COMPLEMENTS OR SUBSTITUTES? EQUIVALENT FUTURES CONTRACT MARKETS—THE CASE OF CORN AND SOYBEAN FUTURES ON U.S. AND JAPANESE EXCHANGES

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This article examines the relationship between corn and soybean futures volumes for contracts traded in the United States and Japan. Because the contract specifications for corn and soybeans futures traded on the Chicago Board of Trade (CBOT), the Tokyo Grain Exchange (TGE), and the Kanmon Commodity Exchange (KCE) are highly similar, the existence of interactions might be expected. Previous research has identified price

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relationships between these similar contracts. With the advent of agricultural trading on the CBOT's Project A overnight electronic trading system, an overlap of trading times of the U.S. and Japanese exchanges for these commodity contracts resulted. An analysis of TGE and KCE corn and soybean futures volumes indicates that these contracts, rather than acting as substitutes, exhibit a *complementary* relationship. © 2002 Wiley Periodicals, Inc. Jrl Fut Mark 22:355–370, 2002

INTRODUCTION AND PREVIOUS LITERATURE

While there are numerous studies using price and volatility data for similar contracts across international financial markets, relatively few use volume data. With the introduction of corn and soybean futures contracts on the Chicago Board of Trade's (CBOT) overnight trading system, Project A, an opportunity to examine the volume relationship with similar contracts traded at the same time became available. At its inception, Project A's trading hours overlapped those of the Tokyo Grain Exchange (TGE) and the Kanmon Commodity Exchange (KCE). The purpose of this study is to see if the introduction of corn and soybean futures contracts on Project A has an effect on Japanese corn and soybean futures volume, leading to a better understanding of the competitive nature of these markets.

This research exploits the fact that while the US observes Daylight Savings Time, Japan does not. This causes a change in the overlap of trading between Project A and the first afternoon trading session of the Japanese exchanges, resulting in the opening of Project A changing with respect to the first afternoon trading session at the Japanese exchanges. Project A is open during this session for only half the year. Using a generalized linear model (GLM) and the parametric t-test to take advantage of the unique overlap of Project A with the first afternoon trading session at the Japanese exchanges allows an analysis of the effect of Project A trading on the volume of these contracts at the Japanese exchanges.

Two underlying themes represent the majority of the literature examining the relationship between international commodity and financial markets:

1. the efficiency of markets and the impact of information and market structure on price, volume, and volatility, and
2. linkages between similar contracts traded in different markets.

Market Structure and Information Effects

The structure of a market and the way in which information comes to the market are important factors affecting the speed of price adjustment to equilibrium. For example, Marsh and Webb (1983) compared the

volatility of soybean futures prices of similar maturity contracts traded at the CBOT, a continuous auction market, and the TGE, a single-price call market. They reported that the volatility of TGE soybean futures prices exceeded that of corresponding CBOT prices, a result that runs counter to the information dissemination hypothesis of Goldman and Sosin (1979). Engle, Ito, and Lin (1990) used a GARCH model to examine the impact of news in one market on the volatility of other markets through intraday yen–dollar exchange rates. They found evidence of volatility clustering and spillover into foreign markets. Webb (1991) examined the volatility, path, and speed of convergence to equilibrium using provisional price data on TGE soybean futures. Though provisional prices tended to over or under shoot equilibrium, there was a rapid convergence, suggesting that large price changes were more likely due to new information rather than the mechanics of the pricing process.

Market Linkages

Beyond the more general discussions of market structure and information transmission are those studies that focus specifically on the linkages between markets with similar contracts. For instance, Booth, Lee, and Tse (1996) found evidence that trading in Nikkei futures across the Osaka, Singapore, and Chicago exchanges was driven by the same kind of information because the variance of trading per hour was similar across the three markets. Tse, Lee, and Booth (1996) examined the hypothesis that the Eurodollar futures markets in Chicago, Singapore, and London were one continuously traded market within the context of information transmission. Their results suggested that a common factor drives all three markets and the responses of these markets to the common factor are fully settled within a day. Research by Booth and Ciner (1997) documented a clear price and volatility relationship between corn futures traded at the CBOT and the TGE. They found that intraday returns on CBOT corn futures significantly affected TGE trading returns, an indication of information linkages between these markets. Booth, Brockman, and Tse (1998) studied wheat futures traded in the US and Canada. While the Canadian contract was exclusively for animal consumption and the U.S. contract was primarily for human consumption, these differences did not seem to hinder the price cointegration of these contracts.

Low, Muthuswamy, and Webb (1999) examined the joint dynamics of futures prices for the storable commodities, soybeans and sugar, which were traded on the TGE and the Manila International Futures Exchange (MIFE), both single fixed-price call markets. Of the two

contracts, sugar had the closer correspondence in trading sessions, delivery months, and deliverable grade and therefore was the more natural contract to arbitrage. Soybeans appeared to be less substitutable as the TGE and MIFE had potentially different deliverable grades, which could preclude arbitrage. Interestingly, Low et al., reported a lack of cointegration between the commodities traded on the two markets, finding no evidence of arbitrage activity for either commodity.

Leuthold and Kim (2000) compared the effectiveness of hedging cash corn price risk using the CBOT's overnight Project A corn futures contracts versus the corn futures contracts of the TGE. They examined the co-movement of mean price changes for cash corn in Chicago (proxied by the CBOT's daytime nearby futures contract) with Project A contracts and again with TGE contracts. The price changes between daytime Chicago cash prices and TGE futures, as well as Project A futures, were correlated positively and cointegrated with each other, but none were statistically different from zero. The authors formed simulated hedges for three periods: (i) overnight, (ii) day-to-day, and (iii) two day. They concluded that hedging short-term price risk in Tokyo was not very effective and that Project A, while it had potential, needed more liquidity to become an effective hedge.

Research Issues

Can it be concluded from the evidence of price cointegration, or lack thereof, that these contracts are competing with one another; are they complements or substitutes? For example, in Booth et al. (1998) the contracts did not appear to be substitutable and yet the prices were cointegrated, while Low et al. (1999) found a lack of cointegration for a contract market (sugar futures) that appeared highly substitutable. A closer examination of cases of price cointegration where the contracts appear to have similar characteristics should provide interesting results.

Prior research has not focused on volume relationships between contracts to test for substitutability/complementarity. However, volume has been analyzed in previous studies of competition between exchanges. For instance, Silber (1981) discussed successful innovation and competition in futures markets, where success was measured by annual contract volume. Relative market share based on volume was used to gauge success in cases of contract competition when two or more exchanges competed for the same contract market. Silber noted that when identical contracts traded, market participants responded more quickly to price discrepancies due to the simplicity in calculating the arbitrage opportunity. Pirrong (1996) examined the competition between DTB (now Eurex) and LIFFE

for Bund Futures contracts. In a clear case of substitution, the transfer of volume from LIFFE to DTB came about due to arbitrage by a common set of market participants. Market participants successfully have used volume data to indicate activity by market participants, thereby providing insight into the nature of contract relationships.

As a preview, this research suggests that, based on statistical evidence and differences in trading of the most active contract, availability of corn and soybean futures markets on Project A does not affect volume on Japanese exchanges. These results indicate that while these markets may act as information complements, they do not appear to be substitutes for one another, and thus are not competitive markets. This can be important to the exchanges in terms of product design and marketing issues, as the nature of competition can impact the decision of an exchange with regard to the considerable expenditures associated with new products (Silber, 1981).

The organization of the rest of the article is as follows. The next section provides characteristics of corn and soybean futures contracts traded at the Japanese and U.S. exchanges. This is followed by a discussion of the competitive issues and exchange volumes for these contracts. The research questions, along with an analysis of the test results, are presented in the next section, while the final section offers a summary and some concluding remarks.

CORN AND SOYBEAN FUTURES IN THE U.S. AND JAPAN

Nearly identical corn and soybean futures contracts are traded at the CBOT, TGE, and KCE. The deliverable commodities for these contracts are U.S.-produced yellow corn and U.S.-produced yellow soybeans. The CBOT began trading corn futures during daytime open-outcry sessions in 1877. Soybeans followed in 1936. Overnight trading in CBOT corn and soybean futures began on Project A, the CBOT's after-hours electronic trading platform, the evening of February 29, 1996, with hours from 10:30 pm to 4:30 am Central Time.[1] The TGE and KCE launched soybean futures in 1984 and 1961, respectively, and both launched corn futures in 1992.

The CBOT contracts call for delivery of 5000 bushels of the underlying commodities. The TGE and KCE corn contracts call for delivery of

[1]On March 29, 1998, the CBOT extended the hours of operation for Project A agricultural products, changing the starting time to 9:00 pm. On February 21, 2000, the starting time was moved up an additional hour to 8:00 pm, and the closing time was extended to 5:00 am.

100,000 kilograms of corn (about 3968 bushels), while the soybean contracts call for delivery of 30,000 kilograms of soybeans (about 1190 bushels). Tables I-A and I-B summarize the contract specifications for each of the three exchanges' corn and soybean futures contracts.

Trading on the CBOT is a continuous auction market for both open-outcry day trading and electronic after-hours trading. The KCE and TGE operate as electronic call markets, with trading occurring in

TABLE I
Contract Specifications for Corn and Soybean Futures Contracts

*Contract Specifications**	*Chicago Board of Trade*	*Tokyo Grain Exchange*	*Kanmon Commodity Exchange*
A: Contract Specifications for Corn Futures Contracts at the Chicago Board of Trade, Tokyo Grain Exchange, and Kanmon Commodity Exchange			
Launch Date	January 1877	April 1992	May 1992
Contract Size	5000 bushels (126,000 kilograms)	(3968 bushels) 100,000 kilograms	(3968 bushels) 100,000 kilograms
Par Contract Grade	U.S. No. 2 Yellow corn	U.S. No. 3 Yellow corn	U.S. Yellow corn
Contract Months	March, May, July, September, December	January, March, May, July, September, November	February, April, June, August, October, December
Trading Hours/ Sessions (Local Time)	Trading Hours 9:30–13:15 Pit 22:30–4:30 Project A	Sessions† #1 9:00–am1 #2 11:00–am3 #3 13:00–pm1 #4 15:00–pm3	Sessions #1 9:00–am1 #2 10:00–am2 #3 11:00–am3 #4 13:00–pm1 #5 14:00–pm2 #6 15:00–pm3
Minimum Price Fluctuation	0.25 cents per bushel	10 yen per 1000 kg	10 yen per 1000 kg
Method of Settlement	Physical delivery (multiple Midwest delivery points)	Physical delivery (multiple Japanese ports)	Physical delivery (executed upon the presentation of arrived vessel's Delivery Order)
B: Contract Specifications for Soybean Futures Contracts at the Chicago Board of Trade, Tokyo Grain Exchange, and Kanmon Commodity Exchange			
Launch Date	October 1936	March 1984	1961
Contract Size	5000 bushels (126,000 kilograms)	(1190 bushels) 30,000 kilograms	(1190 bushels) 30,000 kilograms

(Continued)

TABLE I
(Continued)

*Contract Specifications**	*Chicago Board of Trade*	*Tokyo Grain Exchange*	*Kanmon Commodity Exchange*
Par Contract Grade	U.S. No. 2 Yellow soybeans	U.S. No. 2 Yellow soybeans produced in Indiana, Ohio, and Michigan	U.S. No. 2 Yellow soybeans produced in Indiana, Ohio, and Michigan
Contract Months	January, March, May, July, August, September, November,	February, April, June, August, October, December	January, March, May, July, September, November
Trading Hours/ Sessions (Local Time)	Trading Hours 9:30–13:15 Pit 22:30–4:30 Project A	Sessions #1 10:00–am2 #2 11:00–am3 #3 13:00–pm1 #4 14:00–pm2	Sessions #1 9:00–am1 #2 10:00–am2 #3 11:00–am3 #4 13:00–pm1 #5 14:00–pm2 #6 15:00–pm3
Minimum Price Fluctuation	0.25 cents per bushel	10 yen per 1000 kg	10 yen per 1000 kg
Method of Settlement	Physical delivery (multiple Midwest delivery points)	Physical delivery (multiple Japanese delivery points)	Physical delivery (executed upon the presentation of arrived vessel's Delivery Order)

*Contract months, trading hours or sessions are for the time of the study, see the CBOT, TGE, or KCE web sites for current contract months and trading hours or sessions.
†Corn trading recently has been extended at the TGE to all sessions each trading day.

distinct trading sessions. The KCE and TGE have three trading sessions in the morning and three trading sessions in the afternoon.[2] Each trading session covers multiple commodities and typically lasts up to thirty minutes, with all transactions within each contract expiration cycle clearing at the same price. Webb (1991) provided a cogent discussion of the Itayose-Hoh or single fixed-price auction system employed at the TGE and KCE.[3]

[2]The six sessions are formally AM1, AM2, AM3, PM1, PM2, and PM3. During the period of the study, the TGE did not trade corn during their AM2 and PM2 sessions.
[3]In short, under this system, a provisional price is posted and traders submit the quantity that they will buy or sell at that price (the previous session's settlement price typically is floated as the first price for the current session). If supply is greater (less) than demand then a new lower (higher) provisional price is posted to encourage additional demand (supply). This process continues until the quantity demanded equals the quantity supplied. The last price floated is the settlement price for that session, and contract expiration and all orders transact at that price.

FUTURES CONTRACT COMPETITIVE ISSUES

In 1996, the CBOT launched overnight trading of corn and soybeans futures on Project A.[4] This event—the introduction of CBOT grain contracts on Project A—allowed the study of whether two similar contracts, in which prices have been shown previously to be correlated/cointegrated, were actually substitutes for each other. If the CBOT contracts are viewed as an alternative to their Japanese counterparts, then the introduction of grain contracts on Project A would cause a decrease in volume at the TGE and KCE, as those market participants using the Japanese contracts to arbitrage or hedge could use Project A instead. This would imply that the CBOT and Japanese grain contracts are indeed substitutes for each other. On the other hand, it is also possible that these markets simply share information, as in Booth et al. (1998), and market participants do not view these contracts as substitutes (one may argue that they informationally complement each other). It also may be that there are different users for these markets (some participants trading Chicago and others trading Japan), or that a common set of market participants uses these contracts for different purposes (a type of "market segmentation" exists).

Contract Month Comparisons

Corn and soybean futures contracts trade with different expirations to accommodate the needs of hedgers and speculators. The volume in each contract month for corn and soybean futures traded on the CBOT, KCE, and TGE are shown in Tables II-A and II-B. These tables present the relative contract volumes for the first six contract months for corn and soybean futures. In some cases, more than six contracts may be trading, and, as such, the percentages in the table may not add to 100%. The tables clearly show that the greatest volume of trades at the CBOT is in the nearby to third contract months. The CBOT data includes both daytime and Project A volume. It is not possible to get a volume by contract breakdown for Project A alone for the time periods listed, with the exception of a partial year's worth of corn data. For that small sample of Project A data, the pattern is similar to the total CBOT data.

Approximately 70% of CBOT total daily volume are in the first two contract expirations. However, the volume pattern is reversed at KCE and

[4]Recently (August 2000), Project A was replaced by ACE, the ALLIANCE CBOT EUREX electronic platform.

TABLE II

The Breakdown of Trading by Contract Month for Corn and Soybean Futures

	Percent of Volume by Contract					
Exchange	*Nearby*	*Second*	*Third*	*Fourth*	*Fifth*	*Sixth*
*A: The Breakdown of Trading by Contract Month for Corn Futures on Project A, the CBOT, the KCE, and the TGE**						
CBOT Project A 1996†	29.60%	41.26%	17.79%	8.49%	2.08%	0.68%
CBOT Total 1995	33.20%	35.41%	16.45%	8.08%	4.46%	1.37%
CBOT Total 1996	33.25%	36.00%	17.94%	7.90%	3.09%	1.24%
CBOT Total 1997	38.39%	36.10%	14.55%	6.32%	2.92%	1.13%
CBOT Total 1998	36.96%	31.41%	12.53%	4.20%	2.56%	4.70%
KCE 1996	1.40%	2.82%	5.77%	13.37%	28.67%	47.97%
KCE 1997	1.28%	2.13%	5.65%	13.62%	30.78%	46.54%
KCE 1998	2.85%	3.71%	7.26%	14.17%	28.28%	43.72%
TGE 1994	1.67%	2.77%	6.29%	13.53%	27.83%	47.92%
TGE 1995	1.80%	2.89%	5.49%	11.84%	28.07%	49.91%
TGE 1996	1.64%	3.92%	7.67%	14.39%	28.82%	43.56%
TGE 1997	2.41%	3.57%	7.12%	14.37%	28.93%	43.61%
TGE 1998	4.33%	4.74%	7.36%	12.45%	26.45%	44.66%
*B: The Breakdown of Trading by Contract Month for Soybean Futures on the KCE, and the TGE**						
CBOT Total 1995	30.79%	37.78%	12.86%	10.30%	4.00%	1.68%
CBOT Total 1996	26.95%	37.68%	11.72%	13.34%	5.73%	2.72%
CBOT Total 1997	33.41%	38.13%	12.68%	9.04%	4.02%	1.68%
CBOT Total 1998	34.81%	35.84%	11.90%	10.83%	3.95%	1.58%
KCE 1996‡	1.62%	1.66%	3.36%	9.79%	24.02%	59.56%
KCE 1997	1.20%	2.73%	7.23%	14.51%	27.72%	46.62%
KCE 1998	3.95%	5.67%	6.93%	12.79%	24.77%	45.89%
TGE 1994	6.09%	6.83%	7.53%	13.49%	24.46%	41.60%
TGE 1995	5.40%	5.85%	7.36%	11.61%	24.04%	45.74%
TGE 1996	1.55%	3.15%	6.44%	12.76%	29.30%	46.79%
TGE 1997	2.93%	6.78%	10.72%	16.54%	25.60%	37.44%
TGE 1998	5.57%	7.76%	8.76%	12.79%	23.43%	41.69%

*The percentage of volume is calculated on a daily basis and averaged across the periods shown in the table.
†March 1996 to December 1996. The CBOT totals include both daytime and overnight volume.
‡June 1996 to December 1996. The CBOT totals include both daytime and overnight volume.

TGE, as the greatest volume of trades occurs in the longer-dated contracts. In contrast to the CBOT, more than 70% of the total daily volume on the Japanese exchanges is in the fifth and sixth contract expirations.

Marsh and Webb (1983) and Low et al. (1999) also recognized this pattern of higher volume in deferred contracts for the TGE. Because the expiration cycle of a futures contract has an effect on the portfolio duration of the user, these differences in usage of front- versus back-month expirations provides an indication that either the market participants are different or that the participants are using the contracts on Japanese exchanges for different purposes than the contracts on the U.S. exchange.

RESEARCH QUESTIONS AND ANALYSIS

Our analysis takes advantage of the fact that Daylight Savings Time is observed in the US, but not in Japan, as a way to test how the introduction of grain futures on Project A effects KCE and TGE volumes. Figure 1 depicts the overlap of trading hours for these contracts at the KCE, TGE, and Project A for Central Daylight Savings Time (A) and Central Standard Time (B), respectively. During Daylight Savings Time, Project A is closed for the morning sessions but open for the afternoon sessions of both Japanese exchanges. During Central Standard Time, Project A is closed for all the morning sessions and the first afternoon session and open for the remaining two afternoon sessions. This difference in overlap is due only to the mechanical aspects of employing Daylight Savings Time in the US and not in Japan.

Differences in the am and pm Session Volumes

The first question investigated is: Did the advent of corn and soybean futures trading on Project A affect the relative morning/afternoon session volume at the Japanese exchanges? We compare the difference between the sum of the am and pm session volumes when Project A is active, as well as when Project A is not active. The data cover the period from May 2, 1994 to March 29, 1998.[5] Because Daylight Savings Time changes the overlap of Project A trading with the first pm session at the

[5]At its inception, Project A opened in between two trading sessions at the Japanese exchanges. The hours for operation of Project A subsequently were changed by the CBOT on March 30, 1998. The new hours resulted in a simultaneous start of trading on Project A and either the AM3 or PM1 session, depending on whether or not it is during Daylight Savings Time. Because many different contracts trade sequentially in the call sessions at the Japanese exchanges, the concurrence of trading data between the Japanese exchanges and Project A is ill-defined due to the simultaneous start. This precludes the use of data after this date.

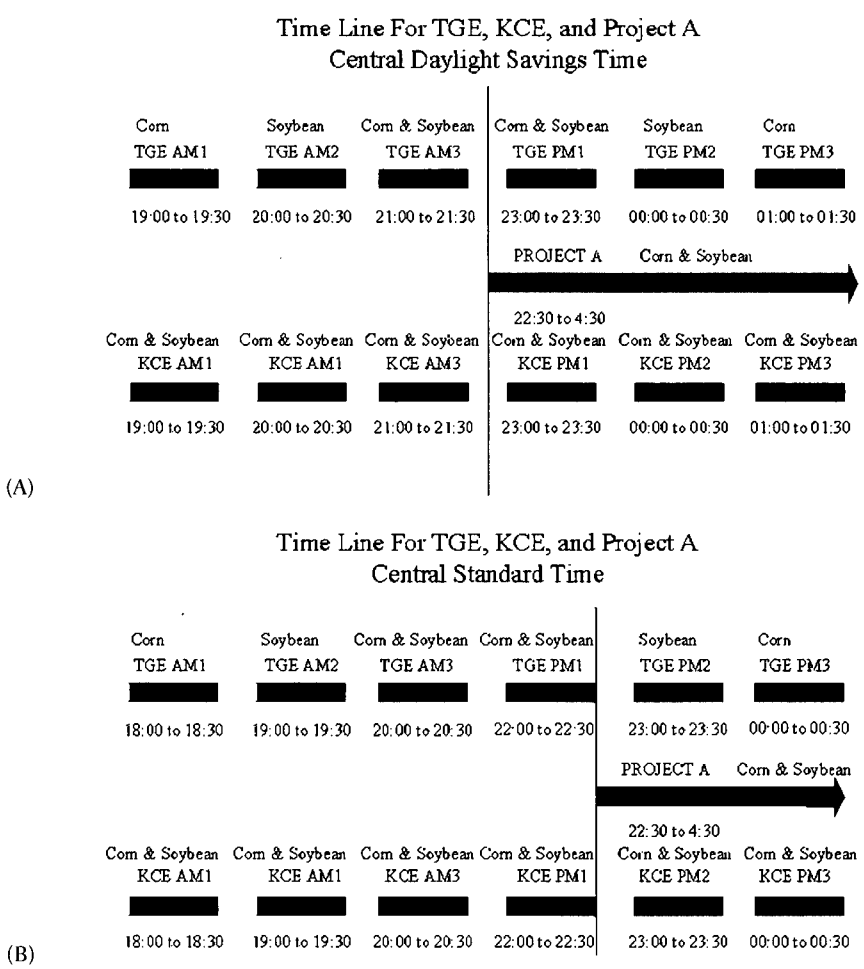

FIGURE 1

(A) Trading time for the CBOT Project A, TGE, and KCE contracts for Central Daylight Savings Time. (B) Trading times for CBOT Project A, TGE, and KCE contracts for Central Standard Time.

Japanese exchanges, only those periods where Project A completely overlaps all of the pm sessions of the Japanese exchanges are used in this first set of tests (Daylight Savings Time only). Table III provides summary statistics for the mean differences in the am and pm session volumes for corn and soybean futures along with the time periods for each comparison. Increases in the mean differences exist for corn futures at the KCE and TGE and for soybean futures at the TGE.

Because the mean differences in am and pm session volumes have changed over the study period, possibly due to changes in overall volume, the GLM approach of McCullagh and Nelder (1989) is used in this

TABLE III

The Means of the Differences Between the am and pm Sessions for Corn and Soybean Futures Volume at the TGE and KCE Exchanges Along With the Average Daily Volumes*

Exchange/ Contract	*Variable*	*All Dates*	*Pre-Project A*	*Post-Project A*
KCE Corn	Difference in Means	−1145.9	−1433.4	−739.6
	Average Volume	16302	18071	13023
	Dates	1/1/95–3/29/98	1/1/95–2/29/96	3/1/96–3/29/98†
KCE Soybeans	Difference in Means	−7.3	NA	−78.4
	Average Volume	2144	NA	2144
	Dates	10/1/96–3/29/98	NA	10/1/96–3/29/98†
TGE Corn	Difference in Means	363.2	−480.0	1740.4
	Average Volume	41719	23706	57616
	Dates	5/2/94–3/29/98	5/2/94–2/29/96	3/1/96–3/29/98†
TGE Soybeans	Difference in Means	2.5	−353.4	295.4
	Average Volume	23364	11464	33845
	Dates	5/2/94–3/29/98	5/2/94–2/29/96	3/1/96–3/29/98†

*Since trading sessions on Project A start between the am and pm trading sessions at the Japanese exchanges during daylight savings time, the differences in volume between the morning and afternoon sessions do not reflect the influence of trading opportunities on Project A. The means are reported for the entire data set, for dates prior to the start of Project A trading, and for dates after the start of Project A trading. For dates after the start of Project A, only during daylight savings times are used. The actual dates for the calculation are shown below each mean.

†During these periods only the days when daylight savings time is being observed are used. Pre-Project A time periods include all days.

analysis. This approach allows the dependent variable to be non-normally distributed. The independent variables can be categorical in nature and have a nonlinear relationship with the dependent variable. The mean difference in the am and pm session volumes is the dependent variable, while the independent variables in this model are total daily volume for the commodity of interest and a categorical variable indicating whether Project A had begun trading or not. Results for the GLM models for corn and soybean futures at the KCE and TGE are shown in Table IV, along with coefficient estimates, Wald statistics, and an indication of significance. In the models for corn and soybeans at the TGE and corn at the KCE, the binary variable indicating the availability of project A is not significant. These results indicate that the advent of trading corn futures on Project A did not change the volume of trading in the pm sessions in relation to the am sessions at the Japanese exchanges. This also is true for the advent of trading in soybean futures on Project A in relation to TGE volume. Limited data availability prevented an analysis of soybeans on the KCE.

TABLE IV

The Results of the Generalized Least Squares Model Tests for Significance*

Exchange/ Contract	*Intercept*	*Daily Volume*	*Project A On or Off*	*Observations*
KCE	−31.795	0.001	−11.886	503
Corn	0.302	0.477	0.486	
KCE	NA	NA	NA	NA
Soybeans**				
TGE	5.612	0.0001	−0.404	504
Corn	84.838†	23.029†	0.919	
TGE	−4.673	0.0001	−9.379	504
Soybeans	11.294†	2.797	0.640	

*Parameter estimates are shown in the first row for each GLM procedure. The second row presents the Wald statistics. Results significant at the 0.05 level are marked '†'. Project A On or Off represents a binary variable indicating whether Project A was open or not open for that observation. Note: In no case was Project A a significant factor in explaining TGE or KCE contract volume.

**Results are not available for soybeans on the KCE since data were unavailable prior to the start of Project A trading.

Differences in the pm Session Volumes

The second question investigated is: Does Project A availability affect the usage of Japanese contracts for the first afternoon session? The second series of tests looks only at the first pm session volumes at both Japanese exchanges. Corn and soybean futures start trading on Project A at 22:30. During Daylight Savings Time, Project A is operating during the PM1 session for both KCE and TGE. During Standard Time, Project A does not open until after the PM1 session is over, allowing a somewhat idealized analysis of the PM1 session databased on this mechanical aspect of time changes in the US. Because volume growth is another factor that might affect the analysis, the PM1 session volume is normalized as an attempt to correct for differences caused by the contemporaneous changes in volume due to market effects.

Table V shows the actual PM1 session volumes during U.S. Daylight Savings Time and U.S. Standard Time, which are the times when Project A is available and not available for that session, respectively. The *t*-test results and levels of significance for the normalized data (PM1 session volume divided by daily volume) also are reported in Table V.[6] The data in this table cover the period from February 29, 1996 through March 29, 1998. None of the *t*-tests were significant at the 5% level, although both

[6]The normalized PM1 session volumes cover a shorter period, and tests for homogeneity of variance (Brown–Forsythe and *F*-test) indicate that the sample meets the assumptions of the *t*-test.

TABLE V
Actual PM1 Session Volumes During U.S. Daylight Savings Time and U.S. Standard Time

Exchange/ Contract	*Mean pm1 w/o Project A*	*Mean pm1 w/ Project A*	t-*value*	p-*value*
KCE	3544	3340	−0.948	0.34
Corn	0.174	0.179		
KCE	674	867	−1.915	0.06
Soybeans	0.154	0.167		
TGE	11118	13821	−1.163	0.24
Corn	0.210	0.220		
TGE	7165	8745	−1.682	0.09
Soybeans	0.231	0.238		

*Because Daylight Savings Time is observed in the U.S. and not in Japan, agricultural product trading on Project A starts prior to the start of the first pm trading session at the two Japanese exchanges (KCE and TGE) for half of the year. The other half of the year, agricultural trading on Project A starts after the first pm session at the Japanese exchanges. The mean volumes of the pm1 sessions with Project A running and without Project A running are presented in the top half of the first two columns, with the normalized (percentage) volumes in the bottom half. The next columns present the results of a standard test of differences on the normalized volumes, the *t*-test.

soybean contracts were significant at the 10% level. The availability of trading on Project A may have an influence on soybean trading in the first pm session at the Japanese exchanges, with higher volume be recorded when Project A is available for trading, although support for this is weak, being only at the 10% level.

SUMMARY AND CONCLUSION

Previous studies have documented an information-transmission relationship between international markets; examples include both U.S. and Japanese futures markets. However, these studies were based on price relationships. Where highly similar contracts exist in multiple markets, information transmission does not necessarily imply substitute usage among them. If market participants view a new contract as a substitute, its introduction might be expected to have an effect on existing contract volume. In cases where prices react to the same informational factors, yet no relationship in volumes exists, contracts may be viewed as having a "complementary" relationship.

Using GLM models on CBOT Project A, TGE, and KCE corn and soybean futures contracts data provide little evidence to support the notion that the introduction and availability of trading on Project A has any effect on the Japanese contract volumes. Using parametric *t*-tests,

the results were mixed. The introduction of corn contracts on Project A shows no effect on the distribution of volume across the different trading sessions at the Japanese exchanges. However, the introduction of soybean contracts on Project A is significant, with higher volume being recorded in the PM1 session when Project A is open, but only at the 10% level.

In light of previous studies finding price interactions, this suggests a complementary relationship between U.S. and Japanese corn futures markets based on the lack of volume interactions and the existence of price relationships. From the perspective of the CBOT, marketing issues would center on the cultivation of new users for Project A rather than on the pursuit of the market participants using the Japanese exchanges. From the perspective of the Japanese exchanges, the introduction of trading on Project A should not be viewed as a direct competitive threat.

One reason that these markets may not be substitutes is the difference in delivery locations. Given the nature of the price relationships found in previous studies and the volume interactions noted here, the question arises as to why similar contracts with different delivery locations fail on other exchanges. Further studies—for example on more fungible financial contracts, such as Eurodollar futures traded at the Chicago Mercantile Exchange and Singapore International Monetary Exchange—may lead to different conclusions about volume relationships.

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