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Producer Ability to Forecast Harvest Corn and Soybean Prices

David Kenyon*

Corn and soybean producer most likely, low and high harvest price expectations were obtained in January and February each year from 1991 - 1996. Average expectations missed corn prices by $0.23 - 0.65 per bushel and missed soybean prices by $0.51 - 1.04 per bushel. Producer price expectations covered a wide range -- $1.00 for corn and $1.70 for soybeans. They consistently underestimated the probability of large price changes from January - February until harvest.

Introduction

Under the 1996 Farm Bill, producers will have increased planting flexibility and face increased price risk. The elimination of acreage restrictions and target prices will make producers much more dependent on market prices. Supply response models and price risk management strategies developed under old government programs will have to be re-evaluated. How producers form price expectations are important in both of these areas. However, few studies of actual producer price expectations and distribution of those expectations are available. In the absence of actual producer expectations, different hypotheses of how producers formulate price expectations have been developed. Some of the models are effective support prices (Houch and Ryan, Evans and Kenyon), futures prices (Gardner), adaptive expectations (Nerlove), and various combinations of the above models. Shideed and White compared six price expectation models for corn and soybeans. No unique specification emerged as the best formulation for both commodities in their study. Eales et al. found producer price expectations were not significantly different from futures prices, but that their estimate of market price variance was always lower than the markets' estimate based on option market implied volatilities. The Eales et al. study is based on one time period in 1987 - 1988. Analysis of producer price expectations over a longer time period may produce more insights into how producers are forming price expectations.

The current study analyzes producer price expectations across six production seasons (1991 through 1996). In January or February each year, producers estimate harvest prices of corn and soybeans. These expectations are analyzed to determine their ability to forecast harvest price and their conformity to various hypotheses about how producers form price expectations.

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Data

Producer price expectations for corn and soybeans were obtained by survey at the annual Corn-Soybean Conference held in January or February each year. The survey was conducted during the first afternoon of the program before any price outlook presentations were made. A short explanation (less than five minutes) was made explaining what information was being requested. Producers were asked for three prices for each commodity--the most likely harvest price, the price with a 1 in 10 chance of falling below at harvest, and the price with a 1 in 10 chance of getting above at harvest. Producers were not allowed to give price ranges. Each producer was asked to specify the market where the majority of each crop was sold. Individual producers were not identified, but most of the responses were from the same producers over the six year period. Many of these producers are industry leaders and may not be representative of all Virginia corn and soybean producers. Each year these producers represented between 5 to 10 percent of Virginia corn and soybean acreage. Each year 50-100 questionnaires were completed.

The corn and soybean industry in Virginia covers a very diverse area with different local supply and demand characteristics. For purposes of this analysis, only those producers located in the grain surplus areas selling in two specific markets were selected. Producers in other regions also raise peanuts, cotton, and tobacco--three relatively profitable crops. On some of these farms, corn and soybeans are not primary crops. In other grain deficit regions, the quality of the cash market price reports is sometimes questionable; therefore these market areas were not included.

Using these criteria resulted in 27 to 64 usable questionnaires each year. The elicitation date and number of producers each year are in Table 1. The elicitation date is before any USDA supply and demand estimates or planting intention reports for the coming season. There may be some very preliminary, private market forecasts concerning the upcoming season, but these are generally sketchy this early in the year. The harvest date was not specified on the survey form. The actual harvest price used in Table 1 is for September 15 or the closest day thereafter for corn and November 15 or the closest day for soybeans. These two dates coincide with 50 percent completion of harvest in the two markets analyzed according to the Virginia Department of Agriculture and Consumer Affairs. The forecast length is approximately 7 to 7½ months for corn, and 9 to 9½ months for soybeans.

Average Price Expectations

Table 1 contains the average price forecast and actual harvest price for both commodities for the six year period. The years 1991-1996 were a difficult period over which to forecast price. Harvest corn prices ranged from $2.07 to $3.36 per bushel, with price changing at least $0.30 a bushel each year. Harvest soybean prices ranged from $5.27 to

$6.75 a bushel, although three of the years had harvest prices between $5.27 and 5.29 per bushel. Given these wide price swings from year to year, the producers' price expectations generally missed harvest prices by a substantial amount. For corn, in five of the six years, their average expectations were off by $0.23 to $0.65 per bushel. For soybeans, in five of six years their price expectations were $0.51 to $1.04 per bushel above or below harvest price. In general, producers tended to overestimate low harvest prices and underestimate high harvest prices.

Table 1. Elicitation Dates, Number Producers, Average Price Forecast, Actual Harvest Price, and Forecast Error.

Elicitation Date	Number Producers	Average Price Forecast	Actual Harvest Price	Average Forecast Error
		Corn ($/bu)		
2/5/91	29	2.43	2.48	-0.05
2/4/92	30	2.65	2.07	0.58
1/19/93	64	2.20	2.43	-0.23
1/18/94	44	2.62	2.13	0.49
2/6/95	27	2.34	2.99	-0.65
2/5/96	28	2.98	3.36	-0.38
		Soybeans ($/bu)		
2/5/91	30	5.81	5.27	0.54
2/4/92	32	5.80	5.29	0.51
1/19/93	62	5.67	6.60	-0.93
1/18/94	41	6.33	5.29	1.04
2/6/95	28	5.64	6.56	-0.92
2/5/96	29	6.81	6.75	0.06

Distribution of Price Expectations

Individual producers had a wide range of price expectations each year. Individual corn producer expectations had a range of approximately $1.00 per bushel or more each year (Table 2). In a typical year, two-thirds of the expectations were within $0.25 per bushel of the average expectation. In 1992, 1994, 1995, and 1996, only one or two producers (less than 5 percent) had price expectations within the $0.20 price range of the eventual harvest price. Hence, in these years, the producers' price expectations were substantially skewed above or below the harvest price. Only in 1991 and 1993 were the producer expectations centered near the eventual harvest price.

Table 2. Distribution of Producer Most Likely Corn Price Expectations, 1991-1996.

Range ($/bu)	1991	1992	1993	1994	1995	1996
	Number of Producers					
1.70 - 1.89	0	0	9	2	0	0
1.90 - 2.09	3	0	16	2	4	0
2.10 - 2.29	6	4	22	2	11	0
2.30 - 2.49	13	7	12	10	10	2
2.50 - 2.69	5	6	2	8	0	0
2.70 - 2.89	1	10	3	13	0	10
2.90 - 3.09	1	2	0	7	1	11
3.10 - 3.29	0	0	0	0	1	7
3.30 - 3.49	0	1	0	0	0	0
3.50 - 3.69	0	1	0	0	0	0
Mean	2.43	2.65	2.20	2.62	2.34	2.98
St. Dev.	0.22	0.26	0.25	0.31	0.27	0.22
Min.	1.90	2.25	1.70	1.72	1.95	2.45
Max.	2.96	3.50	2.75	3.00	3.15	3.25

Individual producer soybean expectations had a range of $1.50 per bushel each year except 1995 (Table 3). In some years, the distributions were very skewed. In 1991, 11 out of 30 producers expected prices between $6.00 - 6.24 per bushel. Only four producers expected higher prices, but 15 producers expected lower prices, with eight producers expecting prices as much as $0.75 - 1.50 lower than the most frequently expected price range. The same general pattern holds in 1992 and 1994, where most of the price expectations are below the most frequently expected price range. In 1995, 21 of the 28 expectations are between $5.25 - 5.99 per bushel. Yet six producers expected prices above $6.25 a bushel. In 1993 and 1996 the price expectations are more evenly spread out around the most frequently expected price range.

Table 3. Distribution of Producer Most Likely Soybean Price Expectations, 1991 - 1996.

Range ($/bu)	1991	1992	1993	1994	1995	1996
	Number of Producers					
4.75 - 4.99	0	1	1	0	0	0
5.00 - 5.24	1	0	2	1	0	0
5.25 - 5.49	0	1	4	1	7	0
5.50 - 5.74	7	7	16	0	8	0
5.75 - 5.99	7	4	18	1	6	0
6.00 - 6.24	11	14	16	10	1	1
6.25 - 6.49	2	4	4	5	4	1
6.50 - 6.74	0	1	1	13	2	7
6.75 - 6.99	2	0	0	5	0	8
7.00 - 7.24	0	0	0	4	0	6
7.25 - 7.49	0	0	0	0	0	3
7.50 - 7.74	0	0	0	1	0	2
7.75 - 7.79	0	0	0	0	0	1
Mean	5.81	5.80	5.67	6.33	5.64	6.81
St. Dev.	0.35	0.34	0.32	0.47	0.41	0.38
Min.	5.00	4.75	4.75	5.00	5.20	6.00
Max.	6.75	6.50	6.50	7.50	6.50	7.67

Like corn, only one or two producers' price expectations in January or February were within the price range of the eventual harvest price. Only in 1996 were the price expectations centered around the eventual harvest price. In all the other years, the eventual harvest price was in the tails of the producer price expectation distributions.

Comparison of the two distributions of expected prices seems to indicate producers have more difficulty reaching a consensus of expected price for soybeans compared to corn. This apparent difficulty may be related to the two month longer forecast period for soybeans and the weather uncertainty associated with the South American soybean crop in January, February, and March. For soybeans, producers must anticipate the weather for two crops--the South American crop in January through March and the United States crop during July through September.

Comparison Expectation Models

How are these producers forming their price expectations? Are they based on cash prices, futures prices, government support prices, errors in previous estimates, or some combination of the above? Table 4 compares the producers average price expectations in January and February to three simple but frequently used proxies for producer price expectations. The first comparison is the futures market price for December corn and November soybean on the elicitation day adjusted for expected basis in the two markets. Expected basis is the average harvest basis from the previous five years. The second proxy is cash harvest prices from the previous year. For example, the harvest price for soybeans on November 15, 1990, was $5.39 a bushel (Table 4). The third proxy is the current cash price on the elicitation day.

All three of these proxies are highly correlated with producer price expectations in January and early February. The simple correlation coefficient is 0.93 or greater for each proxy (Table 5). For corn, the December futures market price is most highly correlated with producers' price expectations. For soybeans, the current cash price is mostly highly correlated with producers' price expectations. However, the differences between these three are extremely small. These preliminary small sample results are consistent with Eales et al. who found price expectations were similar to futures prices. Shideed and White also found that corn price expectations based on futures prices contained the most information. However, they found that soybean price expectations based on last years' prices were superior to futures prices. The soybean results of Shideed and White are not supported by the results in Table 5, but the differences are not significantly different given that they are based on only six observations.

Table 4. Comparison of Producer Price Expectations With Futures Prices, Previous Harvest Prices, and Current Prices.

Year	Average Producer Expectation	Adjusted Futures Price	Previous Harvest Cash	Current Cash Price
		Corn ($/bu)		
1991	2.43	2.56	2.48	2.57
1992	2.65	2.64	2.48	2.77
1993	2.20	2.38	2.07	2.25
1994	2.62	2.68	2.43	2.95
1995	2.34	2.52	2.13	2.47
1996	2.98	2.96	2.99	3.81
		Soybeans ($/bu)		
1991	5.81	6.10	5.39	5.62
1992	5.80	5.89	5.27	5.73
1993	5.67	5.76	5.29	5.72
1994	6.33	6.37	6.60	6.85
1995	5.64	5.55	5.29	5.42
1996	6.81	6.93	6.56	7.36

Table 5. Correlation Between Average Producer Price Expectations and Futures Prices, Harvest Prices, and Current Prices.[a]

Average Producer Expectations	Adjusted Futures Price	Previous Harvest Cash	Current Cash Price
Corn	.984	.949	.967
Soybeans	.969	.930	.982

[a] Based on six annual observations, 1991-1996.

Much more analysis needs to be done with these actual producer price expectations. As more data is gathered, statistical analysis will become possible using more sophisticated expectation models that require more degrees of freedom. The large error in forecast accuracy and wide distribution in producer expectations at a given point in time would suggest the inclusion of previous errors or some measure of dispersion of producer expectations. The wide distribution of expectations suggests that producers are using a wide range of models or methods in forming price expectations.

Producer Distribution Estimates

Producers were asked to estimate a low and high harvest price with only a ten percent probability of going below or above these prices at harvest. The average low and high price estimates for each year are reported in Table 6. For corn, the average spread between the low and high price is $0.84 per bushel. The distributions are skewed to the right with more probability of higher than lower prices. Compared to the most likely price, the high price is $0.40 - 0.67 bushel higher, whereas the low price is only $0.35 - 0.55 bushel lower. The lower bound price could be affected by the loan rate, but only in 1993 were the lower corn price estimates of some producers near the loan rate.

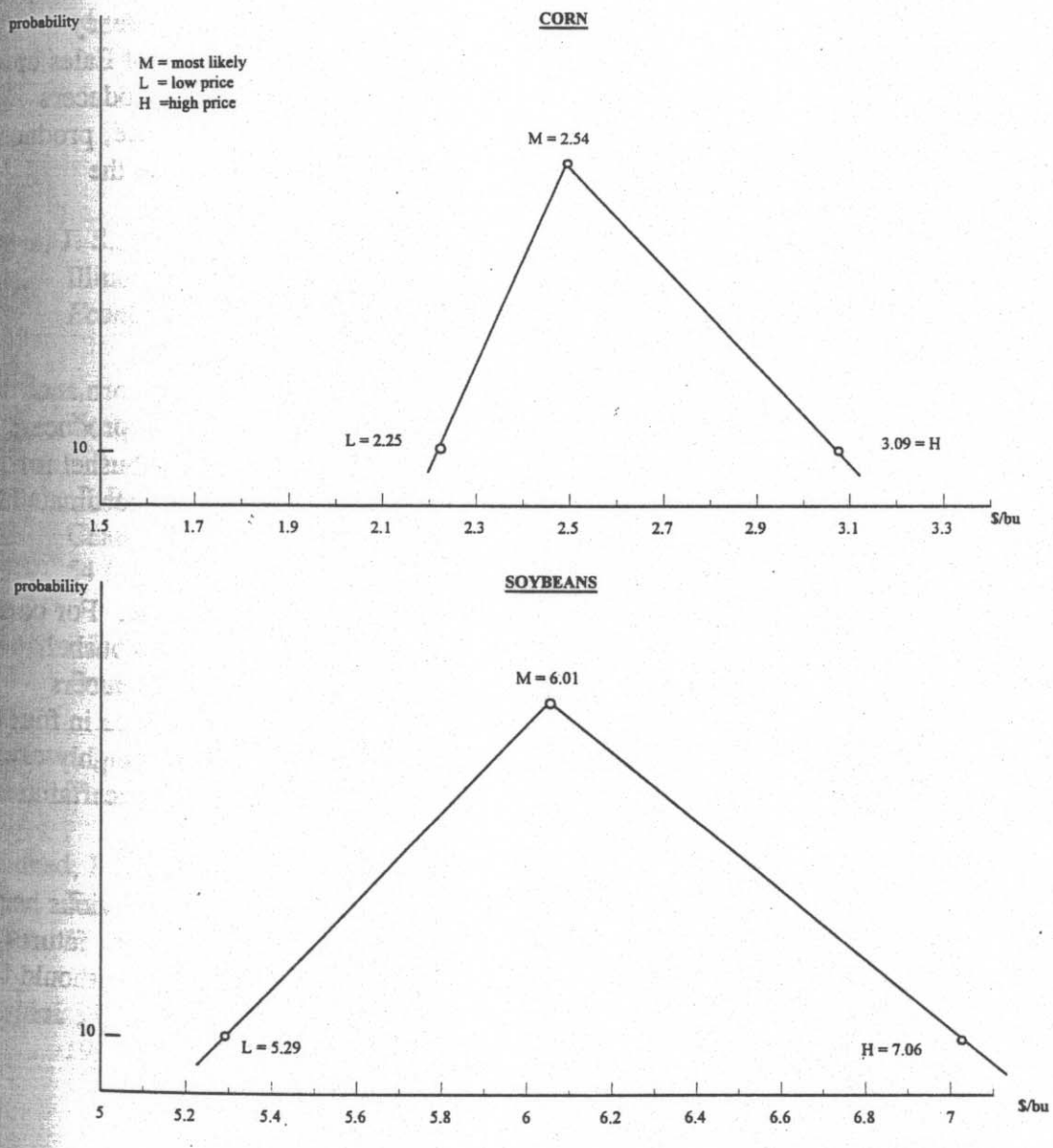
Table 6. Producer Expectations of Most Likely, Low and High Price at Harvest Compared to Actual Harvest Price.

Year	Production Expectations			Actual Harvest Price	Actual Price Exceeds Low (L) or High (H) Price Expectations
	Average Most Likely Price	Average Low Price	Average High Price		
	Corn ($/bu)				%
1991	2.43	2.03	3.00	2.48	0 H
1992	2.65	2.15	3.18	2.07	60 L
1993	2.20	1.85	2.72	2.43	19 U
1994	2.62	2.23	3.23	2.13	52 L
1995	2.34	1.92	2.74	2.99	56 U
1996	2.98	2.43	3.65	3.36	21 U
	Soybeans ($/bu)				%
1991	5.81	4.98	7.16	5.27	7 L
1992	5.80	5.10	6.75	5.29	35 L
1993	5.67	5.03	6.67	6.60	60 U
1994	6.33	5.66	7.38	5.29	68 L
1995	5.64	5.06	6.54	5.56	36 U
1996	6.81	5.91	7.88	6.75	3 L

For soybeans, the average spread between the low and high price is $1.77 per bushel. In most years, the potential price increase is $0.30 - 0.40 a bushel greater than the potential price decrease. The potential for upside movement is at least $0.17 per bushel greater than downside movement each year. In 1991, the upside potential is $0.52 greater than the downside potential.

The most likely, low, and high price expectations across all producers and years are shown as triangular distributions in Figure 1. From 1991 to 1996, Virginia producers placed a higher probability on price increases compared to price decreases.

Figure 1. Average Producer Expectations of Most Likely, Low, and High Harvest Price, 1991-1996.



The average most likely, low, and high price in Figure 1 obscures the wide variation in the level of the upper and lower 10 percent price bounds elicited from individual producers. To demonstrate this wide variation, Table 6 reports the percentage of time the harvest price exceeds the 10 percent lower and/or upper bound price each year. For corn, the actual price exceeded the expected upper or lower bound price of more than 50 percent of the producers in 1992, 1994, and 1995. For soybeans, the actual price exceeded the appropriate boundary price for 35 percent or more of the producers in four of the six years. The actual prices exceeded both the upper and lower boundary prices of the distributions for both commodities. These upper and lower bound calculations indicate that producers have a strong tendency to underestimate the potential change in price from January or February until harvest. Although history indicates their average price expectation for corn may be in error by $0.40 or more per bushel (Table 1), they do not expect on average that corn prices will decline that much by harvest. The same is true of soybeans. Producers in this study had a strong tendency to underestimate the variance in harvest prices. These results are similar to those of Eales et al. based on one year's data. The most obvious implication of this finding is that producers subjective probability distributions have smaller variances than the market. Hence, producers are likely to view option premiums as too expensive, because they underestimate the probability of large price changes.

Summary

Producer price expectations in January or February each year of harvest corn and soybean prices have large errors. From 1991 - 1996, the average expectation of producers missed the harvest price by $0.23 - 0.65 per bushel for corn and $0.51 - 1.04 a bushel for soybeans. Producers had a strong tendency to overestimate low prices and underestimate high prices.

Producers have a wide range in price expectations at a given point in time. For corn, producer expectations in January - February consistently varied by up to $1.00 a bushel, while soybean expectations varied by $1.70 a bushel. Less than five percent of the producers correctly anticipated the correct $0.20 - 0.25 price range of the actual harvest price in four of six years. Soybean producer price expectations were frequently bi-modal or highly skewed. These skewed distributions of expectations may be related to weather uncertainties associated with both the South American and United States crops.

Producer price expectations were highly correlated with futures prices, previous harvest and current cash prices. Corn price expectations were more correlated with futures and soybeans were more correlated with current cash prices. These results should be viewed with caution because they are only based on six years of data and very simple analysis. Additional data and analysis will help clarify these associations in the future.

Each producer's distribution of prices was skewed to the right. Producer expectations of price increases were consistently $0.20 - 0.30 a bushel greater than their anticipated price decreases. Over 50 percent of the harvest corn prices were in the right or left tail of the individual producer's expectations in 1992, 1994, and 1995. For soybeans, the harvest price was in the tail of 35-68 percent of the producer distributions in four of the six years. These results indicate that producers are substantially underestimating the probability of large price changes.

In general, these results indicate that producers have a wide range of price expectations and that they underestimate the probability of large price changes. These results seem to support previous research that suggests no one model of how producers form expectations is consistent across commodities and time. These results also indicate that producers need continued education on how to analyze market prices and how to evaluate the price risks they face.

References

Eales, J. S., B. K. Engel, R. J. Hauser, and S. R. Thompson, "Grain Price Expectations of Illinois Farmers and Grain Merchandisers," *American Journal of Agricultural Economics*, 72 (1990): 701-708.

Gardner, B. L., "Futures Prices in Supply Analysis," *American Journal of Agricultural Economics,* 58 (1976): 8-14.

Houch, J. P. and M. E. Ryan, "Supply Analysis for Corn in the United States: The Impact of Changing Government Programs," *American Journal of Agricultural Economics*, 54 (1972): 184-191.

Kenyon, D. E. and R. S. Evans, *Short-term Soybean Acreage Projection Model Including Price and Policy Impacts*, Virginia Agr. Res. Bul. 106, 1975.

Nerlove, M., *The Dynamics of Supply: Estimation of Farmers' Response to Price*, Baltimore: The Johns Hopkins Press, 1958.

Shideed, K. H. and F. White, "Alternative Forms of Price Expectations in Supply Analysis For U.S. Corn and Soybean Acreages," *Western Journal of Agricultural Economics*, 14 (1989): 281-292.

Virginia Department of Agriculture and Consumer Affairs, *Virginia Agricultural Statistics*, 1995.