The Relationship between Stocks-to-Use and Soybean Prices Revisited

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The 2014-15 marketing year average farm price of soybeans, currently projected at $10.05 per bushel by the USDA, will likely be the lowest marketing year average since 2009-10 and about $2.75 per bushel less than the average of the previous four years. Lower prices have resulted in much narrower operating margins for many soybean producers. Soybean prices during the 2015-16 marketing year will be pivotal in determining if producer operating margins remain weak, worsen, or are reversed.

At this juncture, there are differences of opinion about the likely level of prices during the year ahead, with most expecting prices to average lower than during the current marketing year. USDA projections in the May 12, 2015 WASDE report are for an average farm price in a range of $8.25 to $9.75 (mid-point of $9.00). Last month's projections from the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri include an average farm price for soybeans of $9.17. Our own projection from an April 1 webinar is an average price of $9.75. Price projections differ because of different expectations about the supply of soybeans, the strength of soybean demand, and the interaction of supply and demand to determine price.

In this article, we re-examine the historical relationship between the domestic ending stocks-to-use ratio and the U.S. average farm price of soybeans during the marketing year. This relationship has often been used to reflect the interaction among soybean supply, demand, and price. A strong relationship, then, would make the projected stocks-to-use ratio a useful indicator of the marketing year average farm price. We extend the analysis to the relationship between the world ending stocks-to-use ratio and the U.S. average farm price of soybeans during the marketing year. The latter relationships are examined to determine if soybean prices are better explained by soybean supply and demand interactions beyond the U.S. domestic interaction only. The analysis presented here is similar to the analysis for corn in our *farmdoc daily* article of April 9, 2015 and is an extension of some of the analysis presented by Carl Zulauf in the *farmdoc daily* article of March 13, 2015, which examined trends in the world soybean market.

Analysis

In the classical supply/demand framework, the average price of soybeans in any particular marketing year represents the equilibrium price determined by the intersection of the supply and demand curves. Note that
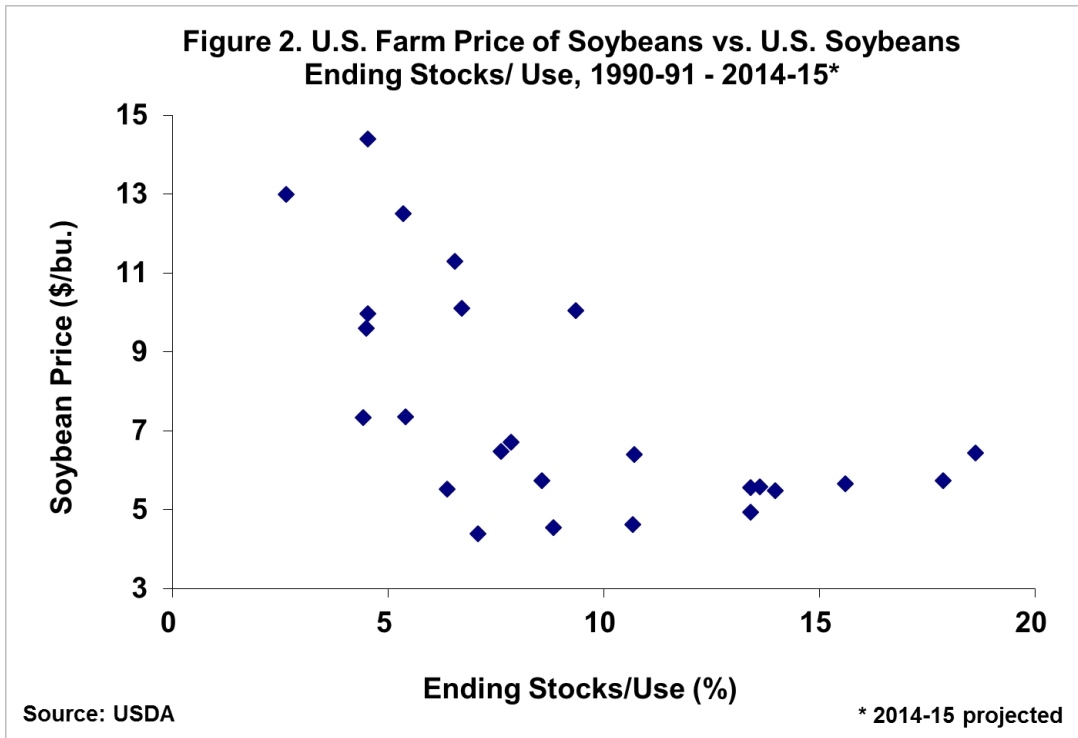
the curves shown in Figure 1 represent total soybean supply from production and imports and total demand for domestic crush, exports, and ending stocks. Over time, the equilibrium price changes as the demand curve, supply curve, or both shift. Those equilibrium prices, then, can be examined with the stocks-to-use ratio serving as a proxy for the interaction of supply and demand in quantity terms.

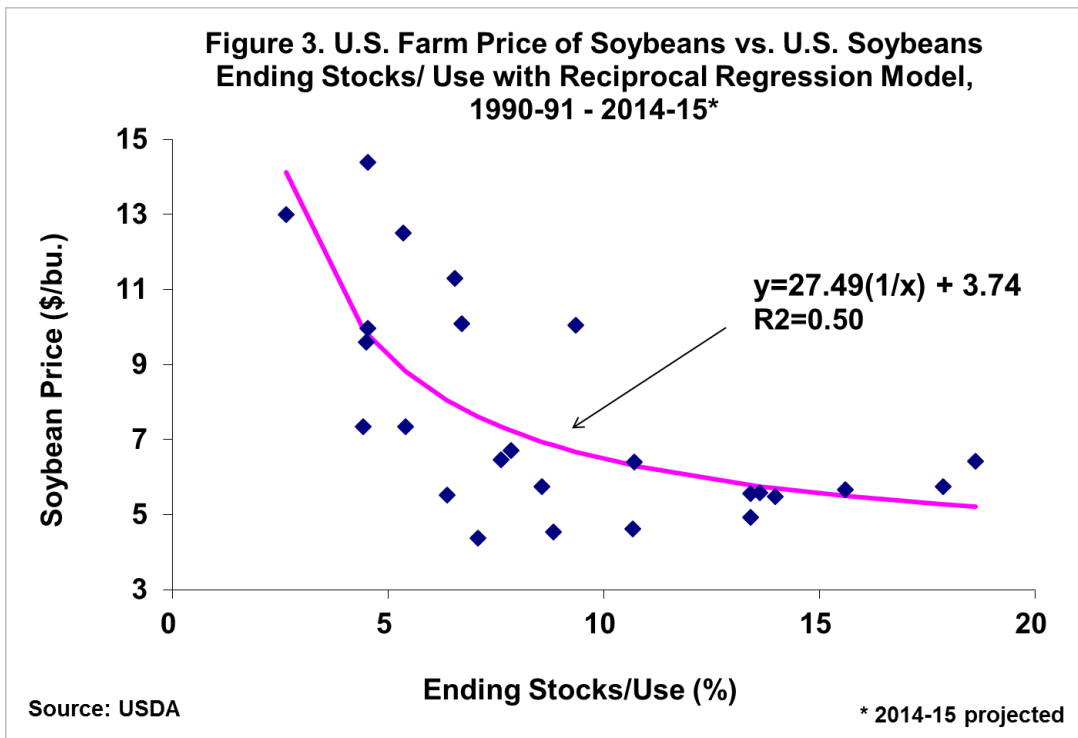**Figure 1. Theoretical Movement of Soybean Supply and Demand Curves Through Time**
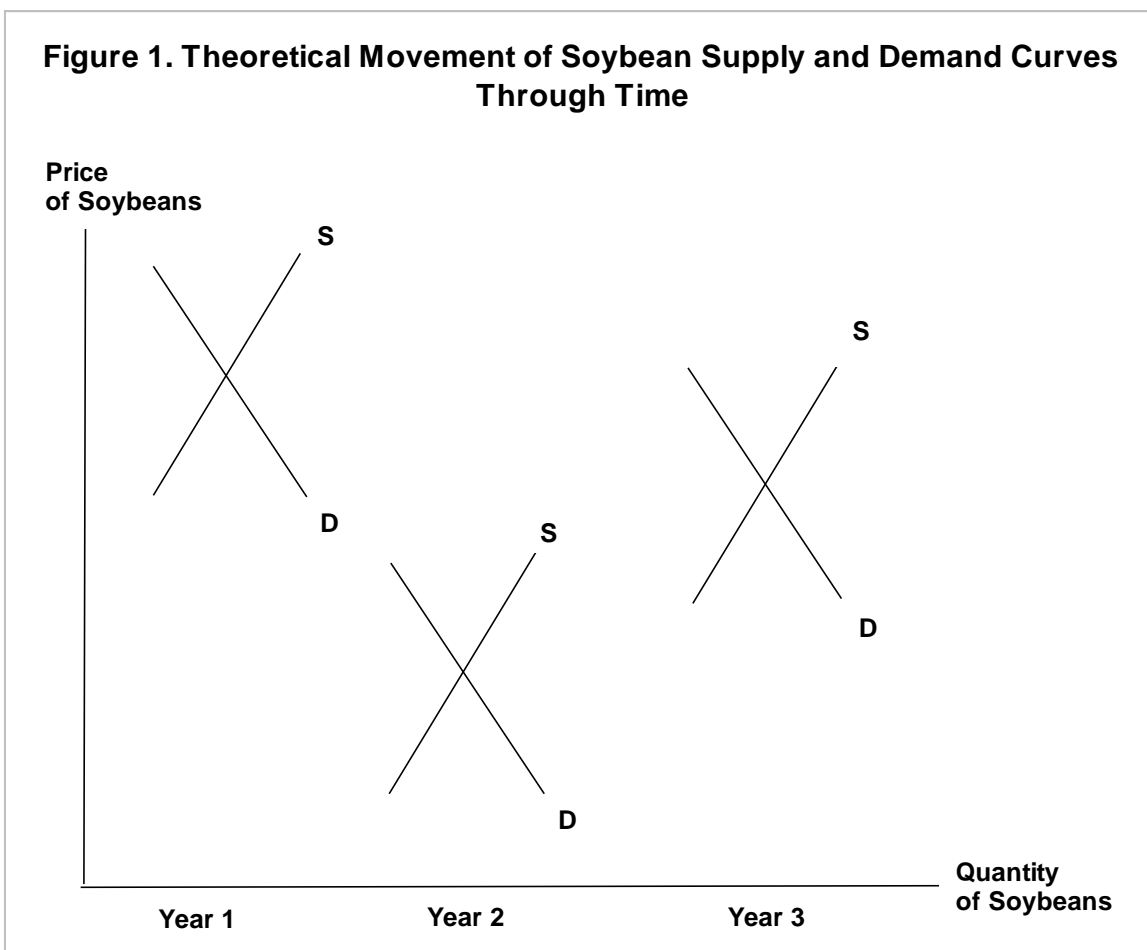
The average marketing year price and ending stock-to-use ratio for the period 1990-91 through 2014-15 is shown in Figure 2. For the current year (2014-15), the projection of year ending stocks and the mid-point of the range of the projected average farm average from the May 12 WASDE report is used. It is tempting to view the relationships in Figures 2 as an attempt at tracing out demand curves for soybeans; but, it should always be kept in mind that the individual price observations reflect the interaction of both supply and demand in each of the marketing years. This is the classic economic problem of identification, where a given price-quantity combination can be the result of the demand curve shifting, the supply curve shifting, or both. The stocks-to-use ratio is therefore only a proxy for the true relationship.

As expected, there is a general negative relationship between the stocks-to use ratio and the average farm price. That is, a low stocks-to-use ratio is associated with a high price and *vice versa.* It is clear, however, that the relationship is not especially strong over the entire time period. For example, note the very wide range of price outcomes for stocks-to-use ratios in the range of 5-7 percent. Nonetheless, we estimated the relationship between the average marketing year price and ending stock-to-use ratio using a reciprocal regression specification, so that:

$$\text{Soybean Price} = a + b\ (1/\text{Stocks-Use Ratio}).$$

Figure 2. U.S. Farm Price of Soybeans vs. U.S. Soybeans Ending Stocks/ Use, 1990-91 - 2014-15*
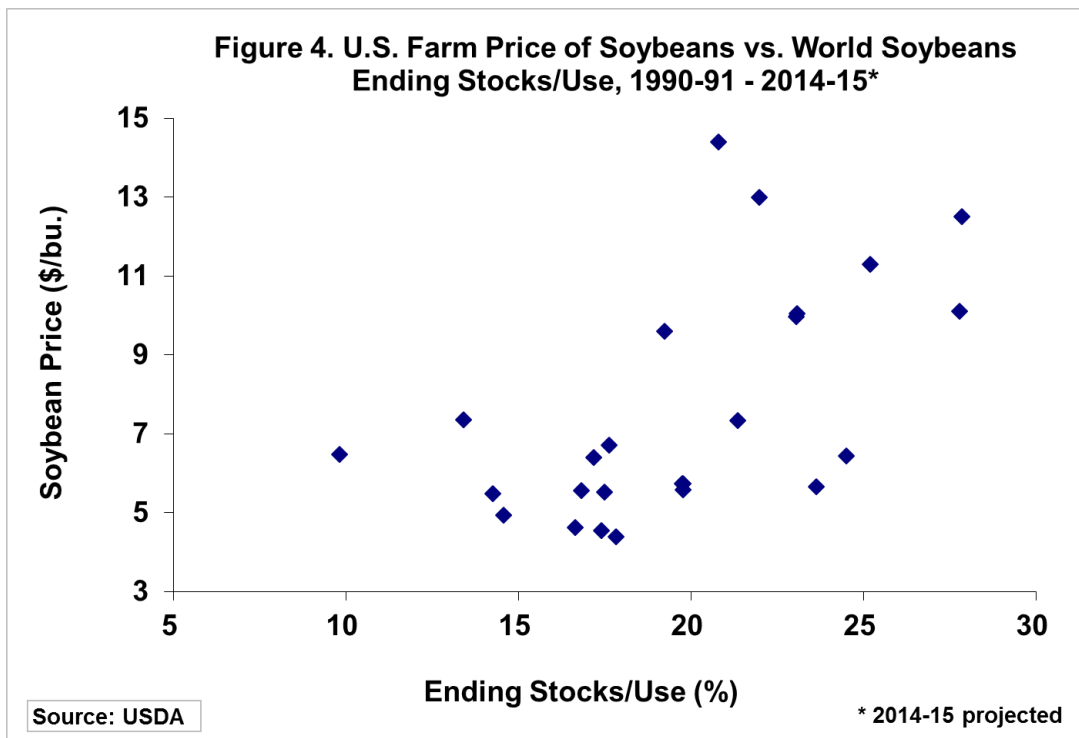

Source: USDA

* 2014-15 projected

This specification is simple and imposes a curvilinear relationship between price and the stocks-to-use ratio. That is, the curve becomes steeper and steeper as the stocks-to-use ratio declines, and *vice versa*. Figure 3 shows the same data points as in Figure 2 along with the estimated reciprocal regression line. The lack of observed fit between the stocks-to-use ratio and average marketing year price is confirmed by the small percentage of variation in price explained by the stocks-to-use-ratio (R2 of 0.50).

Figure 3. U.S. Farm Price of Soybeans vs. U.S. Soybeans Ending Stocks/ Use with Reciprocal Regression Model, 1990-91 - 2014-15*

$y = 27.49(1/x) + 3.74$
$R2 = 0.50$

Source: USDA

* 2014-15 projected

For corn, we argued that the relationship should be viewed in the context of two different eras. The first era in soybeans spans from 1990-91 through 2006-07 and consists of the lower price points in Figure 2. The second era spans from 2007-08 through 2014-15 and it contains the upper and more steeply sloped cluster of points in Figure 2. As we have argued for some time now (e.g., Irwin and Good, 2009; *farmdoc daily*, March 29, 2011; *farmdoc daily*, February 27, 2013), the two eras for soybeans represented in Figure 2 are mainly differentiated by the increase in biofuel production and the rapid increase in Chinese soybean imports that both began in 2007-08. That is, the outward shift in the demand curve resulted in higher prices, for a given level of supply, than was the case in the period prior to 2007-08. While the soybean supply curve likely did not shift at first, there was undoubtedly movement along the supply curve as higher prices resulted in expanded soybean acreage. The resulting large outward shift in the demand curve and movement along a relatively inelastic (price insensitive) supply curve meant that a stocks to-use ratio of a given magnitude was associated with a higher price in the latter era than in the former era. Given more time to adjust there has also undoubtedly been some rightward shifts in the soybean supply curve, but the available evidence suggests that the elasticity of acreage supply is fairly modest even in the intermediate- to longer-run. Unlike what was found for corn, however, separating the observations into two eras does not result in a better "fit" between the stocks-to-use ratio and the average marketing year farm price. The R2 is only 0.20 for the reciprocal regression model estimated over 1990-91 through 2006-07 and only 0.21 for the reciprocal model estimated over 2007-08 through 2014-15.

Since U.S. soybeans must compete in the world market, it could be argued that U.S. soybean prices might better be explained by an expanded stocks-to-use ratio. We examined the relationship of the total world stocks-to-use ratio and U.S. farm price of soybeans (Figure 4) over the entire time period and found that the fit is "poor" and is counter-intuitive in that larger stocks-to-use ratios tend to be associated with higher prices. The lack of fit confirms the results reported by Carl Zulauf (*farmdoc daily*, March 13, 2015) based on observations only for the latter era from 2007 through 2014.

Figure 4. U.S. Farm Price of Soybeans vs. World Soybeans Ending Stocks/Use, 1990-91 - 2014-15*

Source: USDA

* 2014-15 projected

So, what might explain the poor fit between the stocks-to-use ratio and marketing year average farm price for soybeans? We submit that the following two factors should rise to the top of the list:

1) Since soybean production is large in both the U.S. and South America, with harvest separated by roughly six months, there is really not a distinct marketing year for soybeans. This is very

different from corn where production is still concentrated in the northern hemisphere. It is not difficult to imagine, then, that the demand for soybean stocks is very different than the demand for corn stocks, resulting in a poorer fit between stocks and price. That is, the world soybean market is more similar to the wheat market than to the corn market. Wheat is produced in substantial quantities in various parts of the world with a wide range of harvest dates so the demand for stocks is likely quite weak. The relationship between the stocks-to-use ratio (domestic or world) and average U.S. marketing year farm price is extremely limited.

2) The value of soybeans is derived from the value of soybean meal and soybean oil which are produced in relatively fixed quantities when soybeans are processed. The markets for the two products are very distinct with soybean meal predominantly livestock feed and soybean oil predominantly for human consumption, with a recent increase in fuel consumption. The price of those two products in any given marketing year is derived from the interaction of supply and demand in each market. Those interactions can vary considerably from year-to-year, resulting in various combinations of prices and therefore substantial variation in the derived value of soybeans. As a result, forming price expectations for soybeans requires the hard work of evaluating supply, demand, and price prospects for meal and oil. Unlike corn, projecting the stocks-to-use ratio for soybeans does not provide a very useful shortcut for forming price expectations.

Implications

We estimated the relationship between the U.S. stocks-to-use ratio and the world stocks-to-use ratio for soybeans and the marketing year average U.S prices for the period 1990-91 through 2014-15. The analysis did not result in a strong enough fit to render the projected soybean stocks-to-use ratio useful in projecting the marketing year U.S. average price of soybeans. This is in stark contrast to corn where a reasonable fit between the domestic stocks-to-use ratio and marketing year average price suggested that a projected ratio would be useful in projecting the U.S. marketing year average price. The poor relationship between the stocks-to-use ratio and price for soybeans implies that a projected balance sheet provides less price forecasting information than is provided by a corn balance sheet. As a result, one might expect that soybean price expectations would vary widely among market participants and price analysts, even if there is some agreement on the projected balance sheet.

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