The New Era of Corn and Soybean Prices Is Still Alive and Kicking

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There is no shortage of doom and gloom about grain price prospects at the present time. Prices have indeed fallen to quite low levels compared to the high prices that occurred over much of 2008-2013. For some, this is proof that the high prices of 2008-2013 were a temporary spike, albeit a rather long-lasting one, instead of a shift to a permanent and higher level of prices. This flies in the face of our long-argued position that corn, soybean, and wheat prices moved to a new era of higher average nominal prices beginning in late 2006 (Good and Irwin, 2008; Irwin and Good, 2009; *farmdoc daily*, March 29, 2011; April 12, 2011; April 19, 2011; February 27, 2013; February 28, 2013; November 7, 2013). The new era replaced the previous era that spanned from January 1973 through November 2006. We argued that the new era of prices was primarily driven by demand shifts associated with rising biofuel production, particularly corn-based ethanol. Our projection of new era average prices and price ranges was based on an extremely simple analysis. This method turned out to be surprisingly accurate but it lacked a strong foundation in more fundamental supply and demand projections. In this article, we use our recently developed models of the relationship between the year-ending stocks-to-use ratio and marketing year average prices for corn and soybeans to provide a more rigorous economic foundation for the original new era grain price projections. These models are particularly useful in helping to frame the ongoing debate about long-term average grain prices. For additional background information on the debate about the long-term direction of grain prices see the *farmdoc daily* articles by Professor Carl Zulauf on March 11, 2016 and by Professor Paul Peterson on September 3, 2015.

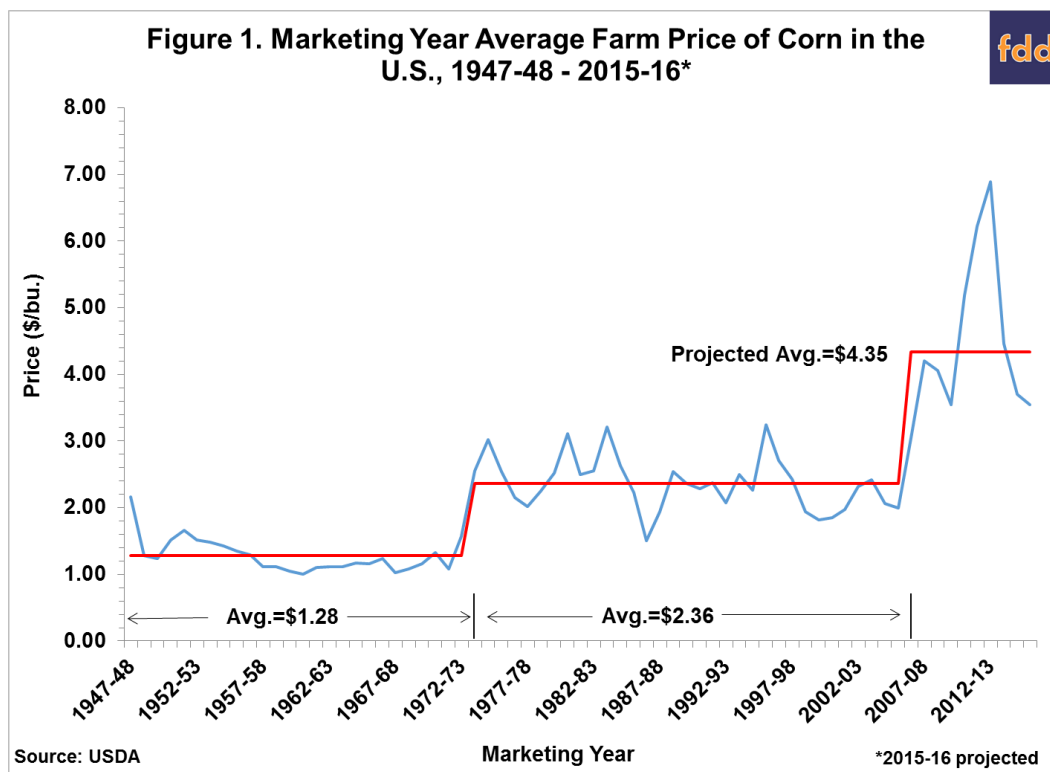**Review of New Era Grain Price Projections**

Our first new era projections of grain prices were published in Good and Irwin (2008) and Irwin and Good (2009). In these publications, we projected the likely average and range in monthly farm prices received in Illinois. The projection of average monthly prices in the new era was centered on corn since it was believed that the new era of prices that began in late 2006 was associated with the rapid expansion in biofuels (ethanol) production and the impact on corn demand. The analysis began with the identification of two previous price eras for corn and the change in average price between those two periods. The first era was the post-war period that extended from January 1947 through December 1972 when the average monthly corn price in Illinois was $1.28 per bushel. The second period, associated with the rapid increase in corn export demand in 1973, extended from January 1973 through November 2006 when the average monthly

price of corn was $2.42. The projection of the average price in the new era made the simple assumption of an equal percentage price change that occurred between the previous two eras. The average price projection of $4.60, then, was calculated as ($2.42/$1.28) X $2.42 = $4.60. Soybean prices were first projected at $11.50 using a similar approach as corn. In later publications we switched to using a ratio to corn prices—initially 2.3:1 and $10.58 then to 2.4:1 and $11.04. Likewise, the average price of wheat was based on an expected ratio of wheat to corn prices of 1.26, resulting in a projection of $5.80.

Since U.S. marketing year average prices are of more general interest than monthly prices and are typically the focus of price forecasts, we compute new era average price projections for U.S. average marketing year prices using the same ratio analysis applied to Illinois monthly prices. Average farm prices for the 1947-48 through 2015-16 marketing years are presented in Figures 1 and 2 for corn and soybeans, respectively. This sample period has the same starting year as the original monthly analysis (January 1947) and extends through projections for the current marketing year. The first post-war era extends from 1947-48 through 1972-73, with an average marketing year corn price in the U.S. of $1.28 per bushel. The second period extended from 1973-74 through 2005-06 when the average marketing year price of corn was $2.36. The average price projection for the latest era is $4.35, calculated as ($2.36/$1.28) X $2.36 = $4.35. Soybean prices are projected using a 2.4:1 ratio to corn price, or $10.44.

Figure 1. Marketing Year Average Farm Price of Corn in the U.S., 1947-48 - 2015-16*

Source: USDA

Marketing Year

*2015-16 projected

Figure 2. Marketing Year Average Farm Price of Soybeans in the U.S., 1947-48 - 2015-16*
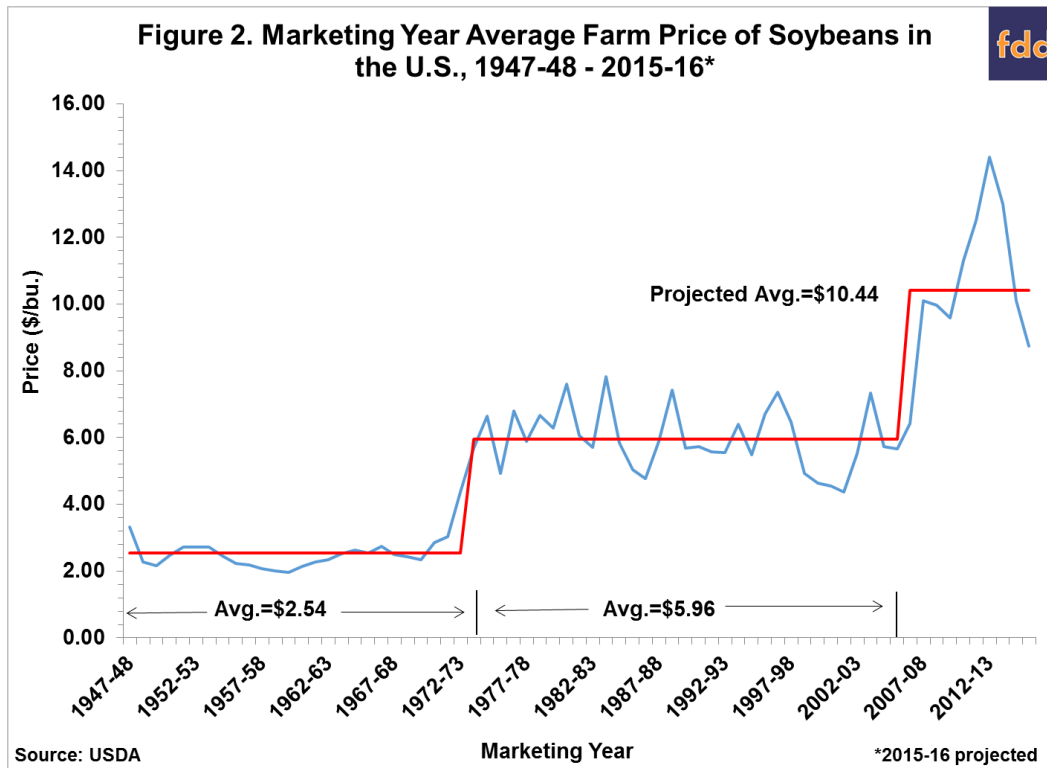

Table 1 summarizes the projections of average prices and actual prices for corn and soybeans when computed using U.S. marketing year average prices and Illinois monthly average prices. Not surprisingly, the new era average (nominal) price projections are fairly similar, with Illinois monthly average prices $0.25 and $0.60 per bushel higher than U.S. season average prices. This reflects the stronger basis in Illinois compared to most other locations in the U.S. and the fact that the marketing year average price is a weighted average. Like the Illinois monthly average projections, the U.S. marketing year average projections turned out to be quite accurate, with the new era price projection for corn only $0.14 too low and the projection for soybeans $0.17 too low. This confirms our previous five-year review of new era price projections (*farmdoc daily*, February 27, 2013), where we concluded that, "Despite some differences between projections and actuals, the new era projections for the price of corn, soybeans, and wheat that we made almost five years ago have held up remarkably well." Regardless of the accuracy, the simple method used to make the new era price projections lacks a clear economic foundation, and therefore, is of limited value in assessing the crucial question of whether the current low grain prices represent a run of prices near the bottom of the new era price range or signal that the new era has come to a halt and a "new, new" era of even lower grain prices is on the horizon.

Table 1. Projected and Actual Average Prices for Corn and Soybeans during the New Era

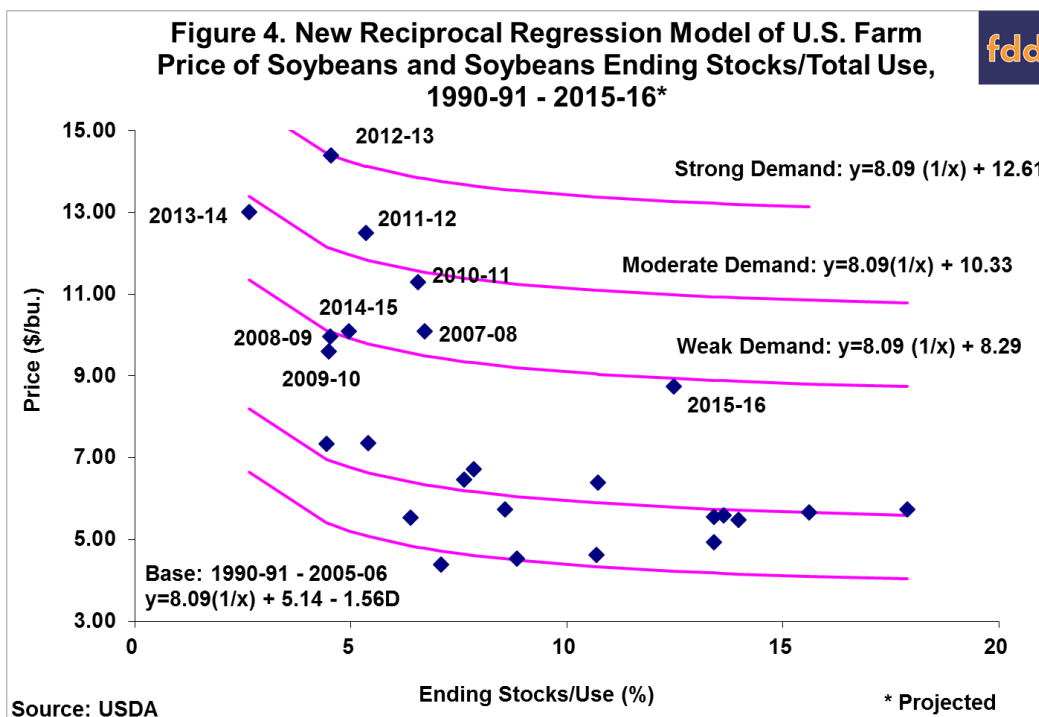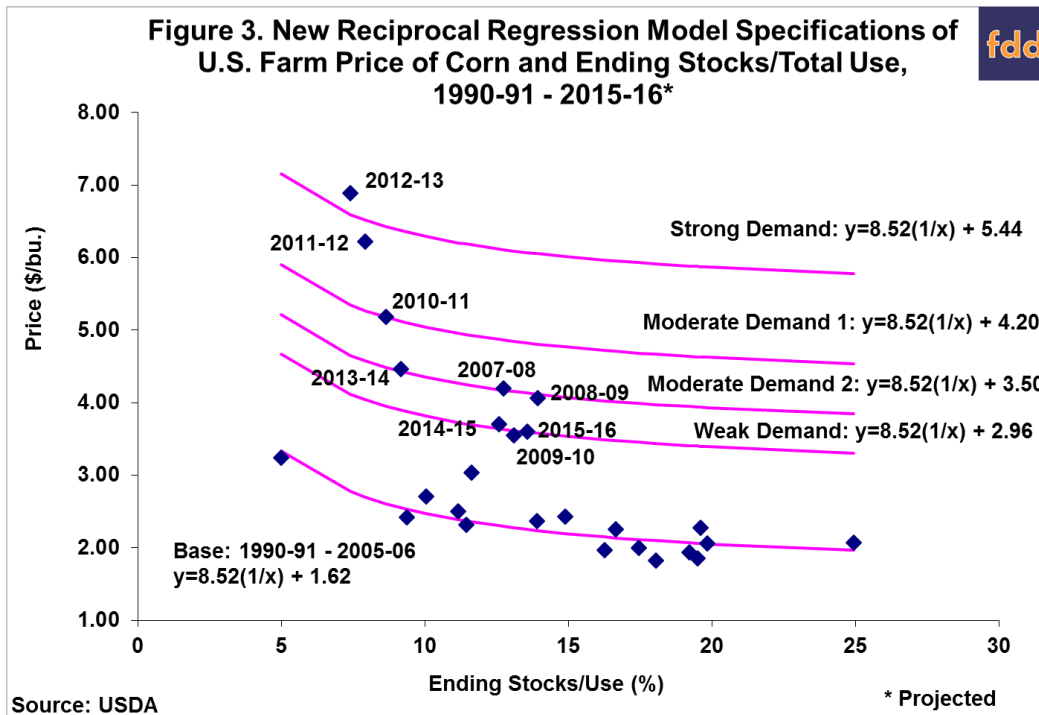| Crop	U.S. Marketing Year Average Price		Illinois Monthly Average Price	
	Projected	Actual	Projected	Actual
Corn	$4.35	$4.49	$4.60	$4.70
Soybeans	$10.44	$10.61	$11.04	$11.41

Note: Actual for the U.S. marketing year average is from 2006-07 through projections for 2015-16. Actual for Illinois monthly average price is from December 2006 through February 2016.

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Review of Ending Stocks and Price Models

The marketing year ending-stocks-to use ratio is a widely used indicator of the supply and demand "tightness" of corn and soybean market conditions and is very commonly used to project prices. Tomek and Kaiser (2014, p. 379) note that a variety of non-linear functional forms are used in these models because, "This accommodates the idea that, as current stocks approach zero (but cannot be less than zero), price must necessarily rise sharply to ration these stocks among competing demands." In a recent article (*farmdoc daily*, April 6, 2016), we followed the work of Tomek and Kaiser (2014, pp. 378-382) and Verteramo and Tomek (2015) and estimated a base reciprocal regression model of the U.S farm price of corn and soybeans and the ending stocks-to-use ratio for the period 1990-91 through 2005-2006, skipped 2006-07 as a transition year, and then estimated relationships after 2005-06 that are exactly parallel to the base period model. In the new model, we assumed the slope is unchanged between the base period and relationships after 2005-06, but the intercept varies in the latter period to reflect demand shifts that occurred after 2005-06. The years after 2005-06 were grouped into four demand scenarios for corn (weak, moderate 1, moderate 2, and strong) and three demand scenarios for soybeans (weak, moderate, and strong). This specification differs from our previous model specifications that fit a regression to the stocks-to-use for two different time periods for corn (1990-91 through 2005-06, and 2007-08 through 2015-16) and a single time period for soybeans (1990-91 through 2015-16).

Figures 3 and 4 repeat the stocks-to-use and price models for corn and soybeans, respectively, presented in our recent article. We refer the reader to that article (*farmdoc daily,* April 6, 2016) for a detailed discussion of the new models. Note that forecasting marketing year average prices using the new stocks-to-use and price models is a two-step process. The stocks-to-use ratio must be projected first and then the appropriate scenario for demand has to be specified. We illustrated that two-step process for the 2016-17 marketing year using alternative balance sheet projections for corn and soybeans in a *farmdoc daily* article of April 13, 2016.

Finally, it is important to highlight the nature of the pricing models presented in Figures 3 and 4. Tomek and Kaiser (2014, p. 378) classify these types of models as "price determination equations" rather than formal structural models of supply and demand. They point out the complexity of realistic structural models that have separate equations for supply and the various demand categories. As a result, analysts often turn to, "…graphs, tables, and simple regression models of price determination to summarize information." They also helpfully observe that, "The research objective may be to provide a forecasting tool, but more generally, the analysis helps the researcher depict current economic conditions relative to the historical evidence." The bottom-line is that the regression models in Figure 3 and 4 cannot be directly derived (at least easily) from underlying structural and mathematical models of supply and demand. However, this does not mean the models are disconnected from supply and demand for corn and soybeans. There is a connection, and it can be best described as conceptual and logical from an economic standpoint.

Figure 3. New Reciprocal Regression Model Specifications of U.S. Farm Price of Corn and Ending Stocks/Total Use, 1990-91 - 2015-16*

Strong Demand: y=8.52(1/x) + 5.44

Moderate Demand 1: y=8.52(1/x) + 4.20

Moderate Demand 2: y=8.52(1/x) + 3.50

Weak Demand: y=8.52(1/x) + 2.96

Base: 1990-91 - 2005-06
y=8.52(1/x) + 1.62

Price ($/bu.)

Ending Stocks/Use (%)

Source: USDA   * Projected

Figure 4. New Reciprocal Regression Model of U.S. Farm Price of Soybeans and Soybeans Ending Stocks/Total Use, 1990-91 - 2015-16*

Strong Demand: y=8.09 (1/x) + 12.61

Moderate Demand: y=8.09(1/x) + 10.33

Weak Demand: y=8.09 (1/x) + 8.29

Base: 1990-91 - 2005-06
y=8.09(1/x) + 5.14 - 1.56D

Price ($/bu.)

Ending Stocks/Use (%)

Source: USDA   * Projected

Analysis of New Era Projections

We now proceed to analysis of the new era price projections for corn and soybeans using the reciprocal regression models in Figures 3 and 4. Since the regression models project the farm price of corn and soybeans for a wide range of stocks-to-use ratios, we need some method of converting the relationships to a single average price that can be compared to our earlier new era projections. We use a multi-step process, outlined as follows:

1) The ending stocks-to-use ratio is calculated for each marketing year from 1990-91 through 2015-16.

2) The average marketing year price is projected for each of those stocks-to use-ratios based on the new ending stocks and price models for each demand scenario—four for corn and three for

soybeans. So, each of the actual stocks-to-use ratios over 1990-91 through 2015-16 is plugged into each of the regression relationships and prices are computed based on the relationships. Using all stocks-to-use ratios over the 26-year period, and not just the ones used originally to estimate the relationships, provides the most representative sample of stocks-to-use ratios likely to occur in the future.

3) The average of those projected prices is calculated for each demand scenario, and those averages are shown in line (1) of Tables 2 and 3. Based on the historical distribution of stocks-to-use ratios, these represent the likely average price for each demand scenario.

4) The average prices for each demand scenario are weighted by the expected frequency of occurrence for each scenario to calculate a weighted-average projected price in the new era. The first computation uses the frequency of occurrence during the nine-year period from 2007-08 through 2015-16 and is shown in lines (2) and (3) of Tables 2 and 3.

5) The weighted average projected price is also calculated for frequencies of occurrence for two alternative scenarios that differ from the actual frequency of the most recent nine years. The alternatives are more heavily weighted towards the weak demand scenario. The computations of the alternative weighted-average projected prices are shown in lines (4), (5), (6), and (7) in Tables 2 and 3.

Table 2. Demand Scenarios for Corn and Computation of Alternative Projected U.S. Marketing Year Average Prices for the New Era

	Demand Scenario				Weighted-Average
	Weak	Medium 1	Medium 2	Strong	Projected Price
(1) Average Price ($/bu.)	$3.67	$4.21	$4.90	$6.15	
(2) New Era Frequency (# years)	3	3	1	2	
(3) New Era Frequency (% years)	33%	33%	11%	22%	$4.54
(4) Alternative Frequency 1 (# years)	4	3	1	1	
(5) Alternative Frequency 1 (% years)	44%	33%	11%	11%	$4.26
(6) Alternative Frequency 2 (# years)	5	3	1	0	
(7) Alternative Frequency 2 (% years)	56%	33%	11%	0%	$3.99

Note: New era frequencies refer to the 2006-07 through 2015-16 period. Weighted-average prices are computed as the sum of average prices in line (1) times the corresponding percentage frequencies in line (3), (5), or (7).

Table 3. Demand Scenarios for Soybeans and Computation of Alternative Projected U.S. Marketing Year Average Prices for the New Era

	Soybean Demand Scenario			Weighted-Average
	Weak	Medium	Strong	Projected Price
(1) Average Price ($/bu.)	$9.45	$11.50	$13.78	
(2) New Era Frequency (# years)	5	3	1	
(3) New Era Frequency (% years)	56%	33%	11%	$10.62
(4) Alternative Frequency 1 (# years)	6	3	0	
(5) Alternative Frequency 1 (% years)	67%	33%	0%	$10.14
(6) Alternative Frequency 2 (# years)	7	2	0	
(7) Alternative Frequency 2 (% years)	78%	22%	0%	$9.91

Note: New era frequencies refer to the 2006-07 through 2015-16 period. Weighted-average prices are computed as the sum of average prices in line (1) times the corresponding percentage frequencies in line (3), (5), or (7).

Based on the ending-stocks-to use ratios for the past 26 years and the frequency of weak, moderate, and strong demand scenarios over the past nine years, the new ending stocks and price models project the U.S. average marketing year farm price of corn and soybeans in the new era at $4.54 and $10.62, respectively. The computation for corn is,

$$\$4.54 = (\$3.67 \times 0.33) + (\$4.21 \times 0.33) + (\$4.90 \times 0.11) + (\$6.15 \times 0.22)$$

and for soybeans,

$$\$10.62 = (\$9.45 \times 0.56) + (\$11.50 \times 0.33) + (\$13.78 \times 0.11).$$

As expected, these projections are close to the average prices actually experienced over the past nine marketing years. They are not exactly the same because the model averages represent points on the respective regression lines while the actual averages generally do not lie on the lines.

The alternative scenarios assume higher frequencies of the weak demand conditions in order to provide more conservative average price projections. The first alternative for corn removes one year from the strongest demand scenario and transfers it to the weakest demand scenario. The second alternative for corn removes both years from the strongest demand scenario and transfers them both to the weakest demand scenario. The re-calibration results in average price projections for the new era of $4.26 and $3.99, respectively. A similar re-calibration for soybeans results in average price projections for the new era of $10.14 and $9.91, respectively. These alternatives are particularly interesting because, even after assuming the frequency of strong demand will be less in the future than in the last nine years, the average price projections are relatively high—near $4.00 for corn and $10.00 for soybeans.

Of course, one could come up with a large number of alternative re-weightings of the demand scenarios and generate associated average price projections. One interesting alternative is to assume that corn and soybean markets remain stuck in the weak demand scenario for the foreseeable future. This amounts to putting a weight of 100 percent on the weak demand scenario in the computation of new era price projections in Tables 2 and 3, which implies that the price projections can be read directly off the average prices for the weak demand scenario in row (1) of Tables 2 and 3. The averages are $3.67 for corn and $9.45 for soybeans, and they can be thought of as lower bound estimates of average corn and soybean prices in the new era. This is particularly interesting since the two most recent marketing years for both corn and soybeans belong to the weak demand scenario. Furthermore, the weak demand scenario also includes marketing years during the Great Recession of 2008-09. This suggests that the low grain prices of recent

years represent a run of prices near the bottom of the new era price range rather than an end to the new era that began in 2006-07. Forecasting average prices significantly lower than $3.67 and $9.45 for corn and soybeans—what might be called the "uber-bear" scenario—requires projecting demand to be even weaker than what we have experienced in the most recent two marketing years and during the Great Recession. This is not to say this absolutely cannot happen, just that it seems unlikely based on the available data for the last nine marketing years.

Implications

The level of long-term average grain prices is central to farm incomes, rents, land values, and expenditures for commodity support programs. Our position for some time has been that grain prices moved to a new era of higher average nominal prices beginning in late 2006. We re-compute our original projections using marketing year average prices and project new era averages of $4.35 and $10.44 per bushel for corn and soybeans, respectively. For comparison purposes, we make projections of new era average prices based on reciprocal regression models of the U.S farm price of corn and soybeans and the ending stocks-to-use ratio, and find that these are very consistent with simple projections based on a ratio of the previous era average prices. Since the new stocks and price models are based on a stronger economic foundation, we are more confident in these results. Our most conservative scenarios project U.S. average corn and soybean prices of about $4 and $10 in the new era, and averages of $4.25 and $10.50 seem quite plausible. In sum, we conclude that the current period of relatively low corn and soybean prices reflects a combination of moderately high stocks-to-use ratios substantially influenced by good crop weather around the world and a weak demand environment, not a halt to the new era of higher average (nominal) grain prices.

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