ANALYSIS OF SPREADS IN AGRICULTURAL FUTURES

W. BRIAN BARRETT
ROBERT W. KOLB

INTRODUCTION

Although much, or even most, speculative activity in futures markets is conducted by trading spreads, the price behavior of spreads has received relatively little attention in the academic literature. This article analyzes the price behavior of some popular intermarket and intramarket spreads among grain products. In particular, it examines the profitability of key standard spread positions.

Some spread relationships have attracted the favor of many traders for a long time. The Chicago Board of Trade calls attention to some of these famous spreads in its series of booklets, focusing on individual spread relationships. These include:

"December Corn/Oat Spread 1979–1989"
"July/December Corn Spread 1972–1987"
"July/November Soybean Spread 1966–1986"
"November/December Soybean Crush Spread 1979–1989"
"Soybean/Wheat Spread 1979–1989"
"Wheat/Corn Spread 1977–1988"

In essence, these booklets feature the history of the spreads for each crop year. In most cases, the booklet includes a series of price graphs of the spread, devoting one graph to each year. The booklets present

■ *W. Brian Barrett is an Associate Professor of Finance at the University of Miami.*
■ *Robert W. Kolb is a Professor in the Department of Finance, University of Miami.*

The Journal of Futures Markets Vol. 15, No. 1, 69–86 (1995)

CCC 0270-7314/95/010069-18

no statistical analysis of the price behavior of the spreads, nor do they aggregate information about the price behavior of spreads across years.

The Chicago Board of Trade booklets carefully avoid recommending any trading strategy, but many market advisors do recommend positions in these spreads from time to time. While these spreads are volatile and do present profit opportunities in individual crop years, some market pundits imply that these spreads exhibit regularities in their price behavior. For instance, some advisers imply that it is typically wise to be long or short a particular spread during a particular season of the year.

If a spread exhibits a regular seasonal price pattern, there is obvious and dramatic profit potential. Further, a sufficiently strong pattern of this type clearly violates familiar market efficiency conditions. While these spreads continue to hold trader interest, there has been no careful examination of the actual price performance of these spreads over time.

This article uses futures data for corn, wheat, oats, and soybeans to test the profitability of these intermarket and intramarket spreads.[1] First, the analysis seeks to determine if spread behavior varies across the calendar months of the year. Second, the study analyzes whether spread profits vary in a systematic way depending on the amount of time remaining until one of the contracts in the spread matures. For intermarket spreads, tests for profit regularities in spreads by calendar month and also by months until expiration are performed. Similarly, for intramarket spreads, tests for differential performance in calendar months and for differential performance depending on the time remaining until expiration are presented.

Some previous studies of spreads focused on the profitability of certain spread trades. For example, Easterwood and Senchack (1986) examined arbitrage opportunities involving spreads between T-bills and T-bonds. Monroe and Cohn (1986) explored intermarket spreads between gold and T-bills and Rentzler (1986) studied the turtle trade—a trade of a T-bond spread against a T-bill futures position. Abken (1989) examined intramarket spreads in heating oil futures.

Other studies focused on other aspects of spreads, such as the distribution of returns in spread positions, or the effectiveness of spread positions in hedging strategies. Poitras (1990) found that the distribution of intermarket gold spread returns exhibits variance nonstationarity, even though a specific functional form was not found to adequately

[1] An intermarket spread is defined for use in this study as a position in two different but related commodities for the same expiration month, while an intramarket spread is a position in two different contract expiration months for the same commodity.

characterize the observed distribution. Johnson, Zulauf, Irwin, and Gerlow (1991) examined the soy complex crush margin to test for speculative opportunities in the crush spread. They found little or no profit opportunities for spread trading the nearby contracts, but they did find that profit opportunities exist for trades of distant contracts. In a theoretical model, Poitras (1989) sought to determine what the optimal futures spread position should be. Likening his work on spreads to the study of optimal hedge positions, Poitras applied a mean-variance utility maximization framework and found that optimal spread positions depend on trader's subjective estimates of statistical parameters and on the spread trader's attitude toward risk.

METHODOLOGY

This article considers spread performance for intermarket and intramarket spreads based both on the calendar month and on the months prior to expiration. This section explains the methodology to be applied in each kind of study.

Analysis of Spread Profits in Calendar Time

The article examines the behavior of spread profits in calendar time on a monthly basis for a variety of spread positions by testing whether spread profits are consistently greater in any calendar month rather than another. Let $S_{y,m,t}$ be the spread's daily dollar profit for a one contract position for year y, during month m, on day t. The mean profit across all daily profits (t) and available years (y) for each calendar month for a particular spread are computed, and this mean profit for month m is denoted by M_m. Therefore,

$$M_m = \frac{\sum_{y=1}^{Y} \sum_{t=1}^{T} S_{y,m,t}}{TY}$$

As an example, for the March Soybean/Wheat spread there are 31 years of data. For a particular month on this spread, such as March, there would be about 21 trading days. Thus, each M_m would be the average of about 651 daily profits. This process would be repeated for the six months of trading before delivery (September–February). If futures positions involve zero systematic risk and require no investment, one

would expect $M_{m,t} = 0$ for each month. This hypothesis is tested with a simple t-test.[2]

Analysis of Spread Profits in Contract Time

In addition to seeking consistencies in profits in calendar time, the analysis examines the performance of various spreads in contract time. For example, corn and wheat trade for expiration in March, May, July, September, and December, which allows five spread trades. These five spreads in contract time are aggregated to determine whether the wheat/corn spread behaves in a systematic way depending on the months remaining until the contract expires. For such an intercommodity spread, the study tests whether the profit varies depending on the time remaining until expiration, irrespective of the calendar month. Thus, in testing the spread behavior in the month prior to expiration, the February, April, June, August, and November values of $S_{v,m,t}$ would be aggregated. Thus, with about 30 years of data for wheat and corn, the one-month to expiration period would have five contracts per year, with about 21 trading days in the month, to yield about 3000 observations.

EMPIRICAL RESULTS

Data for this study are from Dunn and Hargitt, a commercial source of futures market data. Contract expiration dates extend from 1960 to 1990, with daily observations beginning in 1958 for some commodities. This gives a total of 155 contracts that are examined for each commodity. Tests developed in the proceeding section are applied to intercommodity spreads, with a total of 100,963 observations. The study also considers all intracommodity spreads of the nearby contract with the contract next closest to expiration, involving the analysis of 74,225 observations. The study considers two additional intracommodity

[2] The likely presence of heteroscedasticity in the daily dollar profits and losses suggests that simple t tests might be biased upward, leading to a too-frequent rejection of the null hypothesis. If the correlation between the level of profits and the standard deviation of the profits is positive, the sample standard deviation will be under estimated, and the reported t statistics will be biased upward. (See Judge, Griffiths, Hill, and Lee, p. 128.) In this study this is indeed the case. The typical correlation between the level of profits and the standard deviation of profits is about 0.35.

These considerations imply that the t statistics reported in this article may be larger than the true t values. However, the results in the article show infrequent rejection of the null hypothesis, even with this potential bias toward larger t statistics and resultant rejection of the null. The general conclusion of the article is that there are few profit opportunities, and this conclusion is based on simple t statistics, which may be inappropriately large. Correction for heteroscedasticity would merely strengthen the results of the article.

spreads highlighted in the Board of Trade booklets: July/December corn and July/November soybeans.

Tables I and II present the results of testing the intercommodity spreads in calendar time. Table I covers spreads between corn and wheat, wheat and oats, and corn and oats, while Table II presents results for corn and soybeans, wheat and soybeans, and oats and soybeans. In Table I, results cover spread positions between March and May, May and July, July and September, and September and December. In each instance, the analysis considers the six months prior to expiration, the uniform period of time during which both commodities would have sufficient liquidity to ensure meaningful results.

As an example of how to read the tables, the upper left panel of Table I reports results for a spread position for the March expiration of the corn/wheat spread. The first commodity listed is always long, and the second short, so in this instance March corn is long and March wheat is short. Results are reported for September through February, the six months before the expiration month.[5]

Each set of results involves four columns of numbers. The first column shows the average daily dollar profit for a one contract spread position. (Every commodity analyzed has a contract size of 5000 bushels, so the results are directly comparable.) Thus, for the March long corn/short wheat contract, the average daily price profit for the spread in September is −$4.02, showing that wheat (which was held short) rose in price relative to corn. The second column gives the standard deviation of the daily profit for the spread position for observations in a given month. Thus, for this same March spread of corn and wheat in September, the standard deviation is $167.10. The third column gives the number of observations, which is 602 in this example. The 602 observations are drawn from 31 years of March corn/wheat spreads, reflecting the 20–22 trading days typical of a trading month. The final column of numbers presents the *t*-statistic for a test of the null hypothesis that the mean daily profit for the spread is zero. For the September results of the March spread of corn against wheat, the −$4.02 average daily price rise of wheat relative to corn has a *t*-statistic of −0.59, which is not significant. For this same March spread, the results from holding the spread in October–February are reported in successive lines of the table.

[5] The performance of any futures in the delivery month is not considered for two reasons. First, price limits are generally removed when a commodity enters the delivery month. Second, volume and open interest falls dramatically in the early days of the delivery month. This leads to potentially severe problems with market illiquidity and nonsimultaneity of reported prices.

TABLE I

Intermarket Spread Daily Dollar Profits in Calendar Time for Corn, Wheat, and Oats

Observation Month	*Long Corn/Short Wheat*				*Long Wheat/Short Oats*				*Long Corn/Short Oats*			
	Mean	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*
						March Expiration						
SEP	4.02	167.10	602	0.59	3.99	179.69	602	0.54	0.09	93.79	603	0.02
OCT	4.93	182.14	682	0.71	1.43	192.45	682	0.19	3.47	85.07	683	1.07
NOV	1.27	162.09	577	0.19	−4.45	180.05	577	0.59	3.18	94.80	577	0.81
DEC	0.67	153.23	595	0.11	−8.45	173.71	595	1.19	7.77	80.77	595	2.35[a]
JAN	8.07	183.02	637	1.11	−6.63	196.43	637	0.85	1.44	86.23	637	0.42
FEB	0.30	181.65	560	0.04	3.28	195.11	560	0.40	2.98	90.49	560	0.78
ALL	0.09	172.18	3653	0.03	−1.81	186.58	3653	0.59	1.72	88.52	3655	1.18
						May Expiration						
NOV	2.18	162.07	577	0.32	−4.17	175.84	575	0.57	1.49	94.36	576	0.38
DEC	1.52	151.00	595	0.25	−8.71	176.90	597	1.20	6.36	80.35	595	1.93
JAN	8.56	178.64	637	1.21	6.13	189.59	634	−0.81	2.26	83.58	637	0.68
FEB	3.16	167.12	560	0.45	6.26	191.73	564	0.78	3.77	91.06	560	0.98
MAR	19.16	175.60	671	2.83[a]	7.72	193.38	668	1.03	9.97	85.29	671	3.03[a]
APR	9.53	189.25	613	1.25	8.30	197.95	609	1.04	0.59	102.01	613	0.14
ALL	6.72	171.45	3653	2.37[a]	4.98	187.89	3647	−1.60	1.43	89.69	3652	0.97

						July Expiration						
JAN	1.42	155 30	637	0 23	−1 26	167 32	629	0.19	1.63	84.20	637	0 49
FEB	4 80	145 73	560	0 78	9.43	169.42	564	1 32	2.38	79.30	560	0.71
MAR	18.27	155 65	670	3 04[a]	· 9 61	173 25	671	1.44	7.72	83.56	668	2.39[a]
APR	3.03	157 41	613	0.48	−13.91	169.96	610	2.02[a]	4.75	91.45	611	1.28
MAY	8 54	161 13	631	1.33	−1 45	160 14	631	0.23	2.10	94.87	631	0.56
JUN	2 73	220 28	656	0.32	−6.84	246.36	643	· 0 70	0.64	133.89	658	· 0.12
ALL	5.18	168 49	3767	1.89	−4 20	183 93	3748	1 40	1.47	96.82	3765	0.93
						September Expiration						
MAR	19.24	152 63	670	3.26[a]	−10.09	168 10	647	· 1 53	7.06	88.75	646	2.02[a]
APR	1.94	147 72	613	0.32	−7 78	162 23	610	1 18	5.55	82.08	610	1.67
MAY	3.06	158 81	630	0.48	−3 94	159 87	630	· 0 62	0.31	85.56	629	0.09
JUN	4.37	211.64	658	0.53	· 4 86	235.68	657	· 0 53	1 72	127.20	657	0.35
JUL	9.44	204 54	619	1.15	14 83	228 72	616	1 61	4.68	149.87	619	0.78
AUG	16.81	215 19	677	2 03[a]	13 83	218.83	687	1 66	1 91	143.46	677	0.35
ALL	0 43	184 71	3867	0 14	0.44	198 94	3847	0 14	0 48	116.70	3838	0.26
						December Expiration						
JUN	5.19	207 16	658	0 64	−3 72	232 98	658	0 41	1 46	124.02	658	0.30
JUL	9.05	211.56	619	1 06	12 10	225 63	619	1 33	2 62	143.12	620	0.46
AUG	14 93	205.19	686	1 91	14 91	213 20	684	1.83	0 50	125.93	685	0.10
SEP	4 25	172.37	601	0 60	5 30	181 62	599	0 71	0.37	99.91	599	0.09
OCT	5 11	190 53	684	0 70	1 42	198 52	684	0 19	3.69	93 34	684	1.03
NOV	2.51	184.40	578	0 33	· 5.93	192 59	578	· 0 74	3 42	104.06	578	· 0.79
ALL	4 45	196 12	3826	1 40	4 17	208.71	3822	1 24	0 35	116.42	3824	0.19

The table reports the daily dollar profit for a one-contract spread position over the six months prior to the common expiration month.
[a]Indicates a *t*-value that is significant at the 0 05 level.

TABLE II

Intermarket Daily Dollar Profits for Spreads in Calendar Time for Corn, Wheat, and Oats Versus Soybeans

Observation Month	*Long Corn Short Soybeans*				*Long Wheat Short Soybeans*				*Long Oats Short Soybeans*			
	Mean	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*
						March Expiration						
SEP	1.25	328.15	603	0.10	5.26	347.16	602	0.37	2.21	351.82	606	0.15
OCT	1.74	314.93	683	0.14	6.71	336.01	682	0.52	6.24	341.48	678	0.48
NOV	9.59	309.63	577	0.74	8.32	333.93	577	0.60	13.07	328.87	579	0.96
DEC	8.32	280.84	595	0.72	7.65	265.15	595	0.70	13.23	303.13	596	1.07
JAN	5.16	293.7*	637	0.44	2.91	313.18	637	0.23	6.02	317.87	634	0.48
FEB	−11.88	268.59	558	−1.05	−11.36	299.14	558	−0.90	18.20	282.57	555	−1.52
ALL	2.49	299.59	3653	0.50	2.44	317.40	3651	0.46	4.04	322.62	3648	0.76
						May Expiration						
NOV	9.02	304.39	577	0.71	7.90	328.17	576	0.58	10.77	328.89	576	0.79
DEC	7.83	279.26	595	0.71	4.92	260.65	597	0.46	14.18	296.88	595	1.17
JAN	5.32	290.73	637	0.46	3.33	306.94	634	0.27	3.06	312.88	637	0.25
FEB	14.24	263.92	560	1.28	12.40	289.88	564	1.02	18.01	284.66	560	1.50
MAR	15.37	302.04	671	1.32	33.90	332.66	668	2.63*	25.33	314.99	671	2.08*
APR	11.87	380.34	611	0.77	18.11	411.62	607	1.08	11.11	395.19	611	0.69
ALL	3.37	304.86	3651	0.67	9.67	325.76	3646	1.79	4.73	324.70	3650	0.88

					July Expiration						
JAN	2.06	284.67	635	0.18	4.52	322.63	627	0.35	0.64	308.83	635	0.05
FEB	13.09	297.78	560	1.04	13.38	279.64	564	1.14	15.47	310.05	560	1.18
MAR	-14.60	296.79	670	1.27	27.86	317.15	673	2.28[1]	22.45	312.07	669	1.86
APR	9.78	363.99	613	0.67	17.05	377.53	612	1.12	2.64	376.83	611	0.17
MAY	-23.61	356.02	631	1.67	29.54	381.16	631	1.95	25.71	374.59	631	1.72
JUN	18.43	627.46	653	0.75	10.97	656.72	638	0.42	19.90	652.12	653	0.78
ALL	6.56	392.10	3762	1.03	12.16	410.53	3745	1.81	7.48	410.25	3759	1.12
					September Expiration						
MAR	-7.93	257.15	670	0.80	28.91	278.37	671	-2.69[1]	21.97	267.13	647	2.09[1]
APR	-4.86	309.05	613	0.39	7.56	322.46	613	0.58	2.83	322.33	610	0.22
MAY	-25.07	325.33	630	1.93	27.31	344.34	631	1.99	23.85	334.81	630	1.79
JUN	3.29	424.68	654	0.20	8.98	459.63	654	0.50	4.80	466.31	653	0.26
JUL	-2.63	520.21	620	0.13	8.77	563.60	617	0.39	2.52	553.78	617	0.11
AUG	6.28	448.75	677	0.36	22.06	489.81	687	1.18	8.23	491.37	687	0.44
ALL	6.11	391.15	3864	0.97	6.86	422.07	3873	1.01	6.91	419.64	3844	1.02

The table reports the daily dollar profit for a one contract spread position over the six months prior to the common expiration month.
[1]Indicates a t-value that is significant at the 0.05 level.

These results have exactly the same form just discussed for the September performance of the March spread of long corn against short wheat.

The line of results labeled "ALL" shows the average daily profit across all observations in the six individual months over which the spread is analyzed. For the March position of long corn and short wheat, the average daily profit is $.09. This is computed over all of the contract years for all of the six months (September through February) in the holding period. Thus, for a March position of long corn and short wheat held over 31 contract years for six months per year, the average daily profit is $.09 per contract, with a standard deviation of $172.18. This mean is not significantly different from zero ($t = 0.03$). The form of Table II is very similar to that of Table I. Table II reports results for spreads of long positions for corn, wheat and oats, against a short position in soybeans. Table II reports no results for December spreads, because soybeans do not trade for December delivery.

For the most part, Table I and II show that there are very few statistically significant departures from zero profits for the spread positions. Of the 189 reported t-statistics only 15 have an absolute value larger than 2.0.[4] Taking a t-statistic of 2.0 as approximating the 5% level of significance, one would expect 5% of the 189 t-values (9.45) to exceed 2.0 just by chance. While 15 is more than one would expect to find just by chance, it is not dramatically different from the 9.5 that chance alone would predict.[5]

The 15 significant t-statistics are relatively scattered, contributing to the impression of randomness. Four appear in the corn/wheat spread, one in the wheat/oats spread, four in the corn/oats spread, none in the corn/beans spread, three in the soybeans/wheat, and two in the oats/beans spread. Of these 15 significant t-statistics, six are positive and eight are negative. Further, there is little tendency for these to cluster in a particular expiration or in a particular calendar month. In general, these results of intermarket spreads in calendar time appear to

[4] No special significance can be attached to the sign of the t statistic in Tables II and III. One contract is selected as the long and the other assigned as a short in a casual fashion. If a given reported spread earns a profit in a particular period, then the opposite spread, which could just as easily have been reported, would show a loss. This is simply a result of the principle that the futures market is a zero sum game, assuming that transaction costs are ignored.

[5] If the various t-tests are thought of as drawings from a binomial distribution, there is a sample of 189, a probability of achieving a t test greater than 2.0 by chance alone of 5% and 15 successes. The probability of 15 or fewer successes is 97.14%. Therefore, it appears that there may be some regularity in the spread profits, but it certainly is not dramatic

be consistent with randomness. There do not appear to be regularities in the data that one might exploit in a trading strategy.

Table III reports the results of analyzing the same spreads in contract time. The first column of the table indicates the number of months before the expiration month. Because these results are presented in contract time, the observations reported in a particular row can be drawn from many different calendar months and many different calendar years. For example, in the first line of Table III for the corn/wheat spread, the mean daily profit is $5.10 for the six months before the expiration month. With the goods expiring in March, May, July, September, and December, this cell reports results drawn from September, November, January, March, and June for those different contract expirations. For corn/wheat spread in contract time with six months remaining to expiration, the 3144 observations are also reflected in Table I for the sixth month prior to expiration on the corn/wheat spread. Table III reflects the contract time analog of the results for calendar time reported in both Tables I and II. Of the 42 *t*-statistics shown in Table III, only two exceed 2.0 in absolute value. These results also are essentially consistent with what one would expect by chance, and they seem to be fully consistent with the efficient markets hypothesis.[6] If anything, the results in contract time are even more fully consistent with chance than those observed in Tables I and II for calendar time.

Among the spreads considered so far, the Board of Trade booklets call attention to the December corn/oat spread, the wheat/corn spread, and the soybean/wheat spread. As Table I shows for the December corn/oat spread, there is no significant mean profit for any calendar month, and the same is true for the contract time results in Table II. For the wheat/corn spread results in Table I, four *t*-statistics have an absolute value exceeding 2.0. Of these four, three are positive, while the fourth is negative. The three positive *t*-statistics all fall in March, suggesting that corn rose in price relative to wheat. The negative *t*-statistic occurs for August trading.

This tendency of corn to rise in value relative to wheat during March is related to the performance of the soybean/wheat spread. The soybean/wheat spread reported in Table II shows three negative *t*-statistics with absolute values above 2.0, and all three occur in March.

[6]Care should be taken in interpreting the results of Table IV. As discussed in the text, the observations reported in Table IV are already reflected in Tables II and III, so they do not constitute a sample that is fully independent of the previous results.

TABLE III

Intermarket Daily Dollar Profits for Spreads in Contract Time

Months Before Expiration	*Long Corn/Short Wheat*				*Long Wheat/Short Oats*				*Long Corn/Short Oats*			
	Mean	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*
6	5.10	170.37	3144	1.68	3.14	186.97	3111	0.94	1.81	98.30	3120	1.03
5	3.11	170.39	3069	1.01	1.25	187.31	3072	0.37	2.15	97.43	3068	1.22
4	3.16	173.90	3200	1.03	1.62	184.63	3196	0.50	1.66	96.51	3196	0.97
3	0.27	174.38	3027	0.08	3.31	192.93	3025	0.94	2.09	100.05	3022	1.15
2	4.33	183.65	3242	1.34	0.06	196.52	3236	0.02	2.87	104.17	3242	1.57
1	0.80	200.00	3084	0.22	0.50	212.23	3077	0.13	0.77	117.92	3086	0.36
ALL	1.54	179.09	18766	1.18	1.22	193.60	18717	0.86	0.26	102.65	18734	0.35
	Long Corn/Short Soybeans				*Long Wheat/Short Soybeans*				*Long Oats/Short Soybeans*			
6	0.79	292.10	2485	0.13	3.57	319.11	2476	0.56	2.54	314.75	2464	0.40
5	1.82	299.10	2451	0.30	1.90	302.88	2456	0.31	2.35	319.05	2443	0.36
4	6.63	305.79	2514	1.09	13.24	325.74	2515	2.04*	8.16	322.19	2515	1.27
3	4.61	342.99	2422	0.66	7.73	360.09	2425	1.06	2.87	368.63	2420	0.38
2	9.21	377.05	2559	1.24	14.76	407.75	2553	1.83	12.13	399.96	2553	1.53
1	0.96	456.98	2499	0.11	1.94	487.94	2490	0.20	0.70	482.41	2506	0.07
ALL	3.45	360.73	14930	1.20	6.60	373.07	14915	2.16*	3.84	373.07	14901	1.26

The table reports the daily dollar profit for a one contract spread position over the six months prior to all expiration months. Observations in a particular row are drawn from many different calendar months and calendar years, but have a common number of months remaining until expiration.

*Indicates a *t*-value that is significant at the 0.05 level.

These results suggest that soybeans have historically risen in price relative to wheat during the month of March. Also, both corn and soybeans have historically risen in price relative to wheat during March. Given that the standard deviation of the daily profit is six to ten times the size of the daily profit in all six of these instances, caution might be warranted before attempting to profit from the continuance of this regularity.

In addition to the intermarket spreads just discussed, this study also examines the intramarket spreads for a lag of one contract. With the grains generally trading on the March, May, July, September, December cycle, the intramarket spreads are long March/short May, long May/short July, long July/short September, long September/short December, and long December/short March. The exception to this general pattern is soybeans, which trade for expiration in November, but not December. For beans, the results report long September/short November and long November/short March.

The calendar time results for the intramarket spreads are reported in Table IV. Of the 140 *t*-statistics reported in Table IV, only two are significant. Overall the May/July spread for oats lose an average of $1.47 per day, which generates a *t*-statistic of 2.32. For the July/September corn spread, May trading gives an average daily profit of $4.57 per contract, with a *t*-statistic of 2.91. These results appear to be fully consistent with chance, as one would expect more than two significant *t*-values just by chance. Table V presents results for intramarket spreads in contract time, assuming a long position in the nearby and short position in the distant contract. These results offer little evidence of any regularities in pricing, with only two of 35 *t*-values having an absolute value exceeding 2.0.

The Board of Trade's series of booklets focuses attention on two intramarket spreads that have not been considered thus far: the July/December corn spread and the July/November soybean spread. These contract pairs have an intervening delivery month of September, so the adjacent delivery month spreads reported in Table V do not cover these two particular spreads. Table VI reports the results for these two spreads in the same form used in the previous tables. For the July/December corn spread, there is a statistically significant tendency in February for the July price to fall relative to the December price. Likewise, the July price tends to fall against the December price in May trading. These two instances show an absolute daily mean profit per contact of about $5.25, with a standard deviation about nine to ten times as large.

TABLE IV

Intramarket Daily Dollar Profits for Spreads in Calendar Time

Observation Month	*Mean*	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*
Long March Short May	*Wheat*				*Soybeans*				*Oats*				*Corn*			
SEP	0 80	62.99	602	0 31	2 60	60 30	611	−1 06	−0.43	66 11	600	0 16	0 11	27.58	603	0 10
OCT	0 68	63.95	682	0 28	0 30	64 68	676	−0 12	0 36	27.64	679	0.34	0 08	26.25	683	0 08
NOV	0 83	60.45	577	0 33	1 62	58 30	575	−0 67	0 54	27 89	579	0 47	0 08	26.25	577	0.07
DEC	0 22	60.92	595	0 09	0 49	60 76	602	−0 20	1 09	28 11	593	0 94	0 63	27.23	595	0.56
JAN	0 53	55.92	637	0 24	0 65	53 25	628	0 30	0 73	36 32	631	0 51	0 05	22 19	637	0.06
FEB	4 53	70.97	560	1.51	3 36	53 97	552	1 46	−1 00	50 85	542	0 46	1 67	25.23	560	−1 57
ALL	0 18	62 57	3653	−0 17	1 22	58 81	3644	1 26	0 24	41 65	3624	0 34	0.36	25 82	3655	−0.84
Long May Short July	*Wheat*				*Soybeans*				*Oats*				*Corn*			
NOV	0 89	89 53	578	0 24	0.99	58 37	577	0.41	0.30	35 53	548	0 20	−0 04	26 42	577	0 04
DEC	−1 73	84.43	594	0 50	1.66	58.73	595	−0.69	1 12	31 92	588	0.85	−0.81	26 86	595	0 73
JAN	−6.03	86 32	638	1 77	2.46	67 79	635	−0.91	0.25	30 93	637	0 20	0 36	22 95	637	0.42
FEB	−1 31	79.75	561	0 39	0 33	169 02	560	0.05	2 21	48.87	560	1 07	−0.81	24 46	560	0 79
MAR	1.84	82 85	664	0 57	1 58	69 84	671	0.59	1.44	33 87	669	1 10	1 00	25 63	670	1 01
APR	−7.08	96.61	594	1 79	3 15	113.74	611	0.68	3 48	44 61	611	1 93	0.85	30 25	613	0 69
ALL	−2.51	86.72	3629	−1 74	0.02	96 64	3649	0 01	1.47	38 00	3613	2.32*	0.13	26 18	3652	0 30
Long July/Short September	*Wheat*				*Soybeans*				*Oats*				*Corn*			
JAN	0 12	60 50	630	0 05	−9.49	158 59	634	1 51	1 13	33.45	593	−0.82	−1.57	40.59	637	0 98
FEB	2.83	57 95	567	1 16	5.82	199.07	560	0.69	2 42	30.03	542	1.88	−2 13	31.41	560	1 61
MAR	0 14	43 20	671	0 08	4.39	147.38	671	0 77	0.39	27.58	645	0.36	0.19	42 21	670	0 11
APR	0 17	40 93	613	0 10	4.57	169 60	613	0 67	0.00	33.06	610	0.00	0 37	34 26	612	0 27

MAY	-0.97	50 39	624	-0 48	4 36	177 44	631	0 62	1.75	35 28	630	1 24	4 57	39 47	631	2 91*
JUN	1.66	49 17	629	-0.85	6.74	446 02	653	0 39	1.73	57 13	657	0 78	2 04	60 40	657	0.86
ALL	-0.91	50 67	3734	-1 09	0 35	241 81	3762	0.09	0.48	37 74	3677	0 77	0 08	42 81	3767	0.11

Long September/Short December

	Wheat				*Soybeans*				*Oats*				*Corn*			
MAR	-0 01	39 83	671	-0 01	3.41	113.96	671	0 77	-0 78	30 52	633	-0 64	0 40	41 71	670	0.25
APR	0 82	69 95	613	0 29	3.29	125.66	613	0 65	0 44	27.95	594	-0.39	-0 44	38 91	613	-0.28
MAY	-1.19	39 30	631	0 76	7.06	151.64	631	1 17	0 60	25.19	614	0 59	0 93	38.90	630	0.60
JUN	-0 81	44 03	658	0.47	-2.52	211.36	654	-0 31	0 21	32.29	657	0 17	-2 08	53.48	658	-1 00
JUL	0 18	53 14	617	0 09	-17.71	330 26	617	-1 33	2 48	36.46	618	-1 69	-1 08	67 93	621	-0 40
AUG	-3 12	65 37	686	1.25	-5.70	207.98	687	0 72	1 86	40.33	685	-1 21	-3 82	58 16	677	-1.71
ALL	-0 73	53 22	3876	-0.85	-2.00	202 73	3873	0 61	0 80	32.70	3801	-1 52	-1 04	51 05	3869	-1 27

Long December/Short March

	Wheat				*Soybeans*				*Oats*				*Corn*			
JUN	0.85	39.10	637	0 55	0 63	86 56	595	0 18	1.22	37.60	573	0 78	0.15	23 57	637	0 16
JUL	1 35	69.28	599	0 48	0.38	109.79	633	0 09	-2 75	41.40	575	1.59	0 93	30 66	599	-0 74
AUG	2.10	53.93	665	1.00	0.65	114 31	598	0 14	-0 58	29 88	659	0.50	0.99	30 56	665	-0 83
SEP	-0.50	55 29	582	0 22	4.19	82 53	666	1 31	-0 52	35.99	581	0.35	0.00	26.59	583	0 00
OCT	2 25	44.88	660	1.29	3 97	68 21	583	1 40	1 02	27 41	661	0 96	0 45	32 42	661	0 36
NOV	-0 38	77 35	558	0 12	3.21	82 04	661	1 01	0 63	37.39	558	0 40	0 21	32 39	558	-0 16
ALL	0 18	57 46	3701	0 19	1.87	91 93	3736	1 24	-0.15	34 98	3607	0 26	0.25	2952	3703	0 52

The table reports the daily dollar profit for a one contract spread position over the six months prior to the earlier expiration month of the two contracts in the spread.
*Indicates a *t*-value that is significant at the 0.05 level.
denotes that the spread was formed using the November contract for soybeans, as soybeans do not trade for December delivery.

TABLE V

Intramarket Daily Dollar Profits for Spreads in Contract Time

Months Before Expiration	*Mean*	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*
Long Nearby Short Distant	*Wheat*				*Soybeans*				*Oats*				*Corn*			
6	0 19	60 34	3118	0 17	-2 03	103 68	3088	1 08	0 30	42 69	2947	0 38	0 19	33 12	3124	0 32
5	0 81	69.58	3055	0 64	1 41	120 05	3077	0 65	1 20	32 03	2978	2 04[1]	0.84	31 05	3050	1 49
4	1 76	58 87	3182	1 69	1 70	115 88	3110	0 82	0 13	28 39	3134	0 25	0 08	33 17	3179	0 14
3	0 51	57 20	3009	-0.49	0 56	149 90	3095	0.21	0.25	36 09	3001	0 38	0 66	35 48	3008	1 01
2	0 80	59 13	3202	0 76	2 88	174 22	3130	0.93	0.08	33.98	3209	0 13	1 00	40 58	3220	1 40
1	3.35	73 04	3027	-2 52[1]	3 28	234 11	3164	0.79	1.55	46 68	3053	1 83	1 46	44 94	3065	1 79
ALL	0 89	63 25	18593	- 1 93	0 95	156 53	18664	0 83	0.53	37 10	18322	1 95	0 33	36 73	18646	1 22

The table reports the daily dollar profit for a one contract spread position over the six months prior to all expiration months. Observations in a particular row are drawn from many different calendar months and calendar years, but have a common number of months remaining until expiration.

[1]Indicates a *t* value that is significant at the 0.05 level.

TABLE VI

Intramarket Daily Dollar Profits for Two Intramarket Spreads

Observation Month	*Corn Long July/Short December*				*Soybeans Long July/Short November*			
	Mean	*SD*	*OBS*	*t-Stat*	*Mean*	*SD*	*OBS*	*t-Stat*
JAN	2.41	57.24	631	1.06	14.97	175.04	620	2.13[a]
FEB	5.20	46.01	560	2.68[a]	5.87	225.06	560	0.62
MAR	0.50	59.27	670	0.22	7.80	194.15	671	1.04
APR	0.09	54.25	613	0.04	7.86	229.10	613	0.85
MAY	5.32	60.88	631	2.19[a]	11.42	255.22	631	1.12
JUN	4.21	85.62	658	1.26	9.07	429.75	653	0.54
ALL	0.92	62.29	3763	0.90	1.42	266.68	3748	0.33

The table reports the daily dollar profit for a one contract spread position over the six months prior to the earlier expiration month of the two contracts in the spread.

[a]Indicates a *t* value that is significant at the 0.05 level.

For the July/November soybean spread, the July price tended to fall relative to the November price in January trading. In this case, the daily mean profit is $14.97, with a standard deviation of $175.04. Again, the standard deviation is large relative to the average profit. These large standard deviations relative to the mean profit suggest that these statistically significant profits may not be economically worth exploiting.

CONCLUSION

This article examines the behavior of a number of popular commodity spreads involving wheat, corn, oats, and soybeans. These spreads are often touted as providing good speculative opportunities, with the implication being that there are regularities in the price movements of these speculative positions. Such regularities would lead to trading rules that would earn excess profits. This article tests for the existence of such regularities.

Using 31 years of daily data ranging from 1960–1990, this article tests for profit regularities in both calendar and contract time for intramarket and intermarket spreads. The study finds little evidence of any regularities in profit potential either on a calendar or contract time basis. Further, the general lack of regularities extends to both intermarket and intramarket spreads. While all of these findings are consistent with the efficient markets hypothesis, there does appear to be a statistically significant tendency for wheat prices to fall in March.

BIBLIOGRAPHY

Abken, P.A. (1989). "An Analysis of Intra-Market Spreads in Heating Oil Futures," *The Journal of Futures Markets*, 9(1):77–86.

Easterwood, J., and Senchack, A. (1986, Fall): "Arbitrage Opportunities with Tbill/Tbond Futures Combinations," *The Journal of Futures Markets*, 6:433–442.

Johnson, R.L., Zulauf, C.R., Irwin, S.H., and Gerlow, M.E. (1991): "The Soybean Complex Spread: An Examination of Market Efficiency from the Viewpoint of a Production Process," *The Journal of Futures Markets*, 11(1):25–37.

Judge, G., Griffiths, W., Hill, R.C., and Lee, T-C. (1980): *The Theory and Practice of Econometrics*. New York: Wiley.

Monroe, M., and Cohn, R. (1985, Fall): "The Relative Efficiency of the Gold and Treasury Bill Futures Markets," *The Journal of Futures Markets*, 6:477–494.

Poitras, G. (1989): "Optimal Futures Spread Positions," *The Journal of Futures Markets*, 9(2):123–133.

Poitras, G. (1990): "The Distribution of Gold Futures Spreads," *The Journal of Futures Markets*, 10(6):643–659.

Rentzler, J. (1986, Spring): "Trading Treasury Bond Spreads against Treasury Bill Futures: A Model and Test of the Turtle Trade," *The Journal of Futures Markets*, 6:41–62.