NCCC-134
APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

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Suggested citation format:

Garcia P., and R. M. Leuthold. 1992. "The Effect of Market Information on Corn and Soybean Markets." Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL. [http://www.farmdoc.uiuc.edu/nccc134].

THE EFFECT OF MARKET INFORMATION ON CORN AND SOYBEAN MARKETS

Philip Garcia and Raymond M. Leuthold*

Agricultural economists have long been interested in the effect of information on markets. The ability of markets to reflect available information is an important indication of their efficiency or effectiveness. The extent to which markets incorporate and transmit new information over time and space provides insight into the pricing process and may signal arbitrage opportunities.

Recently, there has been some concern that agricultural markets overrespond to information. Occurrences, such as extreme drought conditions, can make market participants highly uncertain about subsequent prices, resulting in large price changes with changing information. There have also been observations that markets may overreact initially to new information, posssibly due to increased speculation, prior to settling to the equilibrium price level. This hypersensitivity to changes in information may lead to "fishhook" patterns of speculative price behavior (Petzel). In a somewhat similar notion, some research has suggested that prices in efficient (flexible) markets overshoot their eventual equilibrium levels before rather quickly adjusting to new information (Rausser and Walraven). There has been little research investigating these questions and the extent to which price responses in speculative futures markets are transmitted to cash markets.

This paper examines the effect of new market information on the behavior of corn and soybean cash and futures markets immediately after the release of USDA crop reports. The analysis focuses on the extent and speed which these markets respond to new information. Attention is placed on identifying differential behavior to the release of new information across commodities, markets (cash and futures), and under various market conditions. Care is taken to identify the existence and prevalence of patterns of price changes following the release of new information.

Most of the research relating crop announcements to price movements has examined the question of whether USDA forecasts provide new information to the market (Fackler; Sumner and Mueller; Fortenberry and Sumner)[1]. In general, using measures of variance before and after announcements, the findings suggest that the USDA forecasts have economic value, usually leading to increased variance in prices. The work reported here differs from previous research by measuring the effects of USDA crop reports on corn and soybean

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markets in several different dimensions. First, using private analysts' forecasts of crop production as a indication of anticipated information, the analysis measures the effect of unanticipated information (i.e., the difference between the USDA crop report and the anticipated information) on market prices. The use of the unanticipated information permits identification of the specific information on the movement of prices. It also provides an opportunity to study the short-run response or price pattern to changes in information. Second, this study examines the effect of new information on cash and futures markets, and across different futures contracts, which permits an assessment of the degree to which information is effectively transmitted through the marketing system and the constellation of futures prices. Finally, similar to Fortenberry and Sumner, efforts are made to identify differential responses to market conditions, only here the measure is the change in price to the unanticipated market information.

Methodology

To isolate the effect of new crop information on prices, we relate the unanticipated change in crop forecast to changes in futures and cash prices. Under the maintained efficient market hypothesis, prices should only respond to the unexpected component of the announcement, with the expected component already incorporated into price. Similarly, prices should move rather rapidly to the new equilibrium corresponding to the change in information.

In this context, the relationship between the change in price and change in information may be expressed as

$$(1) \qquad P_t - {}^eP_t = (X_t - {}^eX_t)\beta + e_t$$

where: P_t and ${}^eP_t$ are the price and expected price at time t, X_t and ${}^eX_t$ are the information and expected information at time t, and e_t has the classical properties. It is important to note that the model embodies a rational expectations framework and also a model of market equilibrium. While these conditions may not hold exactly because of transactions, storage costs, etc., it is a useful method to examine the effects of new information on futures and cash markets.

Here, we specify equation (1) in terms of percentage changes in prices ($\ln(P_{t+i}) - \ln(P_t)$) and percentage differences between the expected crop production and USDA announcements (ln (expected crop) - ln (USDA)). The expected crop production is generated as a simple average of private forecasts of corn and soybeans produced by Conrad Leslie and Sparks Commodity Inc. These forecasters have issued projections for a number of years and are regarded as extremely credible. The private forecasts are generally released at least two to three days before the USDA announcements so the market should have sufficient time to respond.

Data

The sample data includes USDA and private forecasts for corn and soybean production for 1974-1988. USDA makes corn and soybean crop forecasts in August, September, October and November. The extent to which the private forecasts provide information about subsequent USDA announcements can be seen in table 1 which provides the regressions of USDA announcements on the simple average of the private forecasts. These findings suggest a high degree of explanatory power, with the no intercept significantly different from zero and all the slope coefficient not statistically different from one. Forecasting ability appears to marginally improve as the harvest approaches and, while not statistically significant, there does seem to be some modest evidence of first-order autocorrelation. Interestingly, the use of the private combined forecasts generally reduced the root mean squared error and the modest degree of autocorrelation present. These findings suggest that the private forecasts may not be a perfect measure of the market's expectations, but clearly they do provide a reasonably close estimate of the USDA announcements.

Daily closing futures prices were obtained for harvest (December corn and November soybeans) and deferred (May corn and soybeans) contracts. Daily East Central Illinois new crop cash forward contract prices were also obtained. The cash forward prices reflect offers to the elevators for harvest delivery (October - November) in East Central Illinois.

Results and Interpretation

The results of estimating equation (1) for futures and cash prices for one through five days following the announcement are reported in tables 2 and 3. The corn and soybean equations are estimated for each day in a seemingly unrelated framework, after examining the monthly equations for autocorrelation and verifying the appropriateness of pooling the monthly data (Maddala)[2]. The dependent variable in each equation reflects the cumulative percent price change from the announcement to the close on the specific day. Equation (1) also was estimated using the daily percent price change as the dependent variable for each of the five days with little difference in conclusions. We focus on the cumulative price changes to provide a view of the lagged effect of information on price behavior.

The results of the analysis for the various prices series are relatively similar. The unanticipated information explains the largest percent of the change in price in the first day (reaching as much as 25 percent of the variance of the corn harvest futures) and then generally declines on a gradual basis. On the fifth day, the explained variability is much smaller, particularly considering that the cumulative price change also includes the change in first day. Unanticipated information appears to explain a smaller portion of deferred contracts and cash prices, although in the case of the deferred contracts, the difference is minimal.

The coefficients of the regressions provide an estimate of the effect on price of a one-percent difference between the expected production and the USDA announcement. In the first day, if expected production is one percent less than the USDA announcement, then harvest corn futures prices decline by .44 percent. In the same period, soybean harvest futures decline by .37 percent; corn and soybean cash forward prices by .35 percent and .31 percent, respectively; and the deferred corn and soybean prices decline by .40 percent and .35 percent, respectively. The marginally larger response of corn relative to soybeans may be an indication of a more inelastic demand for the commodity. The generally slightly smaller response of the deferred contracts may in part be reflecting higher prices in the deferred months which for a given absolute price results in a smaller percent change. The smaller effect on the cash forward price was somewhat unexpected given the absolute level of the cash price is smaller than the futures prices. In part, the smaller effect may reflect differences in the ability to transfer risk in the less liquid cash markets, or that the cash market may discount the information more than the futures market. It may also reflect that changing expected production estimates may influence storage and transportation costs.

The overall findings provide little dramatic support for the hypothesized overreaction of prices to new information. If the USDA announcement is less than expected, corn prices for both the harvest and the deferred contract seem to increase gradually through the fourth day and then decline. For soybeans, prices increased slightly through the first three days and then decline (figure 1). Cash forward prices for corn and soybeans follow their respective futures price patterns. Closer examination of results from the day-to-day price changes verified these patterns but found little statistical significance to support overreaction. Further, examination of the individual month equations for the price series suggested marginally different response patterns for corn futures prices in August, with prices initially increasing in the first day and then decreasing slightly.

A potential difficulty in assessing the response of prices to unanticipated information is price limit moves imposed by the exchange. With limit moves, prices on a given day may not reflect a market equilibrium. Examination of the harvest contracts revealed that soybeans contained only two limit moves at day 1 and 2 (3.3 percent of the 60 observations for each equation) and none at more distant days. However, the corn contracts contained 7 limit moves (11.6 percent) for day 1 and 4 limit moves (6.7 percent) for day 2 with none at more distant days. Closer examination of the corn limit moves identified that 5 of the limit moves in day 1, and all four limit moves in day 2 were in August. To examine the possible effect of the limit moves in more depth, the August corn relationships were estimated with the years containing limit moves removed from the sample. In effect, what these relationships show are the effects of small unanticipated production errors. The estimated results with the dependent variable expressed in terms of daily percent price change are similar in pattern to the August corn (discussed above) with all the observations where price initially increased in the first day and subsequently decreased, but demonstrate a much more pronounced reaction and reversal pattern (table 4). Given the limited number of observations and the fact that we are removing observations with large price and unanticipated forecast errors, some care must be taken in generalizing from these results. It appears that reversals in price for a given

level of unexpected information are more likely to occur in corn than soybeans. For corn, it suggests that the price limits imposed by the exchange may smooth out price changes by reducing the likelihood of overreactions to large unanticipated information.[3]

Three variants of equation (1) were estimated to examine the effect of alternative market conditions on the effect of new information on price behavior. Equation (1) was estimated with intercept and slope shifters for drought years (1980, 1983 and 1988) and for the most recent years (1985-1988). The drought years were investigated to identify the effect of periods of higher volatility on price movements. The most recent years were examined because of the recent changes in information dissemination, the introduction of options, and the release of new announcements of the World Agricultural Supply and Demand Estimates (Fortenbery and Sumner). Inclusion of these variables did not increase the explanatory power of the equations and only modestly changed the magnitude of the coefficients, suggesting that USDA announcements still provide information to the market even during periods of perceived increased volatility and additional factors influencing market behavior. In addition, a ratio of the corn and soybean price to their loan rates was included to examine the differential effects of new information during periods of more active goverment participation in the market (Fortenbery and Sumner). Presumably, when the corn and soybean prices are near or at the loan rates, changes in information may have less of an effect on prices. However, the results of the price ratio variables were not consistent with this hypothesis, perhaps suggesting that prices before announcements already incorporate the effects of the government activity in the markets.

Summary and Conclusions

The results of this analysis suggest the price analysts' forecasts of crop production for corn and soybeans are accurate representations of the USDA forecast. Nevertheless, the USDA forecasts contain economic information, with the new information explaining as much as 25 percent of the variance of futures price changes after the announcement. Overall, most of the effect of the change in information occurs on the first day, but some limited evidence suggests that residual effects may exist. For soybeans, for smaller crop expectations, prices gradually increased until day three and then declined marginally. For corn, because of the number of limit moves, the picture is less clear. Here, the presence of limits appeared to smooth out price patterns which demonstrated some reversals in their absence. On a percentage basis, corn prices respond marginally more to new information about production than soybean prices, suggesting a more inelastic demand. The pattern of deferred futures and cash price responses are similar to harvest futures, but the effect of the unanticipated information is marginally smaller in these cases. Attempts to identify specific effects of market conditions were not completely satisfactory.

The findings suggest that these markets are linked and sensitive to new information. The reaction pattern of prices to new information seems to vary modestly across markets and overtime. Further research could examine intra-day price behavior after market

announcements to more carefully ascertain their effect on price behavior. Similarly, developing a more comprehensive understanding of the relationship between market announcements, price behavior, and market characteristics (e.g., composition of the traders, volume traded) might provide insight into the economic forces influencing market behavior.

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Endnotes

1. Research has also appeared over the last few years on the effect of announcement data on livestock markets, particularly the impact of hog and pig reports. For example, see Colling and Irwin.

2. The estimated coefficients of the effect of unanticipated information on prices differed modestly across corn and soybeans for the four months. Generally, the largest announcement effects were encountered in August and November for corn, and September and November for soybeans.

3. In a study which examined the impact of announcements on prices, volume and open interest, French, Leftwich and Uhrig also report a similar reversal pattern for corn futures prices.

Table 1. The Relationship Between Price Analysts' and USDA Forecasts of Crop Production, 1974-1988[a]

Month	Corn					Soybeans				
	α	β	R^2	D.W.	RMSE[b]	α	β	R^2	D.W.	RMSE
August	-313.82 (-1.55)[c]	1.05 (34.43)	.986	1.63	.026	-27.87 (-0.52)	1.02 (36.20)	.987	1.58	.020
September	160.00 (1.64)	.98 (66.30)	.996	1.59	.014	14.52 (0.39)	.99 (46.30)	.992	1.65	.018
October	-4.33 (-0.05)	1.00 (86.95)	.998	1.61	.012	6.57 (0.32)	1.00 (85.66)	.998	2.37	.009
November	94.43 (1.35)	.99 (96.29)	.999	1.52	.009	25.32 (1.22)	.99 (84.54)	.998	2.49	.011
Pooled	-2.38 (-0.03)	1.00 (109.14)	.994	1.72	.017	-0.45 (-0.02)	1.00 (98.45)	.993	1.97	.017

[a] The results are generated regressing the USDA estimate on average of private analysts' forecasts of crop production.

[b] RMSE is the root mean squared error.

[c] t-values are in parenthesis.

Table 2. The Effect of Unanticipated Crop Information on Corn and Soybean Harvest and Deferred Futures Prices, 1974-1988[a]

Horizon	Harvest Contracts							Deferred Contracts						
	Corn			Soybeans				Corn			Soybeans			
	α	β	R^2	α	β	R^2	SR^2	α	β	R^2	α	β	R^2	SR^2
1	.00	.44	.25	.00	.37	.11	.38	.00	.40	.24	.00	.35	.11	.37
	(.22)	(5.29)		(.56)	(2.93)			(.22)	(5.26)		(.56)	(2.80)		
2	.00	.47	.18	.00	.52	.12	.32	.00	.44	.18	.00	.46	.11	.34
	(.54)	(4.50)		(.57)	(2.93)			(.36)	(4.77)		(.73)	(2.86)		
3	-.00	.52	.12	-.00	.57	.13	.26	.00	.46	.09	.00	.52	.12	.25
	(-.34)	(3.84)		(-.07)	(2.72)			(.06)	(3.68)		(.09)	(2.66)		
4	-.00	.75	.17	-.00	.48	.09	.31	.00	.68	.17	-.00	.41	.09	.35
	(-.26)	(4.75)		(-.25)	(1.97)			(.01)	(5.09)		(-.23)	(1.89)		
5	-.00	.52	.04	-.00	.41	.06	.11	-.00	.61	.13	-.00	.31	.07	.29
	(-.05)	(2.25)		(-.98)	(1.50)			(-.30)	(4.53)		(-.73)	(1.42)		

[a]Harvest contracts are December corn and November soybeans. Deferred contracts are May corn and soybeans. Closing prices are used in the analysis. The regression equations for each horizen are: $\ln(P_{t+i}) - \ln(P_t) = \alpha + \beta[\ln(\text{Private Crop Forecast}) - \ln(\text{USDA Announcements})] + e_{ti}$ where t is the announcement day and i reflects the number of days after announcements. SR^2 is the system R^2 from the seemingly unrelated system. The numbers in parentheses are t-values.

Table 3. The Effect of Unanticipated Crop Information on Forward Cash Corn and Soybean Prices, 1974-1988[a]

Horizon	Corn			Soybeans			
	α	β	R^2	α	β	R^2	SR^2
1	.00 (.39)	.35 (3.84)	.16	.00 (.90)	.31 (2.21)	.05	.23
2	.00 (1.06)	.39 (3.00)	.10	.00 (.76)	.40 (2.11)	.06	.17
3	.00 (.19)	.40 (2.48)	.04	.00 (.14)	.43 (1.85)	.06	.13
4	.00 (.12)	.58 (3.07)	.08	.00 (.03)	.29 (1.10)	.04	.15
5	-.00 (-.40)	.43 (2.35)	.03	-.00 (-.57)	.18 (.65)	.02	.09

[a] Prices are the East Central Illinois cash forward contract prices for elevators for October - November delivery. See Table 2 for a description of the model. SR^2 is system R^2. t-values are in parentheses.

Table 4. The Effect of Unanticipated August Crop Production Estimates on December Corn Futures Prices Removing Limit Moves[a]

Horizon[b]	α	β	R^2	D.W.
1	-.00 (-.28)	.60 (2.95)	.47	1.67
2	.01 (2.18)	-.48 (-2.38)	.41	1.49
3	.00 (.70)	-.56 (-2.37)	.41	2.38
4	-.00 (-.50)	.34 (1.99)	.33	2.25
5	-.01 (-1.60)	.12 (.63)	.05	3.08

[a] Observations for an entire year were removed when a limit move occurred.

[b] The time horizons reflect the differences in daily closing prices between successive days, i.e., the dependent variable in each equation is $\ln(P_t) - \ln(P_{t-1})$.

In parentheses are t-values.

Figure 1. Percent Change in Price for a One Percent Change in Unanticipated Information