Rethinking the Soybeans-to-Corn Price Ratio: Is It Still a Good Indicator for Planting Decisions?

by
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Abstract: The soybeans-to-corn price ratio is a simple measure of relative returns for corn and soybeans. This article examines the ratio in terms of its role in explaining the switch between corn and soybean plantings in historical context and the evolution of the soybeans-to-corn breakeven price ratio. In addition, this article points out deficiencies of the ratio as an indicator for planting decisions, particularly after the enactment of the 1996 farm legislation.

Keywords: Soybeans-to-corn price ratio, breakeven price ratio, corn, soybeans.

Analysts have long used the soybeans-to-corn price ratio as an indicator to determine whether there would be an acreage switch from corn to soybeans, or vice versa. If producers expect the soybeans-to-corn price ratio to exceed the breakeven price ratio (BEPR), there would be a tendency to switch from corn to soybean plantings. Conversely, if the expected soybeans-to-corn price ratio is below the BEPR, the reverse would be true. The BEPR is the ratio of expected soybeans-to-corn prices which equates the expected net returns of producing corn and soybeans, given trend yields of corn and soybeans, the expected price of corn, the variable costs of corn and soybean production, the expected program payments, and other program expenses.

The soybeans-to-corn price ratio is a simple measure of relative returns for corn and soybeans. When producers expect the price ratio to exceed the BEPR, it suggests that expected net returns for soybeans are greater than those for corn. In contrast, if the expected price ratio is below the BEPR, it suggests the opposite is true. However, producers do not simply look at the price of soybeans versus the price of corn in deciding what to plant. Other than crop rotation concerns and restraints, the use of the soybeans-to-corn price ratio assumes that the market prices for corn and soybeans accurately reflect their relative net returns. This may be a heroic assumption in the current climate.

This article examines the ratio in terms of its role in explaining the switch between corn and soybean plantings in historical context and the evolution of the soybeans-to-corn breakeven price ratio. In addition, this article points out deficiencies of the ratio as an indicator for planting decisions, particularly after the enactment of the 1996 farm legislation.

Given more planting flexibility, States outside of the main Corn Belt have accounted for much of the change in corn and soybean acreage in the last 2 years. The soybeans-to-corn price ratio presents a less complete picture of crop choices than in the past as (1) corn and soybean production continues to expand to the Central and Northern Plains region and, to a lesser extent, the Delta and Southeast regions over the last 2 years, and (2) plantings became more flexible under the 1996 Act. Analysis of other indicators, such as the soybeans-to-cotton price ratio and the corn-to-cotton price ratio for the Delta and Southeast, becomes necessary to more fully capture the competition for cropland use among major field crops. In addition, due to planting flexibility and a faster yield gain in soybean production since the early 1990's, the BEPR, which used to be around 2.6 at the national level in the early 1990's, hovers around 2.5 for this year, offering producers greater incentives to switch from corn to soybean plantings.[2]

Due to greater planting flexibility, corn and soybean plantings in future years are likely to be increasingly affected by factors other than the soybeans-to-corn price ratio. In the Great Plains region, these other factors could include the soybeans-to-wheat price ratio and the corn-to-wheat price ratio. In the Delta and Southeast regions, these price relationships include the soybeans-to-cotton price ratio, the corn-to-cotton price ratio, and the soybeans-to-wheat price ratio. In the spring wheat areas, the soybeans-to-wheat price ratio could be relevant to forecasting soybean acreage in future

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[2]The soybeans-to-corn price ratio in this article, unless indicated otherwise, refers to the ratio that is computed from the new crop corn and soybean futures price in mid-March after being adjusted by basis, difference between new crop futures prices in the month preceding delivery, and corresponding monthly cash prices received by farmers.

years. Much of the other price relationships need further investigation before the exact relationships are established.

U.S. Soybeans-to-Corn Price Ratios

The soybeans-to-corn price ratio is calculated by dividing November soybean futures prices by December corn futures prices in mid-March—the time when most corn planting decisions are made by producers—at the Chicago Board of Trade after the futures prices are adjusted to a U.S. farm-level equivalent by a basis. The basis is computed by subtracting the monthly average futures price for the month preceding delivery of the contract—November for December corn futures prices and October for November soybean futures prices—from the corresponding monthly price received by farmers. The expected basis for each year during 1986-97 is the previous 8-year moving average of bases (tables B-1 and B-2).[3] The expected basis has been trending downward (in absolute value) for corn and soybeans, with an average value of -$0.26/bu for soybeans and -$0.22/bu for corn at the national level.

Since the late 1970's, the basis for corn and soybeans has been negative, reflecting transportation costs of shipping corn and soybeans from the farm gate to terminal markets at the delivery point of the futures contract. The basis, as shown in tables B-1 and B-2, also refers to an average at the national level, which may not reflect the actual farm price received by producers in specific localities. For example, if new crushing plants are being built further west and north, then the price of soybeans (net of delivery costs) received by farmers would increase as a result of the decline in delivery costs to these new plants.

Since the mid-1980's, U.S. soybeans-to-corn price ratios (as used here) have fluctuated between 2.39 in 1996 and 3.27 in 1988 (table B-3). Based on new crop futures prices in mid-March 1998, the ratio is around 2.35. Over the last few years, the ratio hovered around the range of 2.4-2.6. In general, the price ratio adjusted by basis is higher than the one computed directly by dividing new crop soybean futures prices by new crop corn futures prices. Over the last 3 years, that difference in the two price ratios was generally around 0.1.

The soybeans-to-corn price ratio, as estimated in this article, generally worked well in indicating the direction of the switch between U.S. corn and soybean plantings. For example, in 1987, the corn share of combined corn and soybean intended plantings was 54.3 percent, down from 55.7 percent in 1986, largely because the price ratio increased from 2.70 to 3.13. The increase in the Acreage Reduction Program (ARP) level from 17.5 percent in 1986 to 20 percent in 1987 also contributed to the decline in the corn share of plantings. Similarly, in 1990, the corn share of plantings was 55.7 percent, up from 54.3 percent in 1989, largely because the price ratio declined from 2.86 to 2.53. The ARP was not a factor in the switch that year because it was set at 10 percent for 1989 and 1990.

Over the last 2 years, factors other than the soybeans-to-corn price ratio and ARP levels became increasingly important in explaining producers' acreage choices between corn and soybeans. In 1996, the increase of 4.6 million acres in U.S. corn planting intentions in early March was largely caused by strong corn prices along with the elimination of the annual acreage reduction and 0/85-92 programs under the 1996 Act, which had idled 7.7 million acres in 1995 (table B-3).[4] However, soybean acreage also expanded mainly in the Central and Northern Plains, and Delta and Southeast. In 1997, the sharp rise in U.S. soybean plantings was only partly explained by the increase in the price ratio, from 2.39 in 1996 to 2.59 in 1997. Other important factors include the reduced seedings of winter wheat in the fall of 1996 and a decline of about 1 million acres altogether in corn and cotton plantings in the Delta and Southeast.[5] The reduced seeding of winter wheat had little to do with price. It was because farmers in the Midwest had experienced low-quality 1996 crops due to scab. Also, in some areas soybeans were harvested late, and it was too wet to plant in the fall of 1996.

The recent introduction and fast adoption of new crop technologies will add uncertainty to the soybeans-to-corn price ratio in future years. At this point, these crop technologies tend to achieve more cost-savings in input use for soybeans than for corn. For example, Roundup Ready varieties of soybeans reportedly could achieve a cost-saving of $15 to $20 per acre in herbicide use. On assumption that Roundup Ready varieties will account for about 25 percent of all soybean acreage in 1998, adoption of these varieties would lower the soybeans-to-corn breakeven price ratio by about 0.03.[6] A faster rate of adoption of the crop technology in the future could lower the price ratio even more, assuming no dramatic changes in corn costs. Bt corn, which was developed in recent years primarily to prevent yield losses caused by insect damage, could also affect the breakeven price ratio (see special article on *"The Impact of New Technology on the Corn Sector"*).

Similarly, the use of narrow-row plantings in recent years, facilitated by new seed varieties and herbicides contributed

[3]An 8-year moving average is chosen based on a research finding that expected basis calculated from the previous 8-year moving average has the least forecasting error (Heifner).

[4]In 1995, corn planting intentions in March totaled 75.3 million acres, which are 4.1 million more than the 71.2 million actual plantings due to very wet conditions at planting time.

[5] For producers in these regions that planted soybeans instead of corn or cotton, many of them were not looking at the November soybean futures price relationships. Instead, they were looking at the high, late 1996/97 season prices. A November/December soybeans-to-corn price ratio would not capture this.

[6]This estimate does not factor in any yield change expectations.

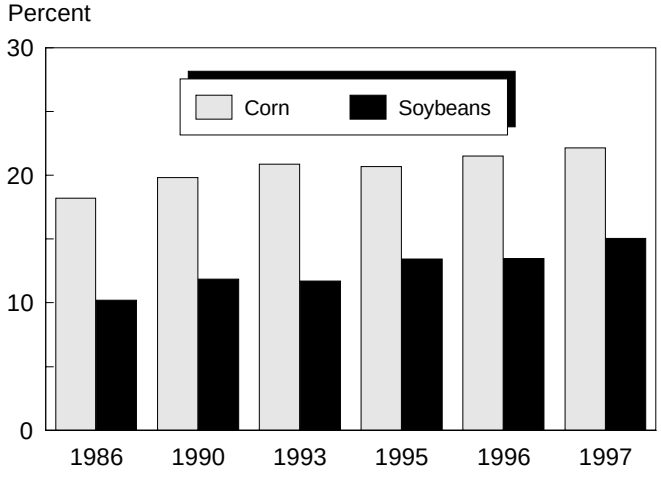
to faster yield gains for soybeans since the early 1990's, relative to the historic yield trend. The yield gains in soybeans have been astounding in recent years, while the yield pattern for corn has been more erratic, and for the last 3 years, at or below trend. Over the last 5 years, higher relative yield growth led to an average decline of 0.04 in the soybeans-to-corn breakeven price ratio.

Locational Shifts in Corn and Soybean Production

Corn and soybean plantings have greatly expanded in the Central and Northern Plains region (including the Dakotas, Nebraska, Kansas, Montana, Wyoming, and Colorado) in recent years (Schwartz). In 1996, corn plantings totaled 17.1 million acres in this region, up 10 percent from its 1993-95 average. More significantly, soybean plantings in 1997 totaled 10.7 million acres, up 15 percent from the average. The expansion of corn and soybean production in this region follows the shift in feedlot operations from the Corn Belt region to the Western States, a long-term trend. However, nearly full planting flexibility under the 1996 Act, coupled with strong corn and soybean prices and adequate precipitation over the last 2 years, enticed producers to switch from wheat, sorghum, barley, and oats to more profitable crops, such as corn and soybeans. Also, the 1996 Act facilitated crop rotations, which were constrained by the previous farm legislation.

In 1997, corn plantings in the Central and Northern Plains regions totaled 17.8 million acres, up from 13.9 million in 1986. The regions' share of U.S. corn plantings increased from 18.2 percent in 1986 to 22.1 percent in 1997 (figure B-1). Similarly, soybean plantings totaled 10.7 million acres, up from 6.2 million in 1986. The regions' share of U.S. soybean plantings increased from 10.2 percent to 15.0 percent during this period. The long-term increasing trends in corn and soybean plantings appeared to be steady.

Figure B-1
The Share of U.S. Plantings in the Central and Northern Plains



Expansion in corn and soybean plantings in the Delta and Southeast regions occurred only 2 years ago. In 1996, corn plantings totaled 6.0 million acres, up 20 percent from the 1993-95 average. Similarly, 1997 soybean plantings totaled 12.4 million acres, up 8 percent from the 1993-95 average. For corn in 1996 and soybeans in 1997, the expansion had largely to do with huge farm price advantages for the regions' early harvested crops. Many producers planned to capture the strength of late 1995/96 corn prices in 1996 and late 1996/97 soybean prices in 1997. Despite the growth of corn and soybean plantings, the regions' share of U.S. plantings remained virtually unchanged in recent years—7.1 percent for corn and 17.5 percent for soybeans in 1997. In the mid-1980's, the share of U.S. corn and soybean plantings was even higher—9.3 percent for corn and 24.5 percent for soybeans. Corn and soybean acreage actually declined, from 7.1 million acres of corn and 14.8 million acres of soybeans in the mid-1980's to 5.2 million of corn and 11.3 million of soybeans in the mid-1990's. In contrast, cotton acreage expanded during this period.

Evolution of the Soybeans-to-Corn Breakeven Price Ratio

The BEPR has gone through changes over time. At the national level, the BEPR hovers about 2.54 this year, down from 2.60 in the early 1990's and 2.95 in the late 1980's. In the North Central region (including Iowa, Illinois, Ohio, Indiana, Missouri, Minnesota, Michigan, and Wisconsin), the BEPR hovers around 2.50, down from 2.55 in the early 1990's.[7] In the Delta and Southeast, the BEPR is about 2.55 this year, mainly because the region is a feed-deficit area where corn prices are considerably higher than in the North Central region. Soybean prices in the South are also higher than in the North Central, but not as much as the difference for corn.

The BEPR is lower this year because program payments are no longer a factor in producers' planting decisions, and a faster yield gain for soybeans continues.[8] If corn prices expected by producers were at the same, lower level (around $2.40 per bushel) as in the early 1990's, the U.S. BEPR would be even lower, at about 2.48. Thus, over the last decade, the BEPR has shown a decline as a result of changes in the corn program, a faster yield gain for soybeans since the early 1990's, and changing corn market conditions.

[7]At the regional level, basis is computed as the differential between new crop futures prices in the month preceding delivery and corresponding monthly cash prices received by farmers in the region.
[8]Considerable differences in the reported BEPR's for 1998 exist among analysts, ranging from 2.0-2.1 to 2.4- 2.5 (Good; Kohlmeyer; Smetana). Although a part of the differences is probably attributed to the mechanics of computing the price ratio (i.e., whether the futures prices are adjusted for basis or for non-fundamental influence on futures prices due to the trends), the remaining differences are attributed to other reasons yet unexplained.

From 1986 to 1990

Producers had a tendency to continue growing corn, and were deterred from making a switch from corn to soybean plantings during this period. The potential for large corn deficiency payments during 1986-87, as high as over $1 per bushel, greatly deterred producers from making a switch from corn to soybean plantings. Also, maximum payment acreage during this period was at the highest level in recent history, equaling base acreage less ARP acres. As a result, the BEPR averaged about 2.95 at the national level and 2.80 in the North Central region. However, the same magnitude of increase in the soybeans-to-corn price ratio expected by producers then had a smaller effect on producers' decisions in switching corn to soybean plantings than it would have since 1996. This is because, in addition to the economic barrier to planting flexibility, protecting corn base acreage represented an institutional barrier which is not reflected in the estimated soybeans-to-corn price ratio (Westcott).

The BEPR for this period is defined as:

$$BEPR=(1/P_c*Y_{soy})[(1-ARP)(P_c*Y_c-VC_c)+ (1-ARP)(DP_c*PYc)-VC_{arp}+VC_{soy}]$$

where P_c is the expected price of corn, Y_{soy} is trend yield of soybeans, ARP is the *Acreage Reduction Program* idled acres, Y_c is trend yield of corn, DP_c is per-bushel deficiency payment for corn, PY_c is program yield of corn, V_c, VC_{soy}, and VC_{arp} are variable costs of growing corn and soybeans, and of maintaining conserving-use of the ARP idled acre, respectively.[9] The expected price is the December corn futures at Chicago Board of Trade in mid-March, further adjusted by the basis to allow for price differentials across States.

From 1991 to 1995

Producers had more planting flexibility to switch between corn and soybeans during this period as a result of the evolution of the farm program towards market orientation. The BEPR declined to around 2.60 at the national level and 2.55 in the North Central region during 1991-95. There are three factors that have contributed to the decline: (1) a significant decline in per-bushel corn deficiency payments due to lower target prices, (2) a decline in the maximum payment acres by 15 percent because of normal flex acreage (NFA), and (3) a greater yield gain for soybeans since the early 1990's. The U.S. BEPR would have been even lower, at around 2.55, if program payments had not been a factor in producers' planting decisions. On the other hand, smaller ARP's during 1991-95, relative to those during 1986-90, had kept the BEPR lower.

The deficiency payment for corn declined to $0.10-$0.35 per bushel due to lower target prices lowering program incentives for corn production. In the meantime, producers were given limited planting flexibility through NFA, which amounted to 15 percent of the base, but received no deficiency payments. To many producers, the 15-percent NFA was sufficient flexibility to switch plantings from corn to soybeans, or other competing crops. This greatly reduced the institutional barrier to planting flexibility.

The faster yield gain in soybean production started to show an apparent effect on lowering BEPR since the early 1990's. For example, trend yields for U.S. soybeans increased from 34.7 bushels per acre in 1991 to 38.6 bushels by 1997, a 35-percent increase in the annual yield increment during 1986-90. The faster yield gain lessened the soybean prices in order to equate the expected net returns between corn and soybean production.

The BEPR for this period is defined as:

$$BEPR=(1/P_c*Y_{soy})[(1-ARP)(P_c*Y_c-VC_c)+ (1-ARP-0.15)(DP_c*PY_c)-VC_{arp}+VC_{soy}]$$

All variables have the same meanings as defined earlier.

From 1996 to 1998

The breakeven price ratio continued to decline during this period, from 2.60 during 1991-95 to around 2.54 this year—about 2.50 in the North Central region and 2.55 in the Delta and Southeast regions, but could be lowered to around 2.48 if expected corn prices were at the early 1990's level. The 1996 Act offers producers nearly full planting flexibility by removing institutional and economic barriers. With a few exceptions, producers can plant any crop on their entire base acreage. Also, program payments are no longer a factor in producers' planting decisions. In the meantime, the rising yield gain in soybean production continues in force.

The BEPR for this period is defined as:

$$BEPR=(1/P_c*Y_{soy})[(P_c*Y_c-VC_c)+VC_{soy}]$$

All variables were defined earlier.

Conclusions

While the soybeans-to-corn price ratio may have indicated well the direction of the switch between corn and soybean plantings in the past, it will provide only part of the explanation for producers' acreage choices between corn and soybeans in the future. Producers will increasingly pay closer attention to other price ratios beyond the soybeans-to-corn price ratio as plantings become more flexible under the 1996 Act and as corn and soybean production expands outside the Corn Belt.

[9]This BEPR applies to producers who participated in the feed grains program, about 85 percent of corn base. Nonparticipants would have a BEPR equation identical to the one for the 1996-98 period.

Related to this, is the viewpoint that forecasting future corn and soybean plantings can best be done at the regional level, where other price ratios, such as the soybeans-to-cotton and the corn-to-cotton price ratios in the Southeast and the soybeans-to-wheat and the corn-to-wheat price ratio in the Central and Northern Plains, can be effectively addressed. These other price ratios are difficult to address at the national level. This also means that the soybeans-to-corn price ratio would be more meaningful at the regional level than the national level, including regions such as the Central and Northern Plains, and Delta and Southeast.

Even regional price ratios are only rough proxies for producer decisions. The individual producer's cost and expected return may differ substantially from farm to farm. For example, a corn/soybean farmer in part of the Corn Belt may plant soybeans (no matter what the price ratio) if he/she cannot get Bt corn to plant. Those farmers who faced severe corn borer infestation last year saw dramatically lower yields.

Finally, corn and soybean plantings would still be affected by weather conditions even if all the relevant price relationships are captured in the analysis. Persistent wet conditions in the springtime can delay corn plantings and cause a switch from corn to soybeans regardless of the soybeans-to-corn price ratio. Similarly, plant disease for wheat can lead to switches to soybeans, other oilseeds, or other alternatives, such as summer fallow.

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Table B-1--Adjusting November soybean futures prices in mid-March to a U.S. farm-level equivalent by basis

Year	Nov. soybean futures price in mid-March	Nov. soybean futures price in October	October soybean farm price	Basis	Expected basis*	Expected soybean farm price at harvesttime**
			Dollars per bushel			
1986	5.215	4.817	4.55	-0.267	-0.418	4.797
1987	4.753	5.384	5.04	-0.344	-0.379	4.374
1988	6.453	7.926	7.53	-0.396	-0.376	6.077
1989	7.478	5.617	5.55	-0.067	-0.314	7.164
1990	6.165	6.117	5.88	-0.237	-0.259	5.906
1991	6.093	5.599	5.48	-0.119	-0.256	5.837
1992	6.165	5.379	5.26	-0.119	-0.212	5.953
1993	5.953	6.153	6.01	-0.143	-0.219	5.735
1994	6.565	5.407	5.30	-0.107	-0.212	6.354
1995	6.113	6.558	6.15	-0.408	-0.192	5.922
1996	7.205	7.070	6.95	-0.120	-0.200	7.006
1997	7.260	6.824	6.50	-0.324	-0.165	7.095
1998	6.350	na	na	na	-0.180	6.170

* The expected basis is the previous 8-year moving average of bases.

* * November soybean futures price in mid-March plus expected basis.

Table B-2--Adjusting December corn futures prices in mid-March to a U.S. farm-level equivalent by basis

Year	Dec. corn futures price in mid-March	Dec. corn futures price in November	November corn farm price	Basis	Expected basis*	Expected corn farm price at harvesttime**
			Dollars per bushel			
1986	2.115	1.704	1.47	-0.234	-0.338	1.777
1987	1.730	1.834	1.61	-0.224	-0.334	1.396
1988	2.170	2.695	2.51	-0.185	-0.310	1.860
1989	2.748	2.380	2.24	-0.140	-0.244	2.504
1990	2.538	2.262	2.16	-0.102	-0.208	2.330
1991	2.605	2.434	2.29	-0.144	-0.195	2.410
1992	2.643	2.118	1.98	-0.138	-0.173	2.470
1993	2.395	2.738	2.45	-0.288	-0.167	2.228
1994	2.645	2.157	1.99	-0.167	-0.182	2.463
1995	2.623	3.280	2.87	-0.410	-0.174	2.450
1996	3.133	2.681	2.66	-0.021	-0.197	2.936
1997	2.920	2.761	2.51	-0.251	-0.176	2.744
1998	2.813	na	na	na	-0.190	2.623

* The expected basis is the previous 8-year moving average of bases.

* * December corn futures price in mid-March plus expected basis.

Table B-3--U.S. soybeans-to-corn price ratios and corn and soybean planting intentions:1986-98

Year	Soybeans-to-corn price ratio*	March Intended Plantings**		U.S. corn and soybean intended acres	Corn share of plantings	Soybean share of plantings
		Corn	Soybeans			
		Million acres			Percent	
1986	2.70	78.1	62.0	140.1	55.7	44.3
1987	3.13	67.6	56.9	124.5	54.3	45.7
1988	3.27	66.9	58.0	124.9	53.6	46.4
1989	2.86	73.3	61.7	135.0	54.3	45.7
1990	2.53	74.8	59.4	134.2	55.7	44.3
1991	2.42	76.1	57.1	133.2	57.1	42.9
1992	2.41	79.0	57.4	136.4	57.9	42.1
1993	2.57	76.5	59.3	135.8	56.3	43.7
1994	2.58	78.6	61.1	139.7	56.3	43.7
1995	2.42	75.3	61.5	136.8	55.0	45.0
1996	2.39	79.9	62.5	142.4	56.1	43.9
1997	2.59	81.4	68.8	150.2	54.2	45.8
1998	2.35	80.8	72.0	152.8	52.9	47.1

* The soybeans-to-corn price ratio in column 2 is adjusted by basis first before the ratio of the new crop futures prices is computed.

** U.S. corn and soybean planted acreage in columns 3 and 4 are based on NASS's March planting intentions reports.