting the January 2015 WASDE forecast.

Figures 1-3 indicate that over the period examined, USDA tended to forecast a "steady-state." That is, current prices were generally forecast to persist into the future. The exception was during periods of very high prices when prices were forecast to decline in the early years of the forecast period and then to stabilize at lower prices. Forecasting a steady-state means that forecast errors will be large when supply and/or demand shocks are experienced. The period from 2006/07 through 2013/14 contained a number of supply shocks in the form of low U.S. wheat yields in 2011, fluctuating world wheat production, low U.S. corn yields, particularly in 2012, and a small South American soybean crop in 2012. In addition, the period represented a time of substantial growth in corn demand from ethanol production and large increases in Chinese soybean demand. Large price forecast errors are obvious, particularly in the later years.

Figure 1. USDA 10-Year Baseline Price Forecasts for Corn and Actual Marketing Year Average Prices, 1996/97 - 2024/25*
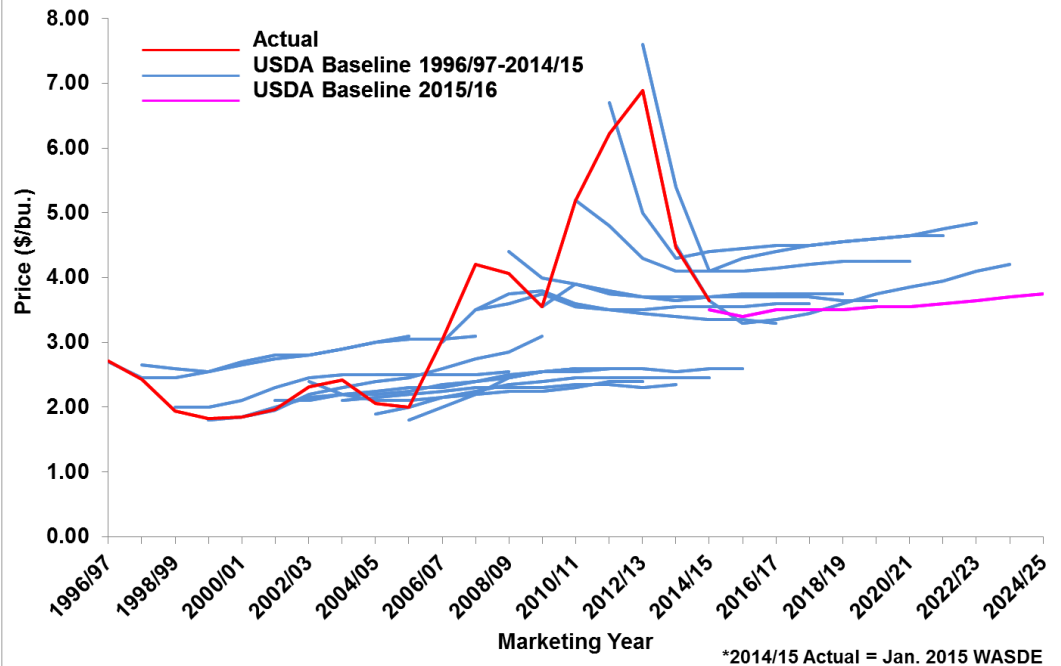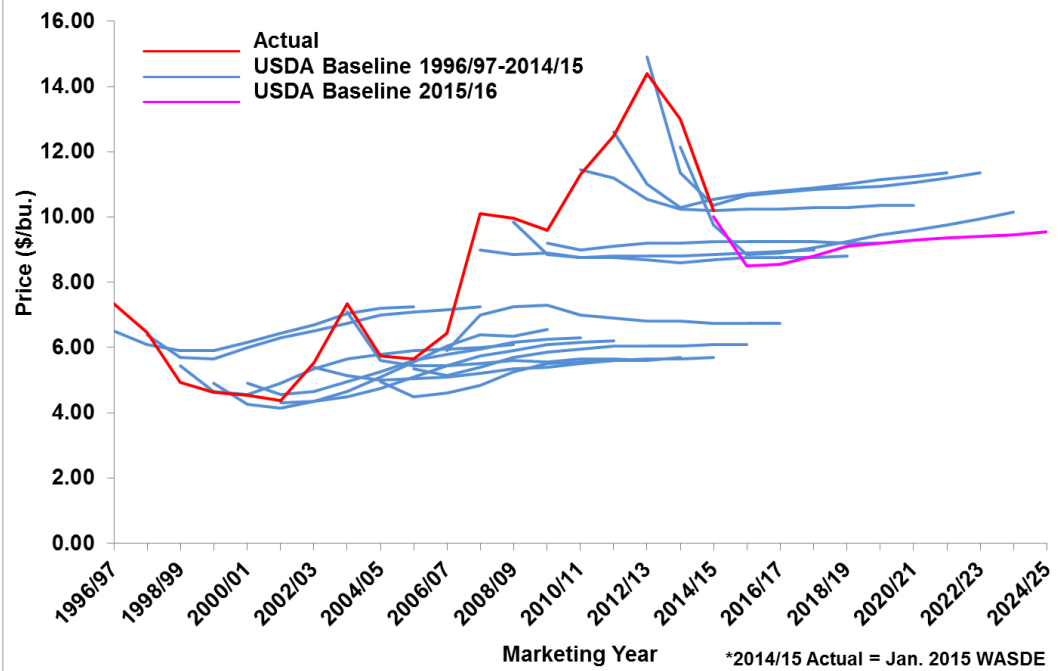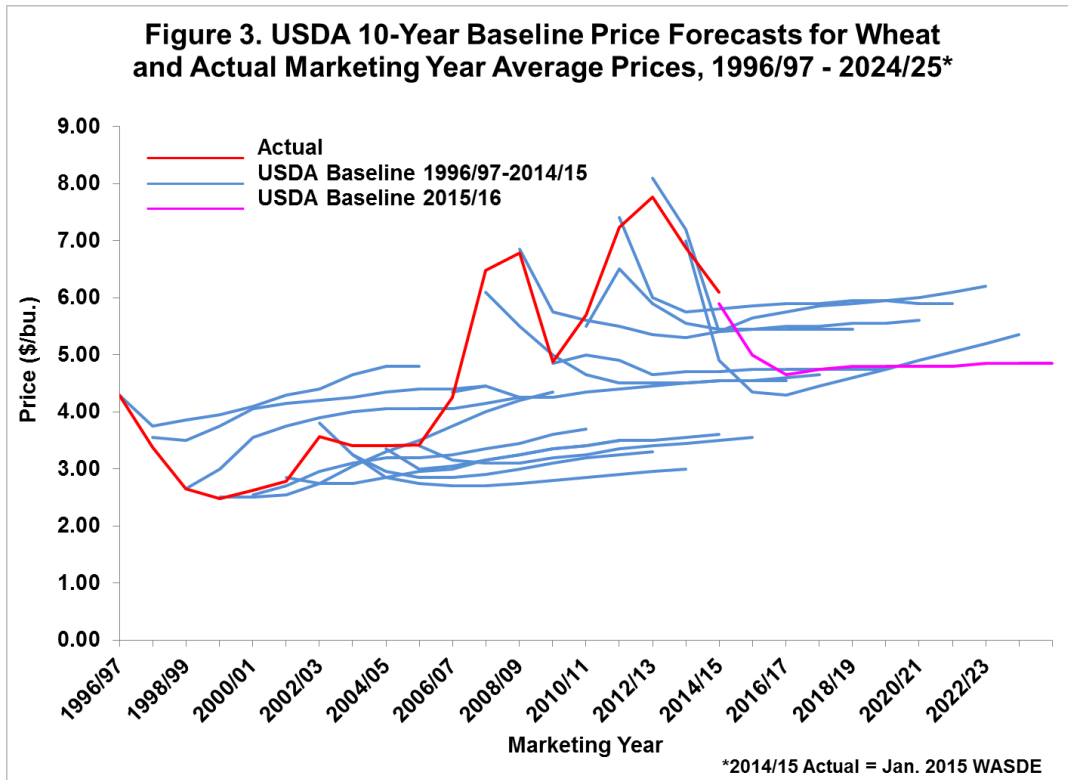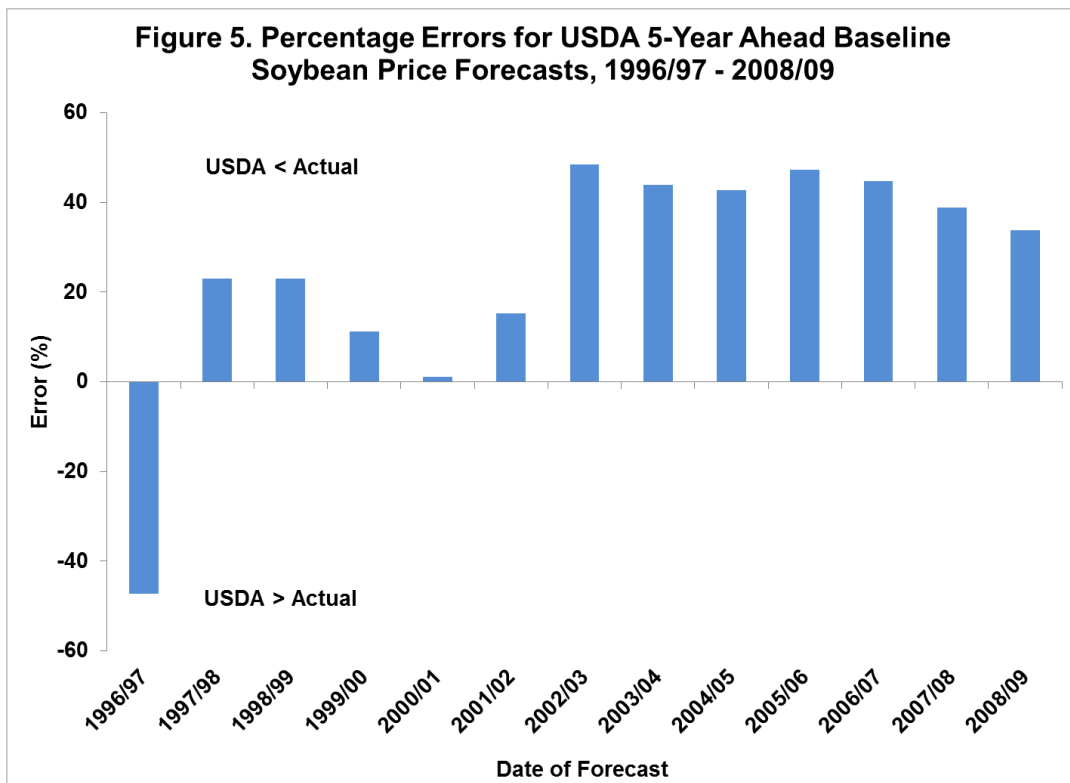
*2014/15 Actual = Jan. 2015 WASDE

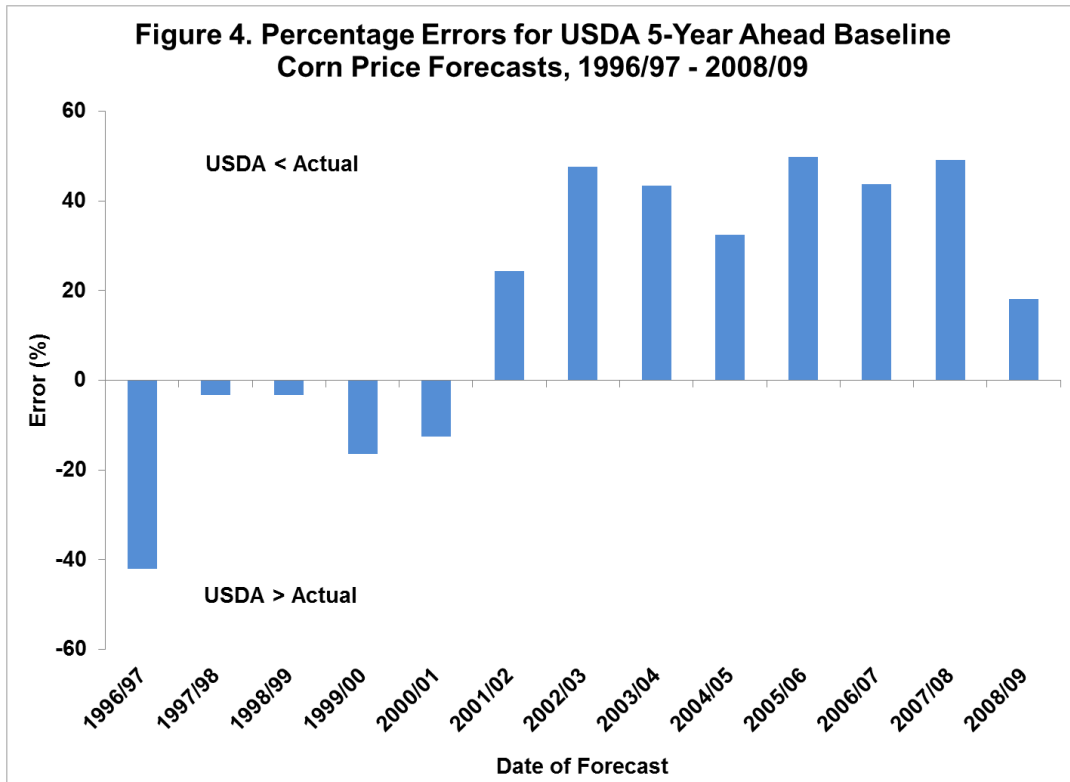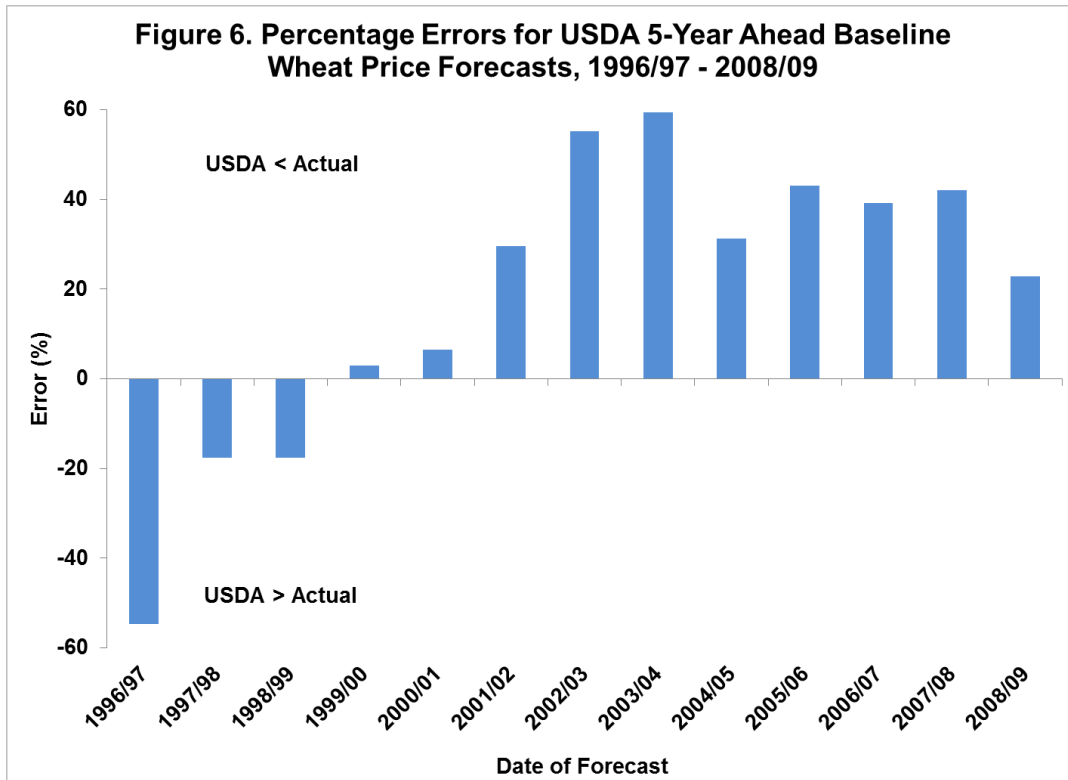**Figure 2. USDA 10-Year Baseline Price Forecasts for Soybeans and Actual Marketing Year Average Prices, 1996/97 - 2024/25***

*2014/15 Actual = Jan. 2015 WASDE

Figure 3. USDA 10-Year Baseline Price Forecasts for Wheat and Actual Marketing Year Average Prices, 1996/97 - 2024/25*

*2014/15 Actual = Jan. 2015 WASDE

It is difficult to fully quantify the magnitude of USDA baseline price projection errors for the period examined due to the fact the price for a particular year is forecast several times. Figures 4-6 show one measure of the magnitude of forecast errors. The percentage error in USDA's five-year ahead projection was calculated for each year in the study period. As generally observed in Figures 1-3, corn and wheat projection errors were negative (USDA forecasts greater than actual prices) in the early years and positive (USDA forecasts less than actual prices) in later years. In contrast, the 5-year ahead soybean price projection error was negative only in the first year of the analysis. Errors were large for all three crops in the first year of the analysis, relatively small in years two through five or six and quite large for years seven through 12. Price projection errors exceed 40 percent in five of the last eight years for corn and soybeans and in four of the past eight years for wheat. One can reasonably conclude that large forecast errors are the norm rather than the exception.

Figure 4. Percentage Errors for USDA 5-Year Ahead Baseline Corn Price Forecasts, 1996/97 - 2008/09

Figure 5. Percentage Errors for USDA 5-Year Ahead Baseline Soybean Price Forecasts, 1996/97 - 2008/09

Figure 6. Percentage Errors for USDA 5-Year Ahead Baseline Wheat Price Forecasts, 1996/97 - 2008/09
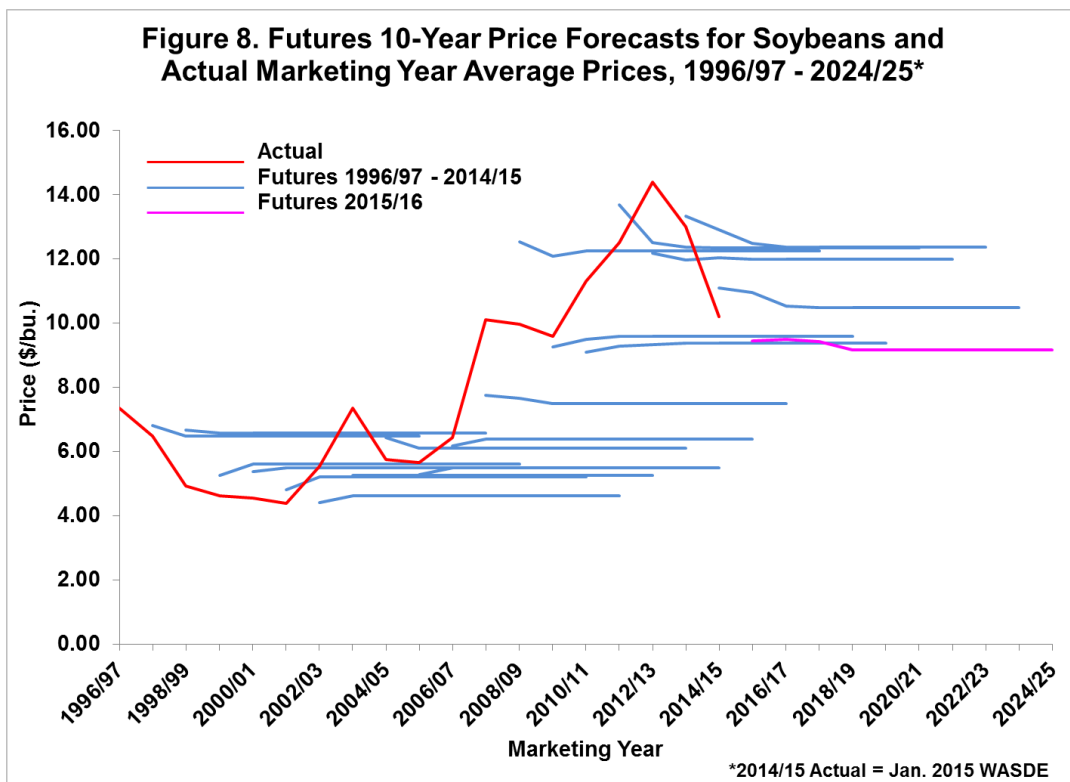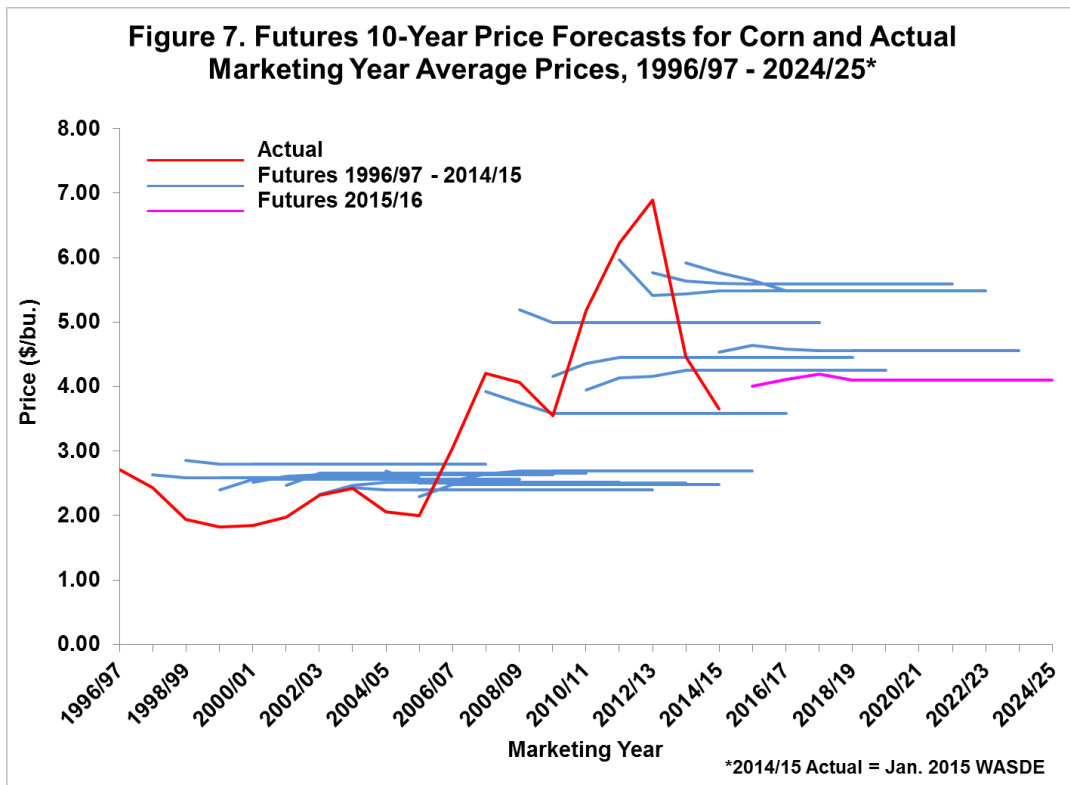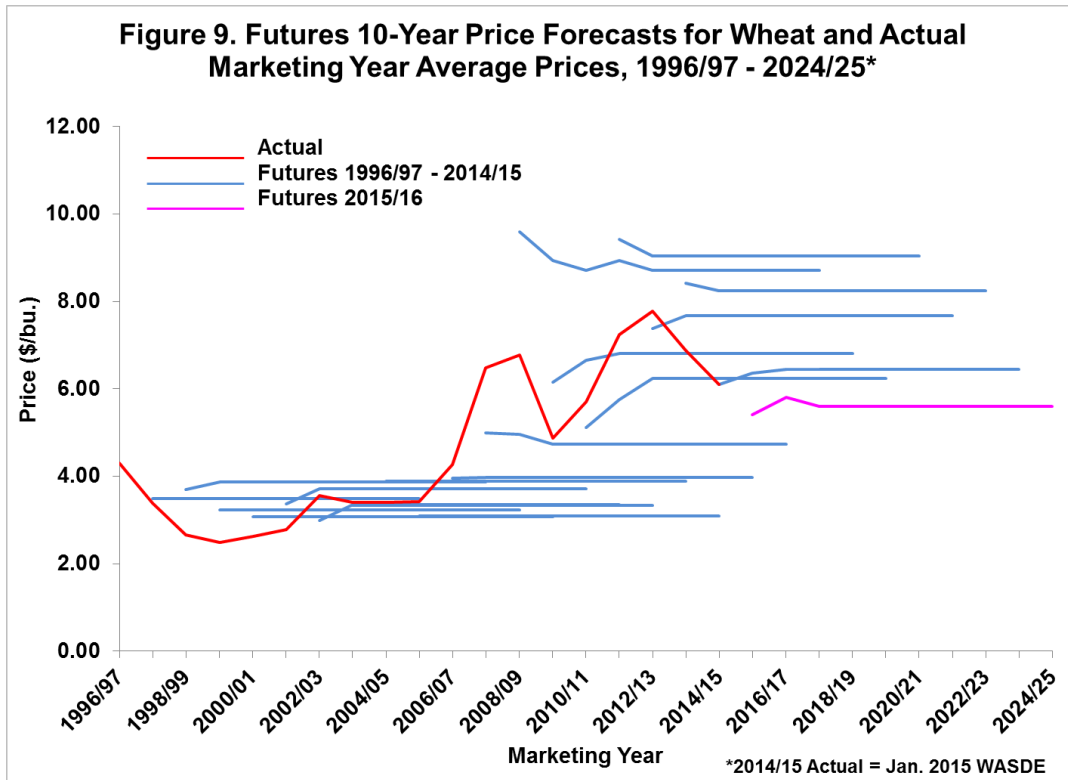
In Figures 7-9, 10-year price forecasts derived from the futures market are compared to the actual marketing year prices in the same fashion as USDA forecasts were compared in Figures 1-3. Deriving cash price forecasts from futures prices is not a straight-forward process and is limited by the fact that futures are not listed for 10 years into the future. The Economic Research Service of the USDA has developed a detailed system for generating season average price forecasts from the corn, soybeans, and wheat futures markets that can be found here. We use a simplified approach in our analysis. The marketing year average cash price forecast is set equal to the December futures price for corn, the November futures price for soybeans, and the July futures price for wheat (on the business day in February closest to) February 1 prior to the start of the marketing year. For wheat, the prices for the Kansas City hard red winter wheat futures contract are used to approximate the average price of all classes of wheat. The all class average includes higher-priced spring wheat, medium-priced hard red winter wheat, and lower-priced soft red winter wheat.

The first new-crop futures price for each crop is used as the forecast of the marketing year cash price under the simplifying assumption that positive carrying charges for futures contracts for the remainder of the marketing year generally offset average basis levels (cash price less than futures price). This assumption is likely more appropriate for corn and wheat, since those futures markets general reflect a positive carry and less appropriate for soybeans, which typically reflects a small or no carry. For the study period, the appropriate futures prices nearest to February 1 were traded only two to four years out. The last December, November, or July contract listed in each year was used as the forecast of the marketing year cash price in each subsequent year of the forecast period. This may appear to be an overly strong assumption, but as we note below, this is consistent with theory.

Figures 7-9 shows that the futures market forecasts also tend towards a "steady state," with future prices expected to be essentially equal to current prices. This is most obviously due to our procedure for filling in the missing futures prices in out years. In addition, the theory of futures markets for storable commodities shows that the positive difference between current and deferred futures prices is limited by the cost of carry, which tends to anchor prices in a steady-state manner. The implication is once again that percentage

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forecast errors are quite large due to unanticipated market shocks. Note that the results are consistent with analysis of one-year ahead futures prices in an earlier *farmdoc daily* article by Carl Zulauf (August 7, 2014).

Figure 7. Futures 10-Year Price Forecasts for Corn and Actual Marketing Year Average Prices, 1996/97 - 2024/25*

Figure 8. Futures 10-Year Price Forecasts for Soybeans and Actual Marketing Year Average Prices, 1996/97 - 2024/25*

Figure 9. Futures 10-Year Price Forecasts for Wheat and Actual Marketing Year Average Prices, 1996/97 - 2024/25*

*2014/15 Actual = Jan. 2015 WASDE

Even though both the USDA 10-year baseline and futures forecasts produced large forecast errors, we would certainly like to know if one is superior to the other. To run this type of "horse race" comparison, we compute mean absolute percentage errors (MAPE) for all forecasts through 2013/14, the last complete marketing year. This resulted in 17 one-year ahead forecasts of price, 16 two-year ahead forecasts of price, and so on to eight 10-year ahead forecasts. Figures 10-12 show the MAPE of the forecasts for each time horizon. Not surprisingly, forecast errors were smallest for one-year forecasts and largest for the longer-term forecasts. USDA corn forecast errors were smaller than the futures market forecast errors for the one-, two- and three-year time horizons, but larger for all longer time horizons except at ten years. USDA soybean forecast errors were smaller than futures market forecast errors for the one- and two-year horizons and for the seven, - eight-, and nine-year horizons. Errors were essentially equal in the 10-year horizon. The USDA wheat forecast errors were smaller than the futures market forecast errors only in the one-year and 10-year horizons.

The results are especially interesting in two respects. First, the smaller USDA forecast errors for the shorter horizons may be surprising to some in light of the efficient market hypothesis, which implies that futures prices reflect all available information at any point in time. One possibility is that our simplified method of using futures prices to forecast season average prices biases the comparisons against the futures market. Recent research suggests this may well be correct for corn. In addition the use of only one class of wheat futures prices and the normal lack of carry in the soybean futures market may bias the results. Second, despite the straight-line method of projecting missing futures prices, the futures market outperforms the USDA baseline in all out years for corn and most out years for wheat. Relative performance is less consistent for out year soybean price forecasts.

Figure 10. Mean Absolute Percentage Errors (MAPE) For USDA Baseline and Futures Corn Price Forecasts, 1997/98 - 2013/14
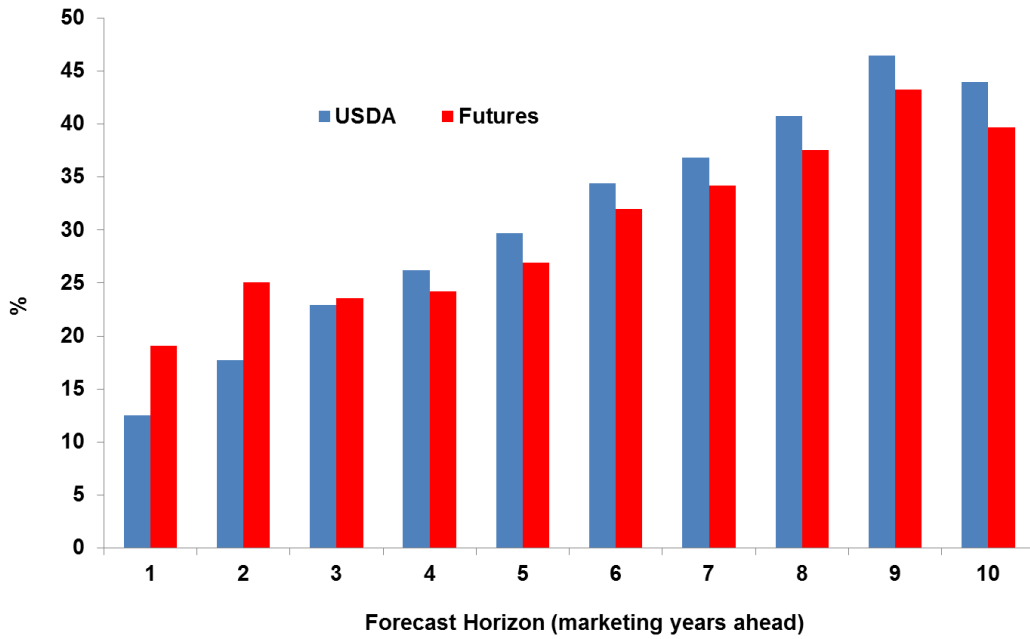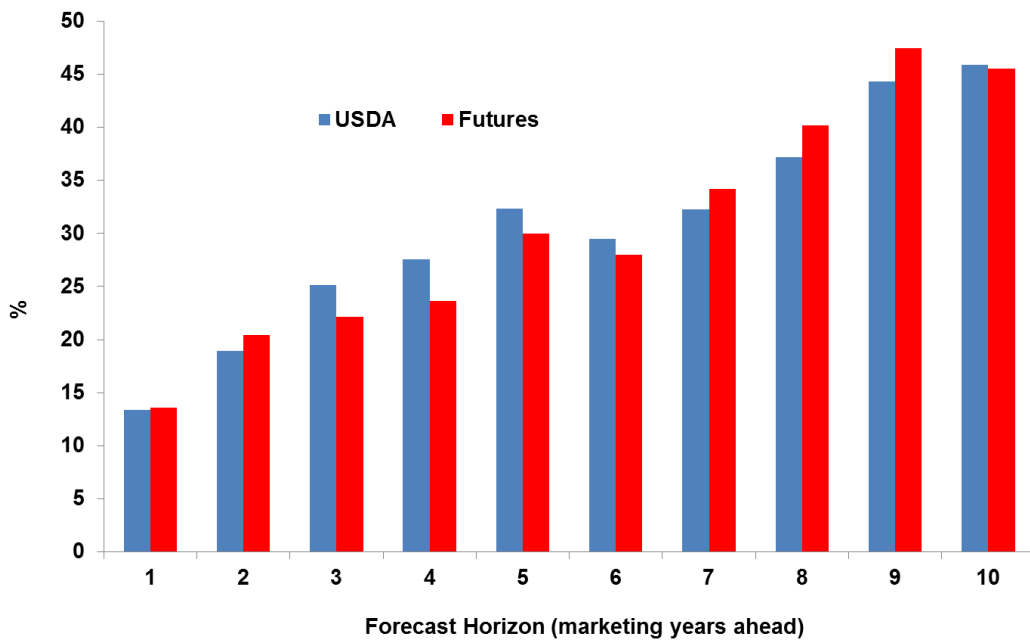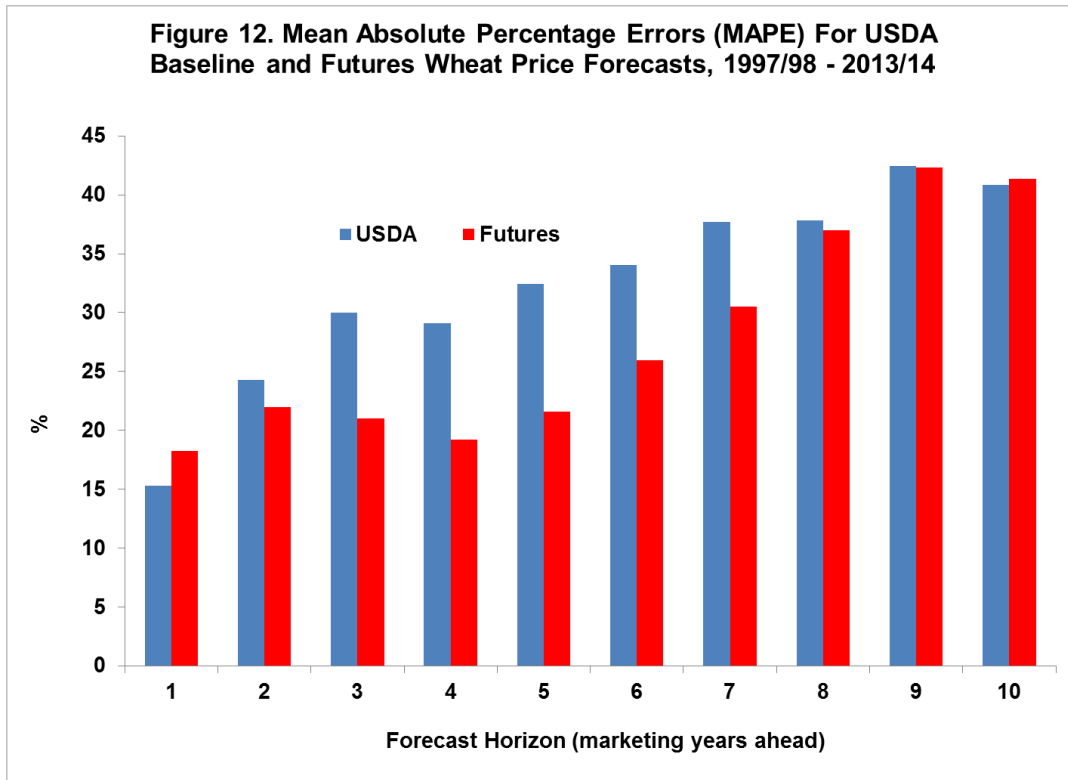

Figure 11. Mean Absolute Percentage Errors (MAPE) For USDA Baseline and Futures Soybean Price Forecasts, 1997/98 - 2013/14

Figure 12. Mean Absolute Percentage Errors (MAPE) For USDA Baseline and Futures Wheat Price Forecasts, 1997/98 - 2013/14

Implications

The analysis of the historical accuracy of USDA 10-year baseline and futures market forecasts of corn, soybean, and wheat prices demonstrates that it is exceedingly difficult to project marketing year average prices very far into the future. This is due to the basic fact that the magnitude and timing of market supply and demand shocks cannot be anticipated. This implies that long-term projections, regardless of the source, may not be very useful in evaluating the current farm program choices. What then can producers do when making these decisions? One response to this kind of uncertainty is to diversify across the choices in order to hedge the risk of making the wrong choice, which could take the form of enrolling some farms in the Price Loss Coverage (PLC) program and others in the Agricultural Risk Coverage (ARC) County program. Another response is to frame the question differently by focusing on the average price that might be expected over the five-year life of the current farm bill. All available current forecasts suggest that corn prices will average near to slightly higher than current prices. This differs from our "new era" expectation, as summarized in this *farmdoc daily* article (February 27, 2013), that the average corn price will likely be well above the current level. The pattern of baseline price projections for soybeans and wheat over the next five years is more variable, but projections are generally lower than our expectations, also summarized in the February 27, 2013 *farmdoc daily* article. Finally, it is important to emphasize that our analysis does not suggest that long-term forecasting exercises are without value. This type of modelling work is important for understanding the dynamics of supply and demand in markets as well as benchmarking impacts of different policies over time.

References

Congressional Budget Office. "CBO's January 2015 Baseline for Farm Programs." Released January 26, 2015, and accessed February 4, 2015.
http://www.cbo.gov/sites/default/files/cbofiles/attachments/44202-2015-01-USDA.pdf

Economic Research Service/USDA. "Spreadsheet Models." Updated January 12, 2015, and accessed February 4, 2015. http://www.ers.usda.gov/data-products/season-average-price-forecasts.aspx

Efficient-market hypothesis. In *Wikipedia*. Modified on 4 February 2015 and retrieved February 4, 2015, from http://en.wikipedia.org/wiki/Efficient-market_hypothesis

FAPRI-MU. "January 2015 U.S. Crop Price Update." Released January 2015, and accessed February 4, 2015. http://www.fapri.missouri.edu/outreach/publications/2015/FAPRI_MU_Bulletin_02_15.pdf

Farm Bill Toolbox. http://farmbilltoolbox.farmdoc.illinois.edu/

Hoffman, Linwood A., Scott H. Irwin, Xiaoli L. Etienne, Evelyn V. Colino, and Jose Toasa. "Forecast Performance of WASDE Price Projections for U.S. Corn." Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, August 2014.

Irwin, S., and D. Good. "Long-Term Corn Price Forecasts and the Farm Bill Program Choice." *farmdoc daily* (5):7, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, January 14, 2015.

Irwin, S., and D. Good. "The New Era of Crop Prices—A Five-Year Review." *farmdoc daily* (3):38, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, February 27, 2013.

Schnitkey, G., J. Coppess, C. Zulauf, and N. Paulson. "Expected Payments from ARC-CO and PLC." *farmdoc daily* (5):15, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, January 27, 2015.

USDA. "USDA Agricultural Projections to 2023." Released February 2014, and accessed February 4, 2015. http://www.usda.gov/oce/commodity/projections/index.htm

Zulauf, C., S. Kim, and G. Schnitkey. "Indicated ARC-CO and PLC Payment for 2014 Crop Year Corn, Soybeans, and Wheat by State: January 2014." *farmdoc daily* (5):12, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, January 22, 2015.

Zulauf, C., and G. Schnitkey. "ARC-CO and PLC Payment Indicator for 2014 Crop Year: December 2014 WASDE U.S. Yield and Price." *farmdoc daily* (4):242, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, December 18, 2014.

Zulauf, C., and G. Schnitkey. "ARC-CO and PLC Payment Indicator for 2014 Crop Year: October 2014 WASDE U.S. Yield and Price." *farmdoc daily* (4):198, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, October 14, 2014.

Zulauf, C., N. Rettig, and M. Roberts. "Do Futures Forecast the Future?" *farmdoc daily* (4):147, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, August 7, 2014.

Zulauf, C., and G. Schnitkey. "ARC-PLC Decision: Importance of the Price Path - The Case of Corn." *farmdoc daily* (4):47, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, March 13, 2014.