Are Crop Forecasts News?

The Impact of U.S.D.A. Announcements on Futures Market Prices

Revised Draft

February 1985

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Abstract: Are Crop Forecasts News? The Impact of U.S.D.A. Announcements on Futures Market Prices

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Statistical analysis shows that the release of U.S.D.A. crop forecasts for corn and soybeans affect future market traders' behavior. Traders have many sources of information, so we test the magnitude of $\left|P_{t+1} - P_t\right| / P_t$ on the Chicago Board of Trade for announcement dates, t, against a random sample of other comparable dates.

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Introduction

This paper uses a simple scheme to assess the information contained in market announcements. We examine whether crop forecasts from the Statistical Reporting Service of the United States Department of Agriculture are news. In order to carefully consider the issue, one must carefully assess the definition of "information," the market context of announcements, and the prior knowledge of market participants.

The previous papers that have studied the impact of USDA forecasts have either (1) considered only the statistical characteristics of these forecasts (Gunnelson, Dobson, and Pamperin, and Just and Rausser), (2) assumed that the reports contained information and went on to analyze their social value (Haimi and Peterson, and Bradfordand Kelejian), or (3) implicitly assumed particular (lack of) prior knowledge by market participants (Belongia and Spilka, Choi, Gorham, Hoffman, Miller, and Pearson and Houck).

The paper is developed as follows: First, we provide a background, develop our concept of information, and discuss the market context of crop forecast announcements. Second, we describe the USDA announcements and very briefly mention their statistical properties. Third, we briefly outline the theory of reactions to information in futures markets. Fourth, we develop and describe our empirical approach and contrast it with previous work. Finally, we present our statistical results for reactions to corn and soybean crop forecast announcements and interpret the economic significance of these results.

This brief paper cannot fully develop the theoretical and econometric aspects of the study. The major results, however, are documented. We find that for both corn and soybeans, market traders do react to USDA announcements and therefore these reports may be said to contain useful information.

The Issue and Background

Government information services provide much statistical and outlook information related to the development of the economy, its markets, and its industries. These services not only are a by-product of activities which satisfy government's need to know, but also are frequently deemed desirable for society. In relation to the provision of information, Knight observed:

> Its importance for society at large is so well recognized that vast sums of public money are annually expended in screening and disseminating information as to the output of various industries, crop conditions, and the like. (p. 260)

In the past, such services have usually been provided free of charge to users. This practice has been sanctioned by economists on the grounds that information has many attributes of public goods (Jesse et al., 1982). When public monies flowed less vigorously, however, government spending for statistical reporting services did not escape significant reduction, and several services have been curtailed (Gardner, 1983). Furthermore, with budget allocations reduced, economists' attention has been drawn toward the identification of the value of these services to society (Bullock, 1981; Just, 1983).

For information services provided by government (or by any other organization) to have more than entertainment value, the announcement must affect both economic agents' decisions and the resulting allocations of goods and services. There are four factors required for information services to be effective. First, information services must cover a topic of interest to economic agents. Second, they must reach agents before all relevant decisions are made. Third, they must be accurate--or at least thought to be accurate; and finally, the announcements must be new in the sense that the interested economic agents do not already possess the information. To be "news," an announcement must be interesting, timely, accurate, and an addition to previous knowledge.

Were information services provided through markets, we would have little reason to doubt the effectiveness of those information services, and we could

measure their value by market prices. In the absence of information markets, however, provision of ineffective information services becomes possible. This study will investigate whether crop reports provided by the United States Department of Agriculture (USDA) have any identifiable effects on economic agents' conduct. We selected two particular reports, the corn and soybean crop forecasts, and attempt to identify their effects on traders in futures markets.

We have chosen corn and soybean reports because of the economic significance of these crops, because these reports have been released periodically for many years, and because research related to these reports has been conducted in the past. We have chosen futures markets because traders in these markets are relatively free to revise their decisions and may react quickly upon receiving information. In addition, choosing these reports and markets allows us to draw tentative conclusions as to why information might be ineffective.

USDA Crop Forecasts for Corn and Soybeans

This section briefly describes the forecasts and assesses their statistical properties. This is only preliminary to considering the economic import of the reports.

The crop reports from the USDA provide prior-to-harvest forecasts of the quantities produced in the United States. If a futures market trader knew the actual supplies for the coming season, he could more accurately forecast prices ahead of their realization. This would obviously allow more profitable positions to be taken in the market.

Forecasts for the corn and soybean crops are released by the Crop Reporting Board for the months of August to November of each year. For corn, additional forecasts usually have been provided in July. These forecasts are based on acreage estimates and yield forecasts which are derived from a nationwide survey network (Spilka, 1983). Crop forecasts are usually released around the 10th of

the month. The exact release dates and hours are announced in December for the following calendar year. The regularity of the announcements plus the long history of these forecasts make it safe to assume that traders know about and have unimpeded access to the forecasts.

Corn and soybeans are classified by USDA as speculative crops so the forecasts are prepared by "speculative boards" which convene in isolation in order to prevent information leakage.

Commodity futures market traders have an interest in harvest forecasts, and the USDA provides these forecasts in time for profitable trades to take place. Thus two of the criteria for effective information are met by the announcements. The third criterion is that the announcements be accurate.

One cannot satisfactorily specify the relationship between statistical criteria used in the evaluation of forecasts and how market traders react. Nevertheless, such an evaluation may still be useful in judging the confidence intelligent traders might have in these forecasts. We emphasize, however, that we may not equate indication of high confidence in forecasts with change in the useful knowledge of market participants.

We have based our evaluation of USDA's crop forecasting performance for corn and soybeans on the results of previous evaluations reported in the literature and on a set of statistics calculated for this study. Gunnelson et al. (1972), Smith (1978), and Choi (1982) have all evaluated the supply forecasting performance of the USDA. The general results of these studies are similar to those of our own analysis. A summary of our evaluations follows. (Details of our own work and a review of previous studies are in an appendix available from the authors.)

From a review of forecast evaluations made by others, and from our own evaluation on the basis of statistical criteria, we conclude that both corn and

soybean forecasts are accurate forecasts of actual crop sizes. Regression coefficients indicate that forecast and actual harvests correspond closely. On purely statistical grounds, the forecasts may be regarded as unbiased and efficient.

As expected, corn forecasts are (on average) more accurate the closer the forecast to the harvest period. This fact holds regardless of the measure of accuracy. In all forecast months, however, USDA tends to underestimate actual crop size. According to results from a regression of forecasts on actual harvests, forecasts contain small negative biases which decrease in absolute terms with proximity of forecast month to harvest time. Most of the forecasts made after July are better than the forecasts made in the preceding month. The least improvement in forecast accuracy is made in September; about one-third of the September forecasts have a forecast error larger than that made in August.

Soybean forecasts are also more accurate the later in the crop year they are made. Soybean forecasts also tend to underestimate actual production. However, soybean forecasts show a smaller bias and higher accuracy than corn forecasts. Errors of September forecasts, however, were often larger than the errors made in August.

Given their performance, we would be surprised if traders lacked confidence in the USDA forecasts. The last criterion for effective information is that the news is new. If traders failed to react to newly released forecasts, we would tend to attribute this failure to small differences between traders' prior expectations and USDA forecasts, rather than to a lack of confidence in these forecasts or failure to meet any of the previous criteria.

The Impact of Information on Market Prices

Data on market behavior of individuals is not readily available. We therefore turn to aggregate market price movements. In theory, the market price can move in any direction or not change at all, even if every trader changes his

individual market positions. For the case of crop report announcements, however, we are willing to assume that if the release of a report shifts the expectations of market participants, the change is generally in the same direction. Therefore the market price determined by aggregate supplies and demands will respond to crop report announcements if they affect the knowledge of participants. Further research on the response of trading volume or open interest would be useful for considering these aggregation questions in more depth.

In speculative markets, traders act upon their beliefs and expectations of future supply and demand conditions. We cannot, however, observe the knowledge of traders. Therefore we also cannot directly observe the changes in knowledge which are brought about by the release of crop forecasts. If we regard traders as "casual Bayesians," the change in knowledge of any one trader will depend upon what he knows before the release of crop forecasts.

Empirical Analysis of Crop Forecast Announcements

With some simple model of prior knowledge of traders, one could predict the direction and magnitude of price changes based on the specific data contained in the announcements. This is the approach of most other papers that have examined the impact of USDA crop forecasts [Pearson and Houck (1977), Gorham (1978), Miller (1979), Hoffman (1980), Belongia and Spilka (1982), and Choi (1982)]. While specifics differ, these papers all (implicitly or explicitly) assume that they are able to specify the information set of traders prior to an announcement. The standard approach relates the size and direction of market price movements to the size and direction of revisions in the USDA forecast from one month to the next. The authors often discuss other information available to traders but do not allow it to affect their empirical procedure or inferences. Such specifications (or related approaches) presume that USDA reports are the major information in the

market and therefore that traders react to changes in USDA forecasts. If that were true, upward revisions in forecasts of supply would cause the market price to fall, and vice versa, but results of the studies that take this approach are disappointing. The authors attribute mixed results of their tests to market imperfections, imperfections in crop forecasts, or other complications of empirical procedures. Our approach avoids the implicit assumption about traders' prior knowledge that we believe has caused problems for previous research.

In this section we examine price changes from one day to the next for a sample of 1056 trading days for soybeans and 1260 trading days for corn. We use Chicago Board of Trade data from 1961 through 1982 for two-week periods surrounding announcements of USDA crop forecasts. For soybeans we examine monthly announcements made in August through November. For corn we also use July announcements in the 17 years in which a July forecast was released.

We examine the effects of the release of USDA crop forecasts by comparing the futures market price for contracts, P_t, before and after the announcement. Our dependent variable is the absolute value of the percentage change in P_t from the day before to the day after the announcements:

$$DP_t = [\,|\, P_{t+1} - P_t \,|\, / P_t\,] \times 100.$$

Releases of forecasts for corn and soybeans are made after the close of trading. Thus our "announcement day" price change is calculated as the difference between the closing price on the date of the announcement and the closing price on the next trading day following the announcement.

Our dependent variable in both the regression and the analysis of means is an absolute value of the price change because one cannot predict the direction of the price change without knowing the prior information of traders. We examine these absolute

values of price changes in response to the date of an announcement rather than examining some measure of the actual supplies forecasted, for a similar reason: it is the USDA forecast--relative to prior information--that matters. No absolute magnitude of the forecast is relevant to price changes unless one can be confident that "high" forecasts are surprisingly high or that "low" forecasts are surprisingly low.

We compare the means of the announcement day price change with the pooled mean of changes on all other days and also with the individual mean of each other one-day price change. These one-day price changes, a full week before or after announcements, are unlikely to be directly affected by the announcement, so act as a natural control sample.

We also use regression analysis to control for other factors that may affect price change. The explanatory variables in the regressions are: (a) a dummy variable that is equal to 1 for an announcement day, (b) linear and quadratic terms for the trading year, (c) a vector of dummy variables representing the day of the week, and (d) a vector of dummy variables representing the month of the trading period. We also examine separate samples by month of announcement.

Empirical Results

We examined simple differences in means between announcement day price changes and changes in other days in the two-week period surrounding announcements. Comparing the announcement day with the non-announcement days pooled as shown in Table 1 tells the basic story. Announcement day price movements for corn and for soybeans are about twice the magnitude of other days. Following the announcement, price moves over 1.5 percent for both crops. On non-announcement days (pooled), the price moves less than 0.9 percent. Statistical tests indicate that these means are different from zero and significantly different from one another.

Table 1 includes means for each other day in our sample. The results confirm that there are significantly larger price movements on the day following an announcement than on any other day in the two-week period surrounding announcements. Further, these means suggest that none of these days is different from any other.

The same sorts of means tests were performed with the sample divided by month as well as by commodity (not included in the table). The t-tests indicate significantly more price movement after announcements for all months except November for each commodity. Even for November the difference was significant at a 0.10 percent confidence level. The monthly pattern of the absolute size of differences in means and of the level of significance shows that the impact of crop reports becomes stronger each month until October and then falls with the November report. Further, for the July corn report, several days in the two-week period have price movements that are not significantly smaller than the announcement day movement. This is also true for several days surrounding the November report.

Table 2 summarizes our major regression results for announcements of USDA corn forecasts. In general, these results strongly reject the null hypothesis that the forecasts provide no new information to the market. Every announcement coefficient is above zero and is more than twice the estimated standard error. Adding control variables for year squared, days of the week, and months (for the samples pooled across months) improves the fit of the regression but does not affect the announcement coefficient.

The results by month tell the same general story. For each month the coefficient of the announcement day dummy variable is significantly larger than zero. Other control variables do not affect the coefficient, so only the results controlling for year and year squared are shown in the table. The pattern over time shows that the t-statistics measuring significance of the announcements'

effects increase each month until November, when they fall. Our evaluation of forecasting performance noted that the September corn forecast was relatively poor. Table 2 shows that the September announcements have smaller effects than those in August. The coefficient of announcements is also smaller in July and November than in the other months.

Concluding Remarks

We have demonstrated that market participants do react to releases of USDA reports. Even though other market information is available, the crop reports add to the information set.

Extensions of this paper are underway. These include further modeling and further data analysis. One pressing item on the agenda is a more thorough theoretic development of the relationships between aggregate market variables and changes in particular traders' information sets. Empirically, examining the effect of crop report announcements on volume and open interest in futures markets would allow a more specific picture of the influence of crop reports.

Our data analysis supports the idea of the hump-shaped impact of crop surveys as the growing season progresses. It seems that early in the season the forecasts are less useful because they are not as reliable as later forecasts. Late in the season, forecasts are less useful because they are not as "new" as earlier forecasts.

This paper does not demonstrate that crop forecasts from the USDA are a good investment of public funds. However, we do show that an analysis of market price movement supports the hypothesis that these reports provide a service valued by the market especially in August through October.

Table 1: Means of Percentage Price Movements by Day Relative to the Announcement (standard errors of means in parentheses)

	CORN		SOYBEANS	
	Percent absolute[a] price change	Absolute[b] price change	Percent absolute price change	Absolute price change
All days	.912 (.026)	.0202 (.0007)	.957 (.031)	.0528 (.0022)
	All days: n=1155 For each day: n=105		All days: n=968 For each day: n=88	
5 days before	.902 (.085)	.0199 (.0024)	.851 (.078)	.0467 (.0056)
4 days before	.991 (.092)	.0224 (.0026)	.967 (.104)	.0540 (.0072)
3 days before	.899 (.093)	.0204 (.0027)	.849 (.088)	.0491 (.0071)
2 days before	.702 (.068)	.0153 (.0020)	.696 (.075)	.0369 (.0050)
1 day before	.600 (.064)	.0134 (.0019)	.703 (.099)	.0394 (.0069)
Announcement day	1.536 (.120)	.0343 (.0034)	1.768 (.135)	.0959 (.0098)
1 day after	.986 (.081)	.0219 (.0025)	.912 (.102)	.0509 (.0075)
2 days after	.898 (.080)	.0193 (.0022)	.913 (.095)	.0509 (.0068)
3 days after	.896 (.087)	.0192 (.0023)	1.058 (.112)	.0581 (.0082)
4 days after	.840 (.076)	.0195 (.0022)	.958 (.102)	.0527 (.0071)
5 days after	.785 (.078)	.0169 (.0021)	.848 (.085)	.0462 (.0058)
Non-Announcement Days Pooled	0.850 (0.026)		0.875 (0.030)	
t-value[c]	5.53		6.83	

[a] $(|P_{t+1} - P_t| \times 100)/P_t$

[b] $|P_{t+1} - P_t| \times 100$. Mean of P_t for corn was \$1.92/bushel. Mean of P_t for soybeans was \$4.60/bushel.

[c] This is from a t-value for the equality of two means with different sample sizes and possibly different variances.

Table 2: Announcement Effects of USDA Forecasts on Futures Contracts for Corn and Soybeans

	CORN		SOYBEANS	
Sample and Model	Coefficient of Announcement Dummy	Standard Error	Coefficient of Announcement Dummy	Standard Error
All months pooled (no control variables)	0.686	0.090	0.892	0.104
All months pooled (T, T^2 included)	0.686	0.085	0.892	0.097
All months pooled (T, T^2, DW included)	0.672	0.084	0.893	0.097
All months pooled (T, T^2, DW, DM included)	0.672	0.083	0.893	0.097
July (T, T^2 included)	0.567	0.206		
August (T, T^2 included)	0.804	0.216	0.963	0.233
September (T, T^2 included)	0.711	0.192	1.090	0.170
October (T, T^2 included)	0.965	0.163	1.092	0.172
November (T, T^2 included)	0.358	0.146	0.424	0.187

Note: The dependent variable is the absolute value of the one-day percentage change in the futures market closing price. T represents year, 61-82, DW represents a vector of day-of-the-week dummies, DM represents a vector of month dummies. December contracts are used for corn; January contracts are used for soybeans.

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