The Effects of USDA Reports in Futures and Options Markets

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INTRODUCTION

Identifying specific sources of price risk in agricultural markets is an important component in developing a marketing strategy for agribusiness firms. Some events which affect prices, such as the attempted Soviet Coup or the invasion of Kuwait are largely unanticipated, making it quite difficult to recognize and manage the associated price risk ex ante. Other events, however, are fully anticipated. Recognizing and adjusting to the potential price risk associated with anticipated events can be a key ingredient to an agribusiness firm's overall performance.

An example of an anticipated event which could result in increased price risk for market participants would be the release of a United States government report. The United States Department of Agricultural (USDA) issues regular reports which contain supply and demand data for a whole host of agricultural commodities on a regular basis. The date and time of release of these reports is published ahead of the release dates, and the type of information the report will contain is also known. An example is the USDA monthly estimates of supply and demand conditions for domestic and international grain markets. The specific date and time of each announcement is known in advance, and the commodities to be included are known.

The supply/demand estimates are considered to be among the most important sources of information affecting trade in farm commodities (Sumner and Mueller). As such, USDA goes to great effort and expense to insure that the specific data contained in each announcement is not leaked to the public until the official release time. While the release of a report is widely anticipated, the specific information contained in the report is not known with certainty. If a report changes the overall perceptions of the supply and demand picture for a given commodity, then one would expect to see a change in the commodity's price level. Since firms would not know a priori whether the new

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information would result in a price increase or decrease, the release of a report could expose a firm to abnormal price risk.[1] If firms can identify the reports whose release on average results in a market moving to a new price level, they can adjust their market position prior to an announcement date, and thus limit their risk exposure.[2] The purpose of this article is to examine the extent to which agricultural agents face abnormal price risks associated with the release of U.S. crop production reports and World Agricultural Supply and Demand Estimates (WASDE).

PREVIOUS LITERATURE

Several studies have investigated the effects of USDA reports on agricultural prices. They include Choi; Pearson and Houck; Gorham; Miller; Hoffman; Milonas; Sumner and Mueller; and Colling and Irwin. Results from this body of literature are mixed. While the literature spans a considerable time period, only the most recent literature is reviewed here.

In 1980, Hoffman investigated the effects of quarterly livestock reports on cattle and hog prices. Specifically, he was interested in price movements of both cash and futures markets on days surrounding livestock report releases. The data period extended from 1970 through 1979, and included 38 Cattle and Feed reports, and 37 Hogs and Pigs reports. Pre-report prices were measured as 5-day average prices leading up to and including the report day. Post report prices were the average of the 5 days following the release of a report. The analysis included both nearby and more distant futures contracts. Hoffman's methodology consisted of regressing the post report prices on the pre-report prices, as well as an announcement effect variable. He found a significant announcement effect in cash markets, but not futures markets. He concluded that futures markets were more efficient than cash markets in anticipating the underlying supply characteristics in the cattle and hog markets.

Milonas looked at the impact of USDA crop announcements on cash commodity prices. Specifically he studied the impact of USDA forecasts of crop size on the cash prices of corn, wheat, soybeans, soybean meal, and soybean oil. His data period extended from 1966 through 1984. Milonas calculated logarithmic price changes of daily cash prices for the twenty days surrounding a report release. A report effect was identified if the residual of price change following a report was significantly different than that of non-report days. In general, Milonas found that cash markets reacted to USDA announcements, but that not all markets reacted with equal strength. Based on the results, Milonas concluded that USDA reports were providing new information to commodity markets. In addition, he concluded that the markets were generally efficient in incorporating the new information.

Another recent study concerning crop reports was conducted by Sumner and Mueller. They examined the informational content of USDA domestic crop production reports by measuring their impact on corn and soybean futures prices for the period 1961 through 1982. The analysis used the absolute differences between price changes following release of a report and price changes on non-report trading days as a measure of market participants' reactions. They found that the mean absolute price changes following announcements was greater than the absolute mean price change on non-announcement days. As such, they concluded that the USDA reports did provide news to the market which changed the overall supply/demand perceptions of market participants.

[1]Abnormal price risk is defined here as a price change following an announcement that is greater than the expected price change in the absence of a report.

[2]For example, they might hedge a cash position or liquidate a speculative position.

Colling and Irwin focused on the reaction of live hog futures prices to the USDA Hogs and Pigs Report. They differentiated between anticipated and unanticipated information and measured the extent to which live hog futures reacted efficiently to the unanticipated information. Their methodology employed an econometric two-limit logit model. The technique was chosen to specifically account for the fact that daily price limits on futures contracts result in a distribution of price changes which is truncated on the right-hand side. They concluded that the live hog futures market was efficient relative to the Hogs and Pigs report. They found that prices did not react to previously anticipated information, did react to unanticipated information, and generally adjusted to unanticipated information within one trading day.

The discussion above suggests that the work in livestock markets is more current than that for grains. Recall that Milonas' data ran through 1984, and Sumner and Muellers' through 1982. Since 1984, however, there have been several changes in the commodities trading industry, in communications technology, and in USDA reporting. Some of these changes may have implications relative to the informational content of USDA reports.

CURRENT SITUATION

A major market change occurred in the fall of 1984 when options on futures contracts were introduced. Options provided traders with increased opportunities for managing the price risk of a cash and/or futures position in particular commodities. Because options simply provide the right but not the obligation to take a position in an underlying futures contract, production reports that affect futures prices should also affect the price of futures options.

Coincidentally with trading industry changes, the U.S. share of world soybean and corn trade has fluctuated. The United States has become generally a less dominant market participant. Also, in 1985, U.S. crop production releases were combined with releases of the World Agricultural Supply and Demand Estimates (WASDE). Prior to this, WASDE was not subjected to the same security measures as domestic reports. Keeping WASDE information protected until its official release time may have affected the relative importance of domestic versus world supply and demand reports. All of these events combined suggest that the role of USDA reports in guiding traders to price discovery may have changed in recent years.

OBJECTIVES

The purpose of this analysis is to evaluate the effects of USDA Crop Production Reports and USDA World Agricultural Supply and Demand Estimates and to focus attention on recent changes in both domestic and world grain and oilseed markets. Specifically, this study explores market reactions to USDA reports over the recent historical period in which both futures and options on corn and soybeans have been actively traded, as well as during trading periods before options on agricultural futures were available.

The empirical procedure is to compare futures price and option premium movements on release dates to their movements on non-release dates. The specific futures and options contracts considered are the January soybean and the December corn contracts.[3] These are selected to roughly coincide with the U.S. harvest and to allow consideration of the impact of production reports on a single contract over complete crop years. The

[3]The November contract is the more appropriate "harvest" contract for soybeans. However, the January soybean contract is used so that the price impact of the November report on the November contract can be included in the number of report day observations.

data consist of daily observations and include the closing futures price, closing options premiums for all traded strike prices of both puts and calls, a zero-one dummy variable for report dates, as well as data on U.S. loan rates and U.S. share of world corn and soybean exports.[4]

EMPIRICAL APPROACH

The empirical approach used here is based on the assumption that market participants' reservation prices are a function of their supply and demand information. If the release of a USDA production report alters the supply/demand perceptions of a sufficient number of traders, then the newly perceived supply/demand situation should be reflected in a market price change. A priori, it is not clear if the market price change will be positive or negative, because it is not clear in which direction perceptions change. On average, price changes following a report are likely to be zero. However, the average of the absolute value of price changes likely will be positive. In addition, the magnitude of change in traders' perceptions will be reflected in the magnitude of price change. Thus, above-average changes in perceptions will result in above-average changes in market price. This line of reasoning has been employed by Anderson and Danthine; Turnovsky; and Sumner and Mueller.

Futures options provide owners the right to take a position in an underlying futures contract. Call options provide the right to buy a future contract, and put options the right to sell a contract. The price, or premium, of an option is a function of the current futures price, as well as the time remaining until the option's expiration, the riskless short-term interest rate, the volatility of the underlying futures price, and the price at which the option can be exercised.[5] Since option values are a function of futures prices, then one would expect an event which affects futures prices to also affect options premiums.

The impact of USDA reports on futures and options markets is tested in several ways. The absolute differences between price changes following a report release are compared to the differences on non-report trading days. If the USDA reports provide news to the

[4]The data is from a variety of sources. The futures prices are from Tech-Tools and the options data from the Chicago Board of Trade. The U.S. loan rates and shares of trade are from USDA sources.

[5]This is evident from the Black–Scholes Option Pricing formula. An empirical formulation and discussion of the Black–Scholes Option Pricing formula is available from Hull. It is important to recognize that an option's premium is made up of two parts; intrinsic value and time value. Intrinsic value refers to the relationship between an option's exercise, or strike price, and the futures price of the underlying commodity. For call options, intrinsic values are positive when the futures price is above an option's strike price. The option allows the holder to buy futures below the current market price. Such an option is said to be in-the-money. For put options, an in-the-money option would be one which has a strike price above the current futures price, allowing the holder to sell futures above the market. An option whose strike price is equal to current futures is said to be at-the-money, and an option without positive intrinsic value is out-of-the-money (generally, negative intrinsic value is not recognized, thus an out-of-the-money option is said to have no intrinsic value). Out-of-the-money option premiums consist only of time value. Any futures price change which increases an option's intrinsic value will have a positive impact on the option's premium. Similarly, any futures price change which has a negative impact on intrinsic value will reduce an option's premium.

Time value is associated with the time remaining to option expiration. The closer to expiration, ceturus peribus, the cheaper the option. This is because opportunities for a profitable execution of an option are reduced as its life diminishes. Time value is also affected by the short-term interest rate and by futures market volatility. If all variables except the interest rate are held constant, then an increase in the short-term interest rate will increase an option's value. This is because an interest rate increase decreases the present value of an option's strike price. Since the strike price is a potential liability for option sellers, option premiums will increase [Zieg and Nix (1978)]. The value of an option will also increase as futures price volatility increases. Increased volatility results in increased probability for a positive intrinsic value. Option sellers view this as a risk deserving of compensation, and buyers as an opportunity worth paying for.

market, then the mean absolute price change (or option premium change) is expected to be greater following the release of a report than on non-report days. Differences in mean price changes on report and non-report days are tested using t-statistics and a series of non-parametric tests.[6] Another test of report news employs regression analysis. This allows a more convenient method for the introduction of explicit interaction measures. As discussed more fully below, the regression model essentially involves regressing the absolute price changes on a dummy variable for report release dates and other explanatory variables.[7]

The empirical analysis uses the movements of closing prices for soybean and corn contracts traded at the Chicago Board of Trade. Daily data for all trading days from January, 1969 through December, 1989 for corn and soybean futures, and January, 1985 through December, 1988 for options are used.[8] For futures, analyses are conducted using all available data, using only data for the report day and 1 day before and after the report, and using data for the report day and 4 trading days before and after the report day. For options, the same trading days, and all reported strike prices are considered as well as just three option strike prices for each trading day; one in, one out, and one nearest to the money. In general, the quality of the results is invariant with respect to the number of non-report days included and the number of strikes for each option.

Beginning in 1985, WASDE reports were released in conjunction with domestic crop reports.[9] The WASDE reports contain information germane to international corn and soybean markets each month. All months from 1985 on are considered in the empirical analysis. In addition, results are disaggregated by month to examine the impact of WASDE reports (i.e., December through July releases) relative to months when relevant domestic harvest forecast reports are also released.

The measure of price change used is based on the absolute difference between daily closing prices (or options premiums). For report days, the relevant price is the closing price the day the report is released and the closing price the following trading day. The USDA releases reports after the close of futures trading. In addition, they employ considerable effort to ensure that information contained in the reports is not leaked before it is officially released. For example, if a report is released on October 10, the relevant measure of market reaction is the absolute difference between the closing price on October 10 and the closing price on October 11 (or next trading day). Differences between prices on all other trading days represent non-report price movements although one cannot rule out any influence by an upcoming or recent report.

[6]The distributions of price changes are truncated on both the left and right-hand side of the distribution. Since the absolute value of the price change is used, the left-hand side of the price change distributions are truncated at zero. Also, there is a 30¢ daily price limit for soybean futures and options, and a 10¢ daily limit for corn futures and options. The daily price limits result in the price change distributions being truncated on the right. The t-test assumes normality. As such, the appropriate test statistics are the non-parametric tests used. The t-tests are included, however, to make a comparison with previous work, and the results are consistent with those of the non-parametric tests.

[7]Again, the normality issue as it relates to regression analysis is recognized. This is discussed more fully in the context of the regression model.

[8]Options on soybeans started trading in November, 1984. Corn options began trading in February, 1985. A calendar-year data period is chosen for simplicity. More current options results are not yet complete.

[9]Monthly world crop reports were first released in July, 1979. These were followed 1 or 2 days later by a world supply and demand report. Beginning January 11, 1985, these two reports were combined into WASDE and released simultaneously with domestic crop production reports (Bange).

A relative price change variable is used to measure price change.[10] This variable accounts for differences in price levels over the data period. This variable is defined as:

$$|\Delta P| = \text{ABS}[(P_t - P_{t-1})/(P_{t-1})]$$

where ABS refers to absolute value, and P represents either futures prices or options premiums.

LOCATION TESTS FOR REPORT EFFECTS

Statistics for the relative price changes of futures and options are tabulated for each commodity. Results suggest that mean price changes for both options and futures generally are not significantly different from zero. However, as expected, the mean of $|\Delta P|$, the absolute value of relative price change, is significantly different from zero. This is evident from Table I. Also, no evidence of serial correlation between day-to-day price movements is found. This suggests that the statistical tests used below are not biased in any obvious way, except for the small sample normality assumption.

The initial tests for differences in mean price changes between report and non-report trading days consist of a series of t-tests, which assume normality in the distribution of $|\Delta P|$, and a series of non-parametric tests, which explicitly account for the non-normality of $|\Delta P|$.

Table I
DESCRIPTIVE STATISTICS FOR THE ABSOLUTE VALUE OF RELATIVE DAILY PRICE CHANGE, 1969–1989 FOR FUTURES AND 1985–1988 FOR OPTIONS

	Futures[a]		Options[a]	
Statistic for $\|\Delta P\|$	Corn	Beans	Corn	Beans
Mean	1.0247[b]	1.1165[b]	0.1158	0.1264
(S.E. of mean)	(0.0202)[b]	(0.0205)[b]	0.0029	0.0025
Variance	0.0106[b]	0.0107[b]	0.0437	0.0270
Skewness[c]	4.2095	1.6639	11.4028	3.8467
Kurtosis[c]	56.3222	4.1619	224.2436	26.0719
Normality[d]	0.1598	0.1400	0.2897	0.2210

[a]Sample sizes are 2597 for corn futures, 2540 for soybean futures, 5425 for corn options, and 4171 for soybean options. Note that a large number of options observations are not independent, since they reflect different strike prices for a given option and futures price. For futures, the data include August through November for 1969–1984 and all months from 1985 on. Options data include all months from 1985 on.

[b]Means, standard errors, and variances have been multiplied by 100.

[c]Significant skewness and kurtosis is found in all cases at the 1% level. Samples of critical values are available from Snedecor and Cochran (1980), Table A20, p. 492.

[d] Normality is measured by the Kolmogorov D-statistic. Normality is rejected at the 1% level in all cases. This is not surprising since the left-hand side of the distribution of $|\Delta P|$ is truncated at 0, and the right-hand side at the appropriate price limit.

[10]The same tests are conducted using a nominal price change variable. This variable is defined as:

$$|\Delta P| = \text{ABS}(P_t - P_{t-1})$$

where variables are as defined above. Results are invariant with respect to the measure of price change employed. Thus, results are reported for the relative price change variable.

The usual formulation of the t-statistic is:

$$t = (\overline{x_1} - \overline{x_2}) \Big/ \sqrt{s^2(1/n_1 + 1/n_2)}$$

where $\overline{x_1}$ and $\overline{x_2}$ are the means from two independent samples, n_1 and n_2 are the number of observations from each sample, and s^2 is the pooled variance. The pooled variance is calculated as:

$$s^2 = [(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2]/(n_1 + n_2 - 2)$$

where s_1^2 and s_2^2 are the variances of the two groups. This specification of the t-test assumes that the population variances of the two groups are equal.

If the variances of the two groups are not equal, the t-test is specified as:

$$t = (\overline{x_1} - \overline{x_2}) \Big/ \sqrt{s_1^2/n_1 + s_2^2/n_2}$$

with degrees of freedom approximated by:

$$DF = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)}$$

where all variables are as previously defined (Steel and Torrie). To test the assumption of equal variances, a two-tailed F-test is conducted. This test is specified as:

$$F = \max[s_1^2, s_2^2] / \min[s_1^2, s_2^2]$$

Since the variable $|\Delta P|$ must be positive it cannot be normal. Further, the normality tests reported in Table I suggest that normality of the price change variable may not be a reasonable approximation. Therefore, a series of non-parametric location tests are employed also. These include the Savage Scores test, the Kruskal–Wallis test, and the Van Der Waerden Scores test. These three tests fall in the general category of rank tests and are based on linear rank statistics. The power of these tests depends on the underlying sample distribution. A discussion of the test statistic specifications and evaluations of their power is available from Hajek.[11]

Several combinations of location tests are conducted to determine if the mean changes in futures prices and options premiums are significantly different immediately following the release of a report as compared to non-report days. For options, the tests initially are conducted combining all strike prices for a given commodity and option. For example, the absolute mean percentage change in options premiums for all soybean puts on non-report days is compared with the mean percentage premium change on report days. The tests are

[11]Hajek (1969) notes that in the case of discontinuous distributions, such as those used here, it is possible to obtain groups of observations of equal value. For example, if a limit price move occurs on both a report day and a non-report day, the variables $|\Delta P|$ would be equal, even though in the absence of a price limit (i.e., a continuous distribution) they may not be equivalent observations. Hajek suggests several methods of dealing with the problem. The method used here involves what Hajek refers to as the "conservative removal of ties." This procedure requires that for two pairs of observations at the limit (either 0 or the price limit) the report price change is assumed to be smaller than the non-report price changes; if $|\Delta P|$ report = $|\Delta P|$ non-report, then assume $|\Delta P|$ report < $|\Delta P|$ non-report. A standard table of critical values can then be used to test for significance given a "conservative attitude," or the explicit recognition that the upper (lower) critical values necessary are smaller (larger) than those reported. It is argued that any potential biases introduced by the use of conservative removal of ties in this study are quite small due to the infrequency with which the bounds of the relative price change distributions are binding. Corn futures contracts, for example, exhibit limit price changes less than 3% of the time, and a near equal number of 0 price changes. Soybean futures exhibit less than 2% limit moves and less than 2% 0 price changes. Options for both commodities experience even fewer limit moves.

conducted by month as well. This allows a comparison of effects for times when only the WASDE report is relevant with effects for times when both WASDE reports and domestic reports relate to corn and soybeans. In addition, the tests are conducted by strike price, and by strike price and month. The tests by strike price are not particularly informative because many strikes include only 4 or 5 report day observations, resulting in few degrees of freedom. An F test is conducted to test the appropriateness of the assumption of equal variances for report versus non-report days. In general, the hypothesis of equal variances is not supported. In those instances when it is not, the t-tests are adjusted to account for the assumption of unequal variances.[12]

Tests are also conducted using only option strike prices nearest the futures, and including only the 4 trading days before and after the report trade day. These include an at-the-money option (or the one closest to the futures price), the nearest out-of-the-money option, and the nearest in-the-money option. The rationale behind three strikes is that they are the most actively traded options, and are likely the most sensitive to information that has an impact on the futures price, since their intrinsic values would change most dramatically as a result of a futures price change.[13] The sample is restricted to 4 days before and after the reports to account for the possibility that trading activity decreases in anticipation of a report, and then increases after the report is released. The results suggest that trading activity just before a report release is not systematically different from that on other trading days. The tests detect no difference in results associated with using all non-report trading days as opposed to using only those days immediately before and after a report release.[14]

Table II provides t-statistics, F-statistics, and non-parametric test statistics comparing report release dates to 4 days before and 4 days after a report release. The results are disaggregated for months when WASDE reports are relevant (i.e., December through July) versus months in which both WASDE and domestic reports relate to corn and soybean markets (August through November).[15] Table IIA is for call options, and Table IIB is for put options. The analysis suggests that, in general, there is no evidence of a systematic, statistically significant reaction to USDA reports in options markets over the data period considered. None of the reported location test statistics are significant at the 5% level. For soybean calls, the non-parametric statistics for both December through July and August through November are significant at less than the 55% level. For soybean puts, the statistics are significant between the 20 and 30% level. Rejections of significance

[12]Tests are conducted also eliminating all options in which there is no trading volume. The rationale is that options with strikes furthest from the futures are the ones with little or no volume, and being so far in or out of the money might not reveal a report effect even if one exists for the market in general. Thus, using the non-traded options might bias the results in favor of the null hypothesis of no report effect. However, a lack of trading volume may indicate a report contains no news, and as such, eliminating no volume options from the set of observations may not be appropriate. The quality of the results turns out to be invariant with respect to keeping or deleting no volume options.

[13]In general, the degrees of freedom from the test are misleading. Many of the option strikes are not independent, since they are based on the same expiration date and futures price. For soybeans there are 44 report dates and for corn 43. This implies the number of independent means for the t- and f-statistics is substantially less than the degrees of freedom reported in Table II. Results for tests which do not aggregate strike prices are available from the authors. However, the results are qualitatively similar to those reported here.

[14]In addition to testing for a report effect using 4 days before and 4 days after the report release, tests are conducted for a report effect using 1 trading day before and after a release, and using all available non-report trading days. The results are invariant to the number of non-report trading days considered.

[15]Tests aggregating all months are conducted also. Results are similar to those reported, and are available from the authors.

Table IIA
MEANS, VARIANCES, AND STATISTICAL TESTS FOR OPTIONS, THREE STRIKES, AND ALL OBSERVATIONS, BY MONTH

	Calls			
	Soybeans		Corn	
Stats for % Change	**Dec–Jul**	**Aug–Nov**	**Dec–Jul**	**Aug–Nov**
Non-report days				
Mean	0.1444	0.1236	0.0947	0.1904
Standard error	(0.0091)	(0.0057)	(0.0049)	(0.0164)
Report days				
Mean	0.1428	0.1348	0.0826	0.1629
Standard error	(0.0225)	(0.0185)	(0.0105)	(0.0236)
t-stat	0.0582	−0.6203	1.0452	0.9571
DF	(519)	(434)	(93.6)	(87.8)
F-stat	1.43	1.19	1.93[a]	4.29[b]
DF	(466,53)	(43,391)	(592,64)	(373,41)
Savage Test				
χ^2-stat	0.16	0.47	0.41	0.26
Kruskal–Wallis Test				
χ^2-stat	0.60	0.29	1.10	0.02
Van der Waerden Test				
χ^2-stat	0.24	0.68	1.13	0.06

[a]Significantly different from zero at the 5% level.
[b]Significantly different from zero at the 1% level.

for corn options are even stronger than those for soybeans. Note that corn calls, and soybean puts for the December/July period appear to have different variances in report and non-report trading days. This is indicated by the calculated F-tests.

Based on the test statistics, no significant price effect is found that results from report releases in corn and soybean options markets. This evidence suggests no significant market reaction is induced by either WASDE or domestic production reports for the period 1985 to 1988. This is in contrast to the findings of Sumner and Mueller for futures markets.

Monthly evidence of the impact of USDA reports in corn and soybean futures markets is given in Tables III and IV. Table III presents t-tests, F-tests, and non-parametric tests for the data period 1969 through 1989. Table IIIA is for soybeans, and IIIB is for corn. The months considered are August through November, since no other reports are directly relevant to corn and soybean markets for the period prior to 1985. Note that these results are generally consistent with those of Sumner and Mueller for 1961 through 1982. In all months both commodities exhibit absolute price changes following a report that are greater than those on non-report days. In addition, the mean price changes between report and non-report trading days are statistically significant at the 5% level for all months and all commodities considered. Note further that price changes are larger following a report than on non-report days.

Table IV presents tests for futures by month for that subset of the data period in which options are traded. As with options, results are reported for the months December through

Table IIB
MEANS, VARIANCES, AND STATISTICAL TESTS FOR OPTIONS, THREE STRIKES, AND ALL OBSERVATIONS, BY MONTH

	Puts			
	Soybeans		Corn	
Stats for % Change	**Dec–Jul**	**Aug–Nov**	**Dec–Jul**	**Aug–Nov**
Non-report days				
Mean	0.1104	0.1261	0.0728	0.1801
Standard error	(0.0078)	(0.0076)	(0.0029)	(0.0180)
Report days				
Mean	0.0937	0.1514	0.0682	0.1752
Standard error	(0.0169)	(0.0234)	(0.0083)	(0.0442)
t-stat	0.8996	−1.0577	0.5073	0.0892
DF	(77.9)	(459)	(682)	(411)
F-stat	1.80[a]	1.07	1.14	1.46
DF	(450,53)	(46,413)	(615,67)	(370,41)
Savage Test				
χ^2-stat	0.03	1.72	0.48	0.06
Kruskal–Wallis Test				
χ^2-stat	0.33	1.04	0.69	0.14
Van der Waerden Test				
χ^2-stat	0.22	1.53	0.92	0.00

[a]Significantly different from zero at the 5% level.

July, and August through November to account for WASDE report impacts. Note that these results differ from those reported above. In general, mean price changes for both corn and soybeans are no different following release of a report than on non-report days for the period 1985–1989.

In addition to the results listed, tests are conducted for the sub-periods 1969–1982, 1982–1989, and 1982–1985. The first subset represents the data period that overlaps between this sample and the sample of Sumner and Mueller. For this subsample, the results are similar in quality to those in Table IV, and consistent with those of Sumner and Mueller. The second period, 1982–1989, represents the most recent futures trading history not included in Sumner and Mueller. In this period, mean price changes following reports are essentially no different than non-report dates.

The last period, 1982–1985, represents the period after the Sumner and Mueller sample and before agricultural options were available. The tests for this period suggest that USDA reports for August through November provide news to futures markets. There is no evidence of news for report dates that apply only to WASDE reports.[16]

The tests provide evidence that futures markets reacted to the release of USDA domestic production reports prior to 1985. The conclusion is that the domestic production reports did, in fact, provide news to the markets in earlier years. Since 1985 both futures and options markets appear to be less affected by USDA reports. This is true for both

[16]Again, note that a relatively small sample is tested. This may be an important factor in evaluating the results.

Table IIIA
MEANS, STANDARD ERRORS, AND STATISTICAL TESTS FOR FUTURES, 9 TRADING DAYS SURROUNDING REPORTS, BY MONTH

	Soybeans 1969–1989			
Stats for % Change	**Aug**	**Sep**	**Oct**	**Nov**
Non-report days				
Mean	0.0139	0.0101	0.0088	0.0099
Standard error	(0.0009)	(0.0008)	(0.0006)	(0.0007)
Report days				
Mean	0.0227	0.0185	0.0194	0.0156
Standard error	(0.0032)	(0.0027)	(0.0024)	(0.0025)
t-stat	−3.1548[a]	−3.55[a]	−4.3046[a]	−2.6122[a]
DF	(186)	(159)	(22.6)	(186)
F-stat	1.57	1.53	1.99[b]	1.59
DF	(20,166)	(17,142)	(20,166)	(20,166)
Savage Test				
χ^2-stat	9.76[a]	10.19[a]	30.88[a]	5.32[b]
Kruskal–Wallis Test				
χ^2-stat	8.31[a]	9.64[a]	17.39[a]	5.10[b]
Van der Waerden Test				
χ^2-stat	8.62[a]	8.49[a]	19.87[a]	4.92[b]

[a]Significantly different from zero at the 1% level.
[b]Significantly different from zero at the 5% level.

WASDE reports and domestic production reports. The tests above suggest no difference in price movements for options or futures markets following a report release compared to other trading days.

REGRESSION TEST FOR REPORT EFFECTS

The results presented in the previous section suggest that USDA reports have not been an important source of supply and demand news for corn and soybean markets in recent years. However, a definitive conclusion is premature. To understand the results more fully, hypotheses related to other factors that may be influencing futures price movements and the impacts of USDA reports on futures prices are tested.

Hypothesis 1. When prices are low, the loan programs limit futures price movements and reaction to news. Prices for much of the 1985–1989 sample period were at or near the loan rate, and world markets experienced large stocks of corn and soybeans. There may have been news in USDA reports, but economic conditions in the relevant markets were such that the news released had no impact on price levels, which were already supported above market clearing levels.

Hypothesis 2. When the U.S. share of world markets is smaller, price movements are smaller and news about U.S. crops has a smaller price impact. The U.S. share of world grain markets has fallen considerably over

Table IIIB
MEANS, STANDARD ERRORS, AND STATISTICAL TESTS FOR FUTURES, 9 TRADING DAYS SURROUNDING REPORTS, BY MONTH

	Corn 1969–1989			
Stats for % Change	**Aug**	**Sep**	**Oct**	**Nov**
Non-report days				
Mean	0.0122	0.0098	0.0084	0.0069
Standard error	(0.0008)	(0.0007)	(0.0005)	(0.0005)
Report days				
Mean	0.0211	0.0159	0.0178	0.0115
Standard error	(0.0031)	(0.0025)	(0.0021)	(0.0024)
t-stat	−2.7401[a]	−2.3235[a]	−4.3519[a]	−1.8641
DF	(22.7)	(22.8)	(22.5)	(21.5)
F-stat	1.91[b]	1.85[b]	2.09[b]	3.37[a]
DF	(20,166)	(20,166)	(20,166)	(20,166)
Savage Test				
χ^2-stat	13.03[a]	8.23[a]	25.93[a]	6.28[b]
Kruskal–Wallis Test				
χ^2-stat	6.46[b]	5.48[b]	17.86[a]	4.43[b]
Van der Waerden Test				
χ^2-stat	6.81[a]	6.32[b]	20.26[a]	4.67[b]

[a]Significantly different from zero at the 1% level.
[b]Significantly different from zero at the 5% level.

the sample period; thus, domestic production reports have become less important. They may still contain news, but the news relates to a reduced market share and is not weighted as heavily by the market. This still would not explain the lack of response to WASDE reports by market participants.

Hypothesis 3. The availability of options markets reduces futures price variability and the impact of news. USDA reports still provide news to the market, but the news cannot be measured directly by price changes because traders use options markets to hedge futures positions against the adverse consequences of news.

To test the above hypotheses two regressions using data from 1969 to 1989 are employed. The first regression takes the form:

$$|\Delta P| = \alpha + \beta_1 \text{SIG} + \beta_2 \frac{\text{PRICE}}{\text{LOAN}} + \beta_3 \text{SHARE} + \beta_4 \text{OPT}$$

where $|\Delta P|$ is the absolute relative price change variable, SIG is the zero/one dummy variable for report dates, PRICE/LOAN is the daily futures price to U.S. loan rate ratio,[17] SHARE is the ratio of U.S. exports to world exports for each commodity, and OPT is

[17]From 1984 on, the loan rate is adjusted to reflect reductions imposed by the Gramm–Rudman deficit reduction act.

Table IV
MEANS, VARIANCES, AND STATISTICAL TESTS FOR FUTURES, 9 TRADING DAYS SURROUNDING REPORTS, BY MONTH

	1985–1989			
	Soybeans		Corn	
Stats for % Change	Dec–Jul	Aug–Nov	Dec–Jul	Aug–Nov
Non-report days				
Mean	0.0104	0.0083	0.0103	0.0084
Standard error	(0.0006)	(0.0006)	(0.0006)	(0.0005)
Report days				
Mean	0.0092	0.0108	0.0082	0.0105
Standard error	(0.0012)	(0.0021)	(0.0013)	(0.0025)
t-stat	0.8663	−1.3348	1.5020	−0.8568
DF	(57.8)	(165)	(59.5)	(20.9)
F-stat	1.98[a]	1.54	1.87[a]	2.68[b]
DF	(294,37)	(18,147)	(311,39)	(19,155)
Savage Test				
χ^2	0.36	1.16	1.10	1.21
Kruskal–Wallis Test				
χ^2	0.00	1.01	0.74	0.08
Van der Waerden Test				
χ^2-stat	0.01	0.77	1.12	0.58

[a]Significantly different from zero at the 5% level.
[b]Significantly different from zero at the 1% level.

a zero/one dummy variable representing the introduction of options. It takes a value of zero prior to the introduction of an option, and one thereafter.

The second regression is similar to the first except multiplicative interaction terms are added between the indicator variable SIG and the other variables. It takes the form:

$$|\Delta P| = \alpha + \beta_1 \text{SIG} + \beta_2 \frac{\text{PRICE}}{\text{LOAN}} + \beta_3 \text{SHARE} + \beta_4 \text{OPT}$$
$$+ \gamma_1 \left(\text{SIG} * \frac{\text{PRICE}}{\text{LOAN}} \right) + \gamma_2 (\text{SIG} * \text{SHARE}) + \gamma_3 (\text{SIG} * \text{OPT})$$

where all variables are as defined above.

Since the F-tests reported earlier generally reject the hypothesis of equal variances for price change distributions grouped by the report day variable, heteroscedasticity based on the SIG indicator is assumed. To account for this, the above equations are estimated using weighted least squares (WLS) as outlined in Judge et al.[18] The results of the tests are presented in Table VA and VB.

[18]Judge, et al. (1985, p. 428) outlines a WLS procedure to be used when it is reasonable to assume that variances are constant within sub-groups of the data, but vary across groups.

One assumption of the WLS procedure used is that of normality. As discussed before, the dependent variable is bounded on the left by zero and on the right by the daily price limit. This violation is not considered critical, however, given the small number of observations which occur at the limits.

An alternative to the WLS approach is the two-limit logit model used by Colling and Irwin (1990). The limit move problem faced by them, however, was much more severe than found here. They faced limit moves

Table VA
WEIGHTED LEAST SQUARES FOR REPORT VERSUS NON-REPORT TRADING DAYS

	Soybeans		Corn	
	Coefficient[a]	*T*-Stat	Coefficient[a]	*T*-Stat
Intercept	87.41[b]	2.117	54.58[b]	3.283
PRICE/LOAN	0.6519[b]	16.563	0.4336[b]	12.370
SHARE	−0.0086[b]	−2.203	−0.0015	−0.756
SIG	0.6333[b]	4.533	0.4668[b]	3.304
OPT	−0.1794[b]	−2.141	0.1077[b]	2.207
R^2	0.2253		0.0822	
DW	1.697		1.679	

[a]Coefficients multiplied by 100.
[b]Significant at the 5% level.

Table VB
WEIGHTED LEAST SQUARES REGRESSIONS FOR REPORT VERSUS NON-REPORT TRADING DAYS, INCLUDING INTERACTION TERMS

	Soybeans		Corn	
	Coefficient[a]	*T*-Stat	Coefficient[a]	*T*-Stat
Intercept	62.14	1.478	56.46[b]	3.357
PRICE/LOAN	0.6616[b]	16.472	0.4316[b]	12.147
SHARE	−0.0062	−1.562	−0.0017	−0.873
SIG	7.449[b]	4.191	−0.1299	−0.151
SHARE * SIG	−0.0726[b]	−3.77	0.0103	0.841
PRICE/LOAN * SIG	−0.2746	−1.511	0.0754	0.352
OPT	−0.1181	−1.385	0.1252[b]	2.533
OPT * SIG	−1.8835[b]	−4.52	−0.7182[b]	−2.362
R^2	0.2445		0.087	
DW	1.718		1.686	

[a]Coefficients have been multiplied by 100.
[b]Significant at the 5% level.

Regression results in Table VA show that in both the corn and soybean markets a lower price-to-loan-rate ratio reduces daily price variability. This supports hypothesis one. If prices are at or near loan rates then one would expect little or no price effect even if a USDA report provided fundamental news to the market. An examination of prices from 1985–1989 shows that for a large part of that period prices of both corn and soybeans were at or near price support levels. Table VB shows the interaction between the price ratio variable and the report day variable is insignificant in both models, suggesting no differential effect on report versus non-report days.

in the live hog market in at least half of their post report trading days. Given the relatively small frequency of limit moves in the current study, the WLS procedure is used here.

Support for hypothesis two, report effects are sensitive to the U.S. to world export share, is provided in the soybean model but not the corn model. In Table VA the share variable is significant for soybeans, but not for corn. In Table VB the share variable for soybeans is not significant. However, the significance of the interaction variable for share and report days suggests that average price changes following a domestic production report are reduced as the U.S. share of world export markets increases. U.S. share of world soybean exports has fallen from a high of over 90% in the early 1970s to a low of just over 60% in 1989. As such, the regression results suggest average price changes following reports should actually be larger in recent years. This is in contrast to the earlier location tests, and does not provide support for hypothesis two. For corn, a larger U.S. share of exports is not associated with larger price changes. The corn market share has not changed as much as soybeans over the data period, and no influence of share change on corn futures price changes is detected.

The tests for both corn and soybeans support hypothesis three, options trading has affected the way futures prices react to news. For both commodities, the interaction terms between options trading and USDA reports in Table VB are statistically significant. The results suggest that options trading may have influenced the way futures markets react to USDA reports.[19] For soybeans there is less price variability since options began trading and for corn more (see Table VA). However, for both corn and soybeans the impact of production reports is smaller since the introduction of options (as measured by the option/report interaction terms in Table VB).

SUMMARY AND CONCLUSIONS

The empirical results suggest that the market impact of USDA reports has declined in recent years. Specifically, from 1985 through 1989 report releases do not result in larger than average price movements. This is in contrast to the results of both this study and others for periods prior to 1985. Based solely on location tests, one might conclude that USDA reports no longer provide news to markets. Perhaps market participants have become sufficiently skilled to anticipate the information forthcoming, and thus no market reaction is detected. Based on regression tests, however, it appears that this conclusion is premature.

The regression tests specifically examine three hypotheses relative to the impact of USDA reports. Tests of the hypothesis related to effects of the price-to-loan-rate ratio provide evidence that prices at or near loan rates do result in smaller price changes. Given the frequency of this occurrence in the post-1985 data, this may very well account for much of the missing report effect in the recent data. If this is the primary reason for the diminished report effect, then it would be reasonable to assume that USDA reports would again affect price levels as markets move away from loan rate levels.

The hypothesis concerned with effects of the U.S. trade share is not supported for corn. Market reactions to domestic crop reports appear to be insensitive to historical changes in the U.S. relative share of corn trade. Evidence of a trade effect does exist for soybeans. In general, one would expect a larger effect in soybean markets as opposed to that in corn. The U.S. share of soybean trade through the 1980s has slipped considerably. While there has been some variation in the U.S. share of corn trade, the current U.S. share is

[19]It is important to recognize that the test for options consists of a simple zero/one dummy variable. It cannot be ruled out that this variable might be picking up something in addition to the introduction of options. As such, this particular result should be viewed as evidence that further investigation into the relationships between futures and options markets is warranted, rather than definitive evidence that report effects have disappeared as a result of options trading.

very near its decade high. However, the soybean evidence is counter to the proposed hypothesis. The regression results suggest report price changes should actually be larger as U.S. export share falls.

The last test, the impact of options trading on market reactions to reports, provides some evidence of a report effect for both markets. However, care must be taken in assigning too much weight to this result given its measurement by a simple dummy variable. Nonetheless, the results do suggest that further study investigating the explicit relationships between futures and options markets is warranted. For example, maybe in the absence of options markets, futures markets over-react to news in the short run as speculators scramble to offset unattractive positions in light of the new information. With an options market, however, speculators can hedge their futures positions with options, and thus avoid an immediate need to liquidate futures positions because of adverse news. This suggestion, of course, provides the direction for further research. First, if futures tend to over-react to news in the short run when options do not exist, it should be possible to detect an inverse correlation between price changes immediately following a report release and price changes on subsequent trading days. Second, the volume in the options market should be greater surrounding the release of a report than on other trading days. While beyond the scope of this article, both of these are testable hypotheses which can provide further insight to the results presented here. Further, one cannot rule out that USDA reports still provide news, but that the news can no longer be measured by a simple price change variable.

It is important to interpret the results of this study in the context of the data period used. The lack of a report effect is found over a relatively small data period, and one of generally depressed prices. It cannot be ruled out that the results are sensitive to the data period studied.

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