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Managed Futures, Positive Feedback Trading, and Futures Price Volatility

Scott H. Irwin and Satoko Yoshimaru*

The purpose of this study is to provide new evidence on the impact of managed futures trading on futures price volatility. A unique data set on managed futures trading is analyzed for the period December 1, 1988 through March 31, 1989. The data set includes the daily trading volume of large commodity pools for 36 different futures markets. Regression results are unequivocal with respect to the impact of commodity pool trading on futures price volatility. For the 72 estimated regressions (two for each market), the coefficient on commodity pool trading volume is significantly different from zero in only four cases. These results constitute strong evidence that, at least for this sample period, commodity pool trading is not associated with increases in futures price volatility.

Introduction

The efficiency of price discovery in futures markets is an important economic issue, as these markets are widely used for risk-shifting by firms as varied as commodity merchants, investment banks, and pension funds. In addition, a wide array of agents use futures prices in forming price expectations, production plans, and consumption schedules. If futures prices are not discovered in an efficient manner, resource allocation will be sub-optimal and there will be a loss in economic welfare (Stein, 1981).

In recent years, a new concern has been repeatedly voiced regarding price discovery in futures markets. The concern, colorfully depicted in the above quotation, is that trading by large, managed futures funds and pools artificially increases price volatility.[1] Two factors appear to be driving the apprehensions regarding managed futures trading. First, investment in managed futures has skyrocketed since the early 1980s. Managed Accounts Reports, a firm that tracks the industry, estimates that investment in managed futures grew from less than $200 million in 1980 to $19 billion in 1994. Hence, managed funds and pools control a substantial amount of the speculative trading capital in futures markets. Second, managed futures trading is purported to be guided by similar, positive feedback trading systems (Elton, Gruber, and Rentzler, 1987; Brorsen and Irwin, 1987).[2] This may cause unwarranted futures price

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movements as managed funds and pools attempt to simultaneously buy after a price increase or sell after a price decrease.

Recent advances in theoretical modeling lend credence to concerns about the market impacts of positive feedback trading by managed futures funds and pools. In the new models, positive feedback trading is a type of non-informational "noise" trading (Black, 1986). This type of trading may not be eliminated from the market because risk aversion on the part of rational traders prevents them from taking large arbitrage positions. Hence, noise trading persists in the market, and it destabilizes prices (De Long, Shleifer, Summers and Waldman, 1990a). Furthermore, rational traders may engage in destabilizing trading strategies in attempting to anticipate the movements of positive feedback traders (De Long, Shleifer, Summers and Waldman, 1990b).

Only one previous study formally investigates the impact of managed futures trading on futures price volatility.[3] Brorsen and Irwin (1987) do not find a significant relationship between commodity pool trading and futures price volatility. However, this finding should be treated quite cautiously. First, Brorsen and Irwin estimate the relationship between price volatility and managed futures open interest, when theoretical models suggest that trading volume, not open interest, is related to price behavior (e.g. Karpoff, 1987). Second, managed futures open interest is estimated with considerable error because Brorsen and Irwin derive their open interest series from aggregate data on public commodity pools. Third, pool open interest is estimated only on a quarterly basis. As Tomek (1987) notes, quarterly data are not likely to exhibit the impact, if any, of commodity pool trading. Concerns center on daily or intra-day price behavior.

The purpose of this study is to provide new evidence on the impact of managed futures trading on futures price volatility. A unique data set on managed futures trading, collected by the CFTC, is analyzed for the period December 1, 1988 through March 31, 1989. The data set includes the daily trading volume of large commodity pools for 36 different futures markets. The cross-section of markets is broad, and includes currency, energy, food and fiber, grain, interest rate, livestock, metal, and stock index futures contracts.

The next section discusses the data on commodity pool trading volume. The following section examines the trading behavior of commodity pools over the sample period. The next to the last section investigates the size and price impact of commodity pool trading. The final section presents the summary and conclusions.

Data on Commodity Pool Trading Volume

The CFTC maintains an extensive database on the trading history of large traders in all futures markets. However, managed futures traders are not explicitly identified in the collection of large trader data. So, when concerns about managed futures trading arose in the late 1980s, the CFTC conducted a special survey to determine the magnitude of managed futures trading in US futures markets. The special survey required all "large" Commodity Pool Operators (CPOs) registered with the CFTC to report trades for the period December 1, 1988 through March 31, 1989.

It is important to note that the trading volume data from the survey represents a subset of all managed futures trading volume. Individual managed accounts are not included in the totals, as well as much of the non-US pool and fund industry. Nevertheless, there is no obvious reason to expect the CPO data to be unrepresentative of all managed futures trading behavior.

A comprehensive description of the survey and data is found in a working paper published by the CFTC (1991). The following discussion draws heavily on information reported in the CFTC working paper. To begin, the sample is determined by the requirement that large CPOs report all daily positions and transactions if they held reportable positions during the survey period. A large CPO is defined as a CPO that held total net assets of $10 million or greater on September 30, 1988. A reportable position is the same minimum number of contracts as the CFTC uses in its regular large trader reporting system.

Of 1208 CPOs registered with the CFTC at the time of the survey, 65 CPOs are classified as large CPOs. These large CPOs controlled about $7.3 billion, or 94 percent of the total net assets of pools managed by all registered CPOs. Of the 65 large CPOs, 41 CPOs held reportable futures positions. Consequently, the data set is based on only 41 reporting CPOs, but covers 82 percent of all net assets of CPOs.[4] This suggests the data should be a reasonable proxy for managed futures as a whole.

The raw records obtained from the survey contain the total trading volume in a contract each day when CPOs held reportable positions. Long and short trading volume is identified separately for each day. Given that the focus of this study is on market price volatility, trading volume is aggregated across all CPOs in each market and contract each day. Unfortunately, the data available for any single contract is limited because the time period of the survey is relatively short. This precludes statistical analysis on a contract-by-contract basis. Instead, trading volume data for consecutive contracts in a market are linked to create a time series of sufficient length for statistical analysis.

The linked volume series are based on the concept of a "nearby" futures contract series, which is widely-used in futures market research. Hence, aggregate CPO trading volume is based on the volume of CPO trading in the contract nearest to maturity, except during the expiration period for each contract.[5] To assure that expiration effects are minimized, rollover to the next nearest to maturity contract is done on the business day closest to the 15th day of the calendar month previous to expiration. For example, the expiration months for soybeans are January, March, May, July, August, September, and November. The trading volume of CPOs for the January contract are used for the period December 1, 1988 through December 14, 1988. Similarly, CPO volume for the March contract is used from

December 15, 1988 through February 14, 1989. Finally, CPO trading volume from the May contract is used for the period between February 15, 1989 and March 31, 1989.

Eleven markets are removed from the data set for a variety of reasons. First, several markets have no records or very few records in the final data set, and hence, these markets are dropped. Second, mini-contracts traded at the Mid-America Exchange are excluded due to the replication of these contracts with other contracts. Third, one market is removed because its expiration months could not be identified.

Table 1 shows the 36 markets included in the analysis, with volume classes defined by the CFTC (1991). The 36 futures markets represent a large and diversified cross-section of market types. This will minimize spurious results due to the particular circumstances of an individual market or a small set of markets.

To facilitate the presentation of results, the individual markets are categorized into eight groups. The groups are: currency, energy, food and fiber, grain, interest rate, livestock, metal, and stock index. The group classification is based on similarity of supply/demand patterns and/or common physical characteristics. The smallest group (stock index) contains two markets, whereas the largest (currency) contains six markets.

Trading Behavior of Commodity Pools

Theoretical models (e.g. De Long, Shleifer, Summers and Waldman, 1990b) suggest that the characteristics of managed futures trading have important implications for the possible impacts of such trading on futures price volatility. In order to better understand the trading behavior of managed futures, several different sets of results are presented in this section. These results are directed towards the following characteristics of commodity pool trading over the sample period: i) markets traded by commodity pools, ii) frequency of commodity pool trading, iii) timing of commodity pool trading relative to other market traders, and iv) relationship of past price movements to commodity pool trading.

Markets Traded by Commodity Pools

The market composition of commodity pool trading volume over the sample period is shown in Figures 1 and 2. The results are arrived at by first summing the number of contracts traded (long or short) across all CPOs and trading days for each market. Then, for ease of presentation, the totals for each market are aggregated by market group.

The figures show the overwhelming dominance of financial futures trading in the portfolios of commodity pools. The combined total of interest rate and currency futures trading represents about two-thirds of all commodity pool trading volume. Interest rate futures trading alone is 51 percent of all long pool trading volume and 42 percent of all short pool trading volume.[6] The largest non-financial group is metal, which represents 10 and 12 percent g and short pool trading volume, respectively. The remaining five groups have trading ne totals of less than eight percent each, long or short.

The concentration of commodity pool trading in financial futures markets is not ising, as these are the largest and most liquid markets. It is interesting to note that nodity pool trading is not concentrated in smaller futures markets, such as livestock es. This corroborates the observation that CPOs and CTAs are keenly aware of the ble market impacts of their trading and seek to minimize the impacts by limiting the size eir trading in smaller markets. This, of course, does not necessarily mean that the ve size of pool trading is small in these markets.

uency of Commodity Pool Trading

The daily frequency of trading by commodity pools is shown in Table 2. The daily uency is calculated as the percentage of days over the sample period in which commodity trading volume is positive (long, short, long or short).

There is a wide range of trading frequencies indicated in the table. The lowest uencies are found for Wheat, KC, where long trading occurs only 3.6 percent of the ple days and short trading does not occur on any day. The largest frequencies are found US Treasury Bonds, with long or short trading occurring nearly every day of the sample. ost any frequency between these two extremes is observed for the individual markets. In ns of groups, trading frequency tends to be highest for currencies, interest rates and metals lowest for grains and livestock.

Overall, the results in Table 2 show that commodity pools are relatively frequent ders over the sample period. The average percentage for both long and short frequency oss all markets is 50 percent. The average percentage for long or short is 66 percent. In er words, commodity pools trade on at least one side of the market two-thirds of the time.

ning of Commodity Pool Trading

Results for the timing of commodity pool trading versus other market participants are esented in Table 3. Timing is indicated by the correlation of the daily trading volume of mmodity pools with total market trading volume. Note that market trading volume is based the volume of the nearest-to-expiration futures contract, as defined earlier.

The correlation coefficients indicate that commodity pools generally trade when other arket participants trade. That is, commodity pool trading volume generally is positively rrelated with market trading volume. The correlations for long, short, and gross (long plus ort) pool trading volume tend to range from about 0.20 to 0.60. Most of these positive rrelations are statistically significant as well.

Overall, the results in Table 3 indicate commodity pools tend to trade when market volume is high rather than low. There is no evidence that commodity pools have a tendency to trade heavily during illiquid market periods, and thereby potentially increase price volatility. Instead, the fact that commodity pools tend to trade during liquid market periods probably works towards diminishing the price impact of their trading.

Past Price Movements and Commodity Pool Trading

As noted earlier, a key factor driving the concern about managed futures is the use of similar, positive feedback trading systems. While there is extensive anecdotal evidence to support this belief, no direct empirical evidence has been available to date.[7] Direct evidence can be produced using the CFTC data.

The relationship between commodity pool trading volume and past price movements is estimating using the following regression model for each futures market:

$$NCPV_t = \beta_0 + \sum_{i=1}^{n} \beta_i \, \Delta p_{t-i} + \varepsilon_t \tag{1}$$

where $NCPV_t$ is net commodity pool trading volume (number of long contracts minus number of short contracts) on day t, Dp_{t-i} is the continuously-compounded change in the closing futures price for day t-i, and e_t is a standard, normal error term.[8] The appropriate lag structure for each regression is determined via the AIC criterion (Akaike, 1969). Note that $NCPV_t$ will take on positive values when commodity pools are net buyers of contracts, negative values when pools are net sellers, and zero when no volume is recorded.

Slope coefficients in (1) can be thought of as the sensitivities of commodity pool "demand" to past price movements. Positive slope coefficients are evidence of positive feedback trading by commodity pools, whereas negative coefficients are evidence of negative feedback trading. The net feedback effect is given by the sum of slope coefficients for each regression. An F-test can be used to test this linear hypothesis regarding the slope coefficients (Greene, 1990, p. 187).

Estimation results for the daily feedback regressions are presented in Table 4. With a few exceptions, the number of price change lags included in the regressions is small. The vast majority of lags are between one and five days, indicating that feedback from price changes to commodity pool trading is of a short-term nature, typically less than a week.

The adjusted R^2s indicate that the regressions explain a surprisingly large part of the variation in commodity pool trading volume. Fourteen of the regressions have adjusted R^2s that exceed 0.15 and three (cotton, live cattle, and live hogs) exceed 0.40. The average adjusted R^2 across all 36 regressions is 0.12. The explanatory power of past price changes is particularly impressive in light of the fact that high frequency data are modeled.

The sum of slope coefficients is positive for 30 of the 36 markets. Furthermore, F-tests indicate that 18 of the 30 positive sums are statistically different from zero at the five percent level of significance. Some intriguing differences are observed across groups. Pool trading in energy, interest rate and stock index futures exhibits little or no relationship to past price changes, while trading in food and fiber, grain, livestock and metals trading exhibits a substantial relationship. The currency finding is especially interesting, as it corroborates the oft-expressed view that positive feedback trading strategies are widely employed in these markets (e.g. Frankel and Froot, 1990). Finally, it should be emphasized that the feedback results are based on only a four-month time series. The difference in results across groups may be a function of the particular sample period analyzed, rather than some underlying fundamental factor. In fact, theoretical models predict that noise trader demand will be unpredictable across markets.

Overall, the feedback regression results suggest that commodity pools use similar, positive feedback trading systems to guide trading decisions. This confirms widespread beliefs about the trading styles of managed funds and pools, and indicates a potential for "herd-like" behavior that could increase price volatility.

Commodity Pool Trading and Price Volatility

The results in the previous section present a mixed story in terms of commodity pool trading behavior. On one hand, commodity pools trade primarily in large markets and during periods of relatively high market volume. These two characteristics tend to minimize the effect of pool trading on price volatility. On the other hand, commodity pools' use of positive feedback trading systems indicates a potential for "herd-like" behavior that could increase price volatility. These conflicting pieces of information reinforce the need for direct tests of the impact of pool trading on futures price volatility.

In this section, results of directly estimating the price volatility impacts of commodity pool trading are presented. Before presenting these results, though, it is useful to examine descriptive statistics on the size of pool trading. This will help provide further perspective for the potential price volatility impact of managed futures trading.

Size of Commodity Pool Trading

Descriptive statistics for the daily trading volume of commodity pools are presented in Tables 5 and 6. The first set of results, in Table 5, are based on the number of contracts traded by commodity pools. The statistics show that the average number of contracts traded per day is not large, particularly when compared to the average daily market trading volume (shown in the last column of Table 5). Across all 36 markets, commodity pools trade an average of only 160 contracts long and 160 contracts short each day. However, the maximum number of contracts traded on any given day is many orders of magnitude larger than the average. Considering the sum of long and short commodity pool trading volume, the lowest maximum is 45 contracts (palladium) and the highest maximum is 18,006 contracts (US treasury bonds).

The relative size of commodity pool trading is reported in Table 6. Relative size is calculated by dividing commodity pool trading volume by total market trading volume. The percentages demonstrate explicitly the patterns suggested in the previous table on number of contracts traded. That is, daily average trading volume of commodity pools over the sample period is a very small percentage of total trading volume. The largest percentage for long plus short trading volume is only 6.1 percent (US dollar index). Averaging across all 36 markets, the figure for average daily trading volume (long plus short) is a minuscule 2.0 percent.

While the trading volume of commodity pools is small on average, maximum percentages show that trading on some days is a large fraction of total trading in the market. There are nine markets where the maximum one day percentage for long plus short volume exceeds 20 percent (cocoa, Canadian dollar, deutsche mark, lumber, pound, Swiss franc, US dollar index, and US treasury bills), and two markets where the maximum exceeds 40 percent (cocoa, US dollar index). It is interesting to note that commodity pool trading, in terms of relative size, is somewhat concentrated in two groups, currency and food and fiber futures markets.

The story that emerges from this analysis is that commodity pool trading volume generally is small in nearly all markets, but this is accompanied by a marked tendency for large spikes in the daily volume of pool trading. To gain further insight into this pattern, daily commodity pool trading volume (long plus short) is plotted for one market in each group. The time-series plots are shown in Figures 3 through 10, and they dramatically illustrate the pattern of sharp spikes in commodity pool trading volume.[9] The pattern of spikes is consistent with the observation that managed futures trading has a tendency to "...come in with huge orders all at once, with waves of buying or selling..." (Taylor and Behrmann, 1994, p. C1)

Commodity Pool Trading and Futures Price Volatility

In this section, the direct impact of commodity pool trading volume on futures price volatility is investigated. Following Kodres (1994), a measure of futures price volatility is regressed against information control variables and the volume of commodity pool trading. Two different models are specified in order to test the sensitivity of results to the specification of commodity pool trading volume.

For a given commodity, the first regression model is specified as follows:

$$\sigma_t = \beta_0 + \sum_{j=1}^{k} \beta_j \sigma_{t-j} + \gamma_1 \%GCPV_t + \mu_t \tag{2}$$

where s_t is the daily volatility (standard deviation) estimate on day t, $\%GCPV_t$ is the gross trading volume of commodity pools (long plus short) as a percentage of market trading volume on day t, and m_t is a standard, normal error term. For a given commodity, the second regression model is specified as follows:

$$\sigma_t = \beta_0 + \sum_{j=1}^{k} \beta_j \sigma_{t-j} + \gamma_t \% NCPV_t + \mu_t \qquad (3)$$

where $\%NCPV_t$ is the net trading volume of commodity pools (long minus short) as a percentage of market trading volume on day t, and all other variables are the same as in regression (2).

Lagged volatilities are included in regressions (2) and (3) to control for other information effects. Again, the AIC information criterion is used to determine the number of lagged volatility terms in each equation. Finally, if commodity pool trading increases futures price volatility, the coefficients on $\%GCPV_t$ and $\%NCPV_t$ will be significantly greater than zero.

Parkinson's (1980) extreme-value estimator is used to measure price volatility. For a given commodity, Parkinson's estimator is:

$$\sigma_t = 0.601 \ln(H_t / L_t) \qquad (4)$$

where H_t is the high futures price for day t, L_t is the low futures price for day t, and ln is the natural logarithm. Wiggins (1991) reports that extreme-value estimators are more efficient than close-to-close estimators. For this reason, both Chang and Schachter (1993) and Kodres (1994) employ Parkinson's estimator in their studies of futures price volatility and aggregate trading volume.

The results of estimating regressions (2) and (3) are shown in Tables 7 and 8, respectively.[10] Generally, the best-fitting model included three or less lags of volatility for each futures contract. Few of the models exhibited high explanatory power, with adjusted R^2 above 0.10 in only a few cases. The F-statistics indicate that the null hypothesis of all slope coefficients equaling zero could be rejected for only 8 out of the 36 markets for both models. Again, these results are not surprising for regressions estimated with high-frequency data.

The results are unequivocal with respect to the impact of commodity pool trading on futures price volatility. For the 72 different regressions, the coefficient on commodity pool trading is significantly different from zero in only four cases (cocoa and feeder cattle, Table 7; US dollar and S&P 500, Table 8). This is precisely equal to the number of significant coefficients expected based purely on a random chance.[11] Furthermore, two of the significant coefficients (cocoa and S&P 500) are negative, indicating pool trading in these markets is associated with decreasing price volatility. Finally, it is worthwhile to note the lack of a pattern in the signs of the coefficients for the commodity pool trading variables. The signs appear to be randomly distributed, with about half positive and half negative.

These results constitute strong evidence that, at least for this sample period, commodity pool trading is not associated with increases in futures price volatility. The appropriate conclusion is that commodity pool trading, despite the use of positive feedback trading systems, did not have any significant relationship with futures price volatility across a broad spectrum of markets.

Summary and Conclusions

The purpose of this research is to provide new evidence on the impact of managed futures trading on futures price volatility. A unique data set on managed futures trading is analyzed for the period December 1, 1988 through March 31, 1989. The data set includes the daily trading volume of large commodity pools for 36 different futures markets. The cross-section of markets is broad, and includes currency, energy, food and fiber, grain, interest rate, metal, livestock and stock index futures contracts.

The first part of the analysis investigates the trading behavior of commodity pools over the sample period. These results present a mixed story in terms of commodity pool trading behavior. On one hand, commodity pools trade primarily in large markets and during periods of relatively high market volume. These two characteristics tend to minimize the effect of pool trading on price volatility. On the other hand, commodity pools appear to use similar, positive feedback trading systems, indicating a potential for "herd-like" behavior that could increase price volatility.

The second part of the analysis examines the size and price impact of commodity pool trading volume. The findings indicate that daily average trading volume of commodity pools over the sample period is a small percentage of total trading volume. Averaging across all 36 markets, the figure for average daily trading volume is a minuscule 2.0 percent. While the trading volume of commodity pools is small on average, maximum percentages show that trading on some days is a large fraction of the total trading in the market. There are nine markets where the maximum one day percentage for long plus short volume exceeds 20 percent.

Regression results are unequivocal with respect to the direct impact of commodity pool trading on futures price volatility. For the 72 estimated regressions (two for each market), the coefficient on commodity pool trading volume is significantly different from zero in only four cases. This is precisely the number of significant coefficients expected based purely on a random chance.

These results constitute strong evidence that, at least for this sample period, commodity pool trading is not associated with increases in futures price volatility. The appropriate conclusion is that commodity pool trading did not have any significant relationship with futures price volatility across a broad spectrum of markets. This evidence is sharply at odds with much of the conventional wisdom regarding the market impacts of managed futures trading.

While the evidence in this study is clear with regard to futures price volatility and managed futures trading, there is a definite need for further research. Investment in managed futures has, at least, doubled since the late 1980s. The continued rapid growth in managed futures, combined with the use of positive feedback systems, indicate the potential for destabilizing futures prices probably has not diminished. In this light, additional tests on more recent data would be highly valuable. Furthermore, the intra-day impact of managed futures trading is not addressed in this study. It is possible that managed futures trading exacerbates price volatility over shorter intervals, such as hours or minutes within the trading day, but this impact is not detectable with daily data. In a related manner, market liquidity within the day may be adversely affected. These issues suggest the market impact of managed futures trading will remain an important research question for some time.

at the same time. This is evidence of "herding" in CTA trading behavior. The analysis in this section seeks to determine whether this trading behavior is related to past price movements.

8 Daily opening, closing, high, and low prices are obtained for each contract from Technical Tools, Inc.

9 Please note the different ranges used for the y-axis in Figures 3 through 10.

10 Several alternative specifications of the volatility regressions are estimated. The Newey-West heteroskedastic-autocorrelation consistent covariance estimator is used instead of OLS. Results are not substantially changed with the alternative estimator. Dummy variables for day-of-the-week and month effects also are included, with no qualitative change in the results. These results can be obtained from the corresponding author upon request.

11 At a five percent significance level, four significant coefficients would be expected based on random chance (0.05 X 72).

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Table 1. **Futures Markets Traded by Commodity Pools, December 1, 1988 - March 31, 1989**

Group	Futures Contract	Exchange	CFTC Volume Class
Currency	Canadian Dollar	International Monetary Market	3
	Deutsche Mark	International Monetary Market	4
	Japanese Yen	International Monetary Market	4
	Pound Sterling	International Monetary Market	4
	Swiss Franc	International Monetary Market	4
	US Dollar	New York Cotton Exchange	2
Energy	Crude Oil	New York Mercantile Exchange	5
	Heating Oil	New York Mercantile Exchange	4
	Unleaded Gasoline	New York Mercantile Exchange	4
Food & Fiber	Cocoa	Coffee, Sugar & Cocoa Exchange	3
	Coffee	Coffee, Sugar & Cocoa Exchange	3
	Cotton	New York Cotton Exchange	3
	Lumber	Chicago Mercantile Exchange	2
	Orange Juice	Citrus Association of the New York Cotton Exchange	2
	Sugar	Coffee, Sugar & Cocoa Exchange	4
Grain	Corn	Chicago Board of Trade	5
	Soybean Oil	Chicago Board of Trade	4
	Soybeans	Chicago Board of Trade	5
	Wheat, CHI	Chicago Board of Trade	5
	Wheat, KC	Kansas City Board of Trade	4
Interest Rate	5-year Treasury Notes	Chicago Board of Trade	3
	Eurodollars	International Monetary Market	5
	Municipal Bond	Chicago Board of Trade	3
	US Treasury Bills	International Monetary Market	3
	US Treasury Bonds	Chicago Board of Trade	5
Livestock	Feeder Cattle	Chicago Mercantile Exchange	2
	Live Cattle	Chicago Mercantile Exchange	4
	Live Hogs	Chicago Mercantile Exchange	3
	Pork Bellies	Chicago Mercantile Exchange	3
Metal	Copper	Commodity Exchange	3
	Gold	Commodity Exchange	5
	Palladium	New York Mercantile Exchange	1
	Platinum	New York Mercantile Exchange	3
	Silver	Commodity Exchange	4
Stock Index	NYSE Composite	New York Futures Exchange	3
	S&P 500	International Monetary Market	5

Note: Volume classes defined by the CFTC (Commodity Futures Trading Commission) are as follows: Class 1: 1- 1,000 contracts/day, Class 2: 1,001 - 3, 000 contracts/day, Class 3: 3,001 - 10,000 contracts/day, Class 4: - 30,000 contracts/day, Class 5: over 30,000 contracts/day.

Table 2. **Daily Frequency of Trading by Commodity Pools, December 1, 1988 - March 31, 1989.**

Group	Futures Contract	Percentage of Days in Sample with Positive Commodity Pool Trading Volume		
		Long	Short	Long or Short
Currency	Canadian Dollar	57.8	33.7	66.3
	Deutsche Mark	79.5	78.3	90.4
	Japanese Yen	85.5	90.4	94.0
	Pound Sterling	57.8	65.1	83.1
	Swiss Franc	57.8	69.9	84.3
	US Dollar	28.9	32.5	47.0
Energy	Crude Oil	71.1	69.9	81.9
	Heating Oil	69.9	61.4	81.9
	Unleaded Gasoline	14.5	13.3	22.9
Food & Fiber	Cocoa	62.7	68.7	92.8
	Coffee	51.8	53.0	79.5
	Cotton	60.2	60.2	85.5
	Lumber	22.9	32.5	48.2
	Orange Juice	6.0	10.8	15.7
	Sugar	79.5	86.7	97.6
Grain	Corn	47.0	44.6	67.5
	Soybean Oil	47.0	49.4	68.7
	Soybeans	21.7	18.1	33.7
	Wheat, CHI	18.1	13.3	28.9
	Wheat, KC	3.6	0.0	3.6
Interest Rate	5-year Treasury Notes	39.8	30.1	57.8
	Eurodollars	89.2	89.2	100.0
	Municipal Bond	22.9	20.5	37.3
	US Treasury Bills	49.4	57.8	78.3
	US Treasury Bonds	95.2	96.4	97.6
Livestock	Feeder Cattle	9.6	2.4	10.8
	Live Cattle	57.8	45.8	71.1
	Live Hogs	51.8	51.8	72.3
	Pork Bellies	33.7	53.0	71.1
Metal	Copper	63.9	72.3	90.4
	Gold	78.3	85.5	86.7
	Palladium	9.6	4.8	12.0
	Platinum	53.0	63.9	83.1
	Silver	79.5	72.3	96.4
Stock Index	NYSE Composite	20.5	15.7	32.5
	S&P 500	92.8	74.7	94.0

Table 3. Correlation of Daily Commodity Pool Trading with Market Volume, December 1, 1988 - March 31, 1989

Group	Futures Contract	Correlation: Long Pool Volume and Market Volume	Correlation: Short Pool Volume and Market Volume	Correlation: Long plus Short Pool Volume and Market Volume
Currency	Canadian Dollar	0.31*	0.29*	0.42*
	Deutsche Mark	0.38*	0.31*	0.46*
	Japanese Yen	0.46*	0.39*	0.60*
	Pound Sterling	-0.03	0.28*	0.25*
	Swiss Franc	0.34*	0.10*	0.29*
	US Dollar	0.56*	0.48*	0.73*
Energy	Crude Oil	0.36*	0.33*	0.43*
	Heating Oil	0.11	0.34*	0.32*
	Unleaded Gasoline	0.04	-0.04	-0.01
Food & Fiber	Cocoa	0.23*	0.32*	0.45*
	Coffee	0.43*	0.35*	0.59*
	Cotton	0.52*	0.39*	0.67*
	Lumber	0.17	0.51*	0.44*
	Orange Juice	0.24*	0.27*	0.31*
	Sugar	0.31*	0.53*	0.62*
Grain	Corn	0.30*	0.35*	0.46*
	Soybean Oil	0.04	0.45*	0.39*
	Soybeans	0.25*	0.07	0.23*
	Wheat, CHI	0.30*	0.08	0.31*
	Wheat, KC	-0.11	NA	-0.11
Interest Rate	5-year Treasury Notes	0.15	0.12	0.20*
	Eurodollars	0.26*	0.37*	0.43*
	Municipal Bond	0.16	0.32*	0.26*
	US Treasury Bills	0.38*	0.21	0.40*
	US Treasury Bonds	0.63*	0.60*	0.70*
Livestock	Feeder Cattle	0.38*	0.56*	0.63*
	Live Cattle	0.44*	0.31*	0.56*
	Live Hogs	0.64*	0.11	0.63*
	Pork Bellies	0.32*	0.36*	0.48*
Metal	Copper	0.39*	0.36*	0.56*
	Gold	0.43*	0.41*	0.59*
	Palladium	0.20	0.00	0.19
	Platinum	0.59*	0.22*	0.57*
	Silver	0.42*	0.43*	0.60*
Stock Index	NYSE Composite	0.18	0.19	0.26*
	S&P 500	0.48*	0.53*	0.63*

Note: A star indicates statistical significance at the five percent level. NA means not applicable.

Table 4. **Results of Daily Feedback Regression Models for Commodity Pool Trading Volume, December 1, 1988 - March 31, 1989.**

		Regression Statistics			
Group	Futures Contract	No. Price Change Lags	Adj. R^2	Sum of Slope Coefficients	F-test: Sum of Slope Coefficients Equal Zero
Currency	Canadian Dollar	1	0.00	10640.10	1.35
	Deutsche Mark	3	0.03	40132.37	5.23*
	Japanese Yen	2	0.12	51787.18	12.25*
	Pound Sterling	1	0.06	9064.21	5.81*
	Swiss Franc	1	0.01	5677.28	1.41
	US Dollar	1	0.01	-9967.11	1.89
Energy	Crude Oil	3	0.08	2534.21	0.14
	Heating Oil	1	-0.01	134.31	0.01
	Unleaded Gasoline	1	0.01	238.57	1.50
Food & Fiber	Cocoa	9	0.28	14398.30	30.17*
	Coffee	4	0.16	5339.30	17.63*
	Cotton	5	0.44	18320.25	54.66*
	Lumber	1	-0.01	183.97	0.11
	Orange Juice	1	0.02	120.58	2.89
	Sugar	2	0.15	14408.95	16.35*
Grain	Corn	3	0.15	11139.98	10.26*
	Soybean Oil	3	0.26	16984.67	31.53*
	Soybeans	1	0.01	1028.80	1.90
	Wheat, CHI	2	0.06	2323.18	7.26*
	Wheat, KC	2	0.03	-485.66	2.20
Interest Rate	5-year Treasury Notes	1	-0.01	-1241.16	0.07
	Eurodollars	15	0.16	-805475.30	1.34
	Municipal Bond	12	0.21	8234.02	4.27*
	US Treasury Bills	1	0.02	-39697.98	2.29
	US Treasury Bonds	1	0.03	66011.22	3.19
Livestock	Feeder Cattle	1	0.03	956.78	3.55*
	Live Cattle	4	0.40	57793.80	48.04*
	Live Hogs	7	0.53	47628.22	86.17*
	Pork Bellies	2	0.19	2417.08	20.89*
Metal	Copper	2	0.23	6161.84	22.19*
	Gold	1	0.02	16112.71	2.50
	Palladium	1	0.01	-71.66	2.16
	Platinum	5	0.29	8700.66	34.39*
	Silver	3	0.34	35617.95	34.39*
Stock Index	NYSE Composite	1	-0.01	252.92	0.04
	S&P 500	1	0.01	7945.94	2.10

Note: A star indicates statistical significance at the five percent level.

Table 5. Descriptive Statistics for Daily Trading Volume of Commodity Pools, by Number of Contracts, December 1, 1988-March 31, 1989.

Group	Futures Contract	Daily Trading Volume of Commodity Pools: Long		Short		Long plus Short		Long minus Short			Daily Market Trading Volume
		Average	Maximum	Average	Maximum	Average	Maximum	Average	Minimum	Maximum	Average
		---number of contracts---									
Currency	Canadian Dollar	90.6	1493.0	42.0	762.0	132.5	1493.0	48.6	-755.0	1493.0	4147.4
	Deutsche Mark	224.0	1201.0	335.4	2013.0	559.3	2073.0	-111.4	-1953.0	1189.0	20823.7
	Japanese Yen	285.7	1850.0	382.4	1637.0	668.1	2006.0	-96.7	-1531.0	1694.0	21949.4
	Pound Sterling	46.5	592.0	111.5	810.0	158.0	810.0	-65.0	-810.0	592.0	7772.9
	Swiss Franc	88.0	700.0	166.8	1279.0	254.8	1301.0	-78.8	-1257.0	700.0	17115.6
	US Dollar	72.8	1316.0	114.3	2016.0	187.1	2057.0	-41.6	-1975.0	1316.0	1869.4
Energy	Crude Oil	219.8	1531.0	279.4	2975.0	499.3	3390.0	-59.6	-2560.0	1189.0	35716.6
	Heating Oil	110.7	785.0	81.7	925.0	192.5	1045.0	29.0	-805.0	707.0	9749.9
	Unleaded Gasoline	6.6	139.0	7.2	186.0	13.8	268.0	-0.6	-186.0	80.0	4697.8
Food & Fiber	Cocoa	60.9	660.0	88.1	634.0	149.1	660.0	-27.2	-616.0	660.0	3182.1
	Coffee	64.7	749.0	40.0	542.0	104.6	749.0	24.7	-542.0	749.0	3786.4
	Cotton	64.2	534.0	37.5	536.0	101.7	564.0	26.7	-536.0	532.0	3280.2
	Lumber	7.6	303.0	8.0	117.0	15.7	303.0	-0.4	-117.0	303.0	675.1
	Orange Juice	1.8	62.0	1.3	45.0	3.1	81.0	0.4	-26.0	62.0	622.9
	Sugar	185.5	1171.0	299.3	3789.0	484.8	3916.0	-113.9	-3662.0	955.0	13999.8
Grain	Corn	73.6	796.0	60.7	712.0	134.3	820.0	12.9	-696.0	796.0	21240.5
	Soybean Oil	74.7	768.0	91.1	841.0	165.8	954.0	-16.3	-728.0	768.0	9274.6
	Soybeans	21.8	295.0	18.3	318.0	40.1	318.0	3.5	-318.0	295.0	26513.4
	Wheat, CHI	18.5	233.0	4.9	124.0	23.3	233.0	13.6	-124.0	233.0	6329.6
	Wheat, KC	1.6	129.0	0.0	0.0	1.6	129.0	1.6	0.0	129.0	3219.8

Table 5 Cont'd. **Descriptive Statistics for Daily Trading Volume of Commodity Pools, by Number of Contracts, December 1, 1988 - March 31, 1989.**

		Daily Trading Volume of Commodity Pools									Daily Market Trading Volume
		Long		Short		Long plus Short		Long minus Short			
Group	Futures Contract	Average	Maximum	Average	Maximum	Average	Maximum	Average	Minimum	Maximum	Average
		---number of contracts---									
Interest Rate	5-year Treasury Notes	41.7	459.0	28.2	323.0	69.9	459.0	13.5	-323.0	459.0	4187.9
	Eurodollars	535.5	5100.0	432.6	2549.0	968.1	5100.0	102.8	-2144.0	5100.0	88008.8
	Municipal Bond	18.7	490.0	12.2	441.0	30.8	931.0	6.5	-209.0	190.0	3234.9
	US Treasury Bills	74.1	817.0	75.4	1169.0	149.6	1398.0	-1.3	-940.0	693.0	4574.2
	US Treasury Bonds	2223.9	14522.0	1837.4	8523.0	4061.3	18006.0	386.5	-3897.0	11038.0	216352.4
Livestock	Feeder Cattle	5.0	159.0	1.8	141.0	6.8	159.0	3.2	-141.0	159.0	811.4
	Live Cattle	115.3	2271.0	96.1	1127.0	211.5	2308.0	19.2	-1107.0	2234.0	9043.9
	Live Hogs	117.1	923.0	81.7	747.0	198.8	923.0	35.4	-724.0	923.0	3979.9
	Pork Bellies	16.7	219.0	23.3	401.0	40.0	401.0	-6.6	-401.0	212.0	2386.0
Metal	Copper	82.1	770.0	102.8	603.0	184.8	933.0	-20.7	-594.0	607.0	7407.0
	Gold	256.1	2781.0	333.0	2971.0	589.2	3198.0	-76.9	-2955.0	2364.0	27024.3
	Palladium	1.4	45.0	0.4	20.0	1.8	45.0	1.0	-20.0	45.0	379.5
	Platinum	51.0	575.0	52.4	488.0	103.3	684.0	-1.4	-488.0	466.0	4583.2
	Silver	186.5	1898.0	174.0	1653.0	360.5	2045.0	12.5	-1582.0	1751.0	12799.8
Stock Index	NYSE Composite	15.7	205.0	15.7	458.0	31.4	458.0	0.0	-458.0	205.0	4720.6
	S&P 500	297.8	1219.0	293.6	1434.0	591.4	1967.0	4.2	-1300.0	742.0	28749.6

Table 6. Descriptive Statistics for Daily Trading Volume of Commodity Pools, Percentage of Market Volume, December 1, 1988 - March 31, 1989.

		Daily Trading Volume of Commodity Pools								
		Long		Short		Long plus Short		Long minus Short		
Group	Futures Contract	Average	Maximum	Average	Maximum	Average	Maximum	Average	Minimum	Maximum
		---percentage of market trading volume---								
Currency	Canadian Dollar	1.8	33.7	0.8	15.4	2.6	33.7	1.0	-15.3	33.7
	Deutsche Mark	1.2	9.4	1.7	25.2	3.0	25.2	-0.5	-25.2	9.4
	Japanese Yen	1.5	29.3	2.0	17.1	3.4	29.3	-0.5	-17.1	29.3
	Pound Sterling	0.9	23.8	1.3	10.8	2.2	23.8	-0.5	-10.7	23.8
	Swiss Franc	0.7	25.8	1.2	14.3	1.9	25.8	-0.5	-14.3	25.8
	US Dollar	2.1	28.7	4.0	47.4	6.1	48.4	-1.9	-46.4	28.7
Energy	Crude Oil	0.6	3.7	0.7	7.3	1.3	8.3	-0.1	-6.3	3.7
	Heating Oil	1.2	7.9	0.8	9.2	1.9	9.2	0.4	-9.2	7.1
	Unleaded Gasoline	0.1	2.9	0.2	5.1	0.3	5.6	0.0	-5.1	1.5
Food & Fiber	Cocoa	2.2	31.5	2.7	15.9	4.9	47.4	-0.4	-13.2	17.1
	Coffee	1.3	16.4	1.0	10.8	2.3	16.4	0.3	-10.0	16.4
	Cotton	1.7	10.6	1.1	8.0	2.7	12.9	0.6	-8.0	10.6
	Lumber	0.9	27.9	0.9	11.6	1.8	27.9	0.0	-11.6	27.9
	Orange Juice	0.2	10.1	0.3	5.6	0.5	10.1	-0.1	-5.6	10.1
	Sugar	1.3	7.7	1.9	12.1	3.2	14.0	-0.6	-10.2	6.7
Grain	Corn	0.3	4.4	0.3	2.2	0.6	4.6	0.0	-2.2	4.2
	Soybean Oil	0.9	7.4	0.9	8.7	1.7	8.7	0.0	-8.7	7.4
	Soybeans	0.1	0.8	0.1	1.5	0.1	1.5	0.0	-1.5	0.8
	Wheat, CHI	0.3	7.4	0.1	2.2	0.4	7.4	0.2	-2.2	7.4
	Wheat, KC	0.1	7.2	0.0	0.0	0.1	7.2	0.1	0.0	7.2

Table 7. **Regression Results for Daily Volatility Models, Long plus Short Commodity Pool Trading Volume, December 1, 1988 - March 31, 1989.**

		Regression Statistics				
Group	Futures Contract	No. of Volatility Lags	Adj. R^2	F-test: Slope Coefficients Equal Zero	Coefficient on Long plus Short Pool Volume	T-statistic
Currency	Canadian Dollar	2	0.04	2.17	0.0018	0.84
	Deutsche Mark	3	0.07	2.44	-0.0086	-1.35
	Japanese Yen	1	0.01	1.60	-0.0043	-0.98
	Pound Sterling	1	0.01	1.38	-0.0095	-1.55
	Swiss Franc	3	0.02	1.46	-0.0094	-1.21
	US Dollar	1	0.00	1.10	0.0017	0.86
Energy	Crude Oil	5	0.08	2.13	0.0191	0.49
	Heating Oil	3	0.03	1.53	0.0199	0.76
	Unleaded Gasoline	5	0.15	3.43*	-0.0516	-0.98
Food & Fiber	Cocoa	2	0.04	2.19	-0.0264	-1.99*
	Coffee	2	0.32	14.13*	0.0037	0.12
	Cotton	1	0.01	1.35	0.0076	0.40
	Lumber	1	0.00	1.01	0.0098	1.42
	Orange Juice	1	0.16	9.04*	0.0239	0.65
	Sugar	1	0.01	1.32	0.0246	0.65
Grain	Corn	1	0.03	2.15	0.0889	1.75
	Soybean Oil	2	0.02	1.53	0.0197	0.87
	Soybeans	1	-0.02	0.14	0.0881	0.51
	Wheat, CHI	2	0.07	2.90*	-0.0189	-0.46
	Wheat, KC	1	0.00	0.89	0.0210	0.57
Interest Rate	5-year Treasury Notes	2	0.02	1.56	-0.0072	-1.63
	Eurodollars	2	0.06	2.81*	-0.0040	-0.71
	Municipal Bond	1	0.02	1.68	0.0084	1.32
	US Treasury Bills	2	-0.01	0.68	-0.0001	-0.09
	US Treasury Bonds	1	0.00	0.85	-0.0071	-0.49
Livestock	Feeder Cattle	3	0.10	3.34*	0.0395	2.88*
	Live Cattle	1	0.00	0.89	0.0111	1.26
	Live Hogs	2	0.00	0.97	-0.0064	-0.87
	Pork Bellies	14	0.16	2.07*	-0.0366	-0.95
Metal	Copper	2	0.01	1.34	0.0025	0.55
	Gold	1	0.01	1.41	0.0267	1.61
	Palladium	2	0.17	6.60*	0.0015	0.02
	Platinum	1	-0.01	0.44	0.0160	0.62
	Silver	1	0.00	0.92	0.0237	1.13
Stock Index	NYSE Composite	2	0.02	1.48	0.0204	1.13
	S&P 500	1	0.00	0.82	0.0240	1.28

Note: A star indicates statistical significance at the five percent level.

Table 8. **Regression Results for Daily Volatility Models, Long minus Short Commodity Pool Trading Volume, December 1, 1988 - March 31, 1989.**

Group	Futures Contract	No. of Volatility Lags	Adj. R^2	F-test: Slope Coefficients Equal Zero	Coefficient on Long minus Short Pool Volume	T-statistic
		Regression Statistics				
Currency	Canadian Dollar	2	0.03	1.96	0.0008	0.37
	Deutsche Mark	3	0.05	2.16	0.0052	0.90
	Japanese Yen	1	0.01	1.23	-0.0019	-0.49
	Pound Sterling	1	-0.01	0.70	-0.0057	-1.02
	Swiss Franc	3	0.01	1.14	0.0036	0.49
	US Dollar	1	0.05	3.32*	0.0043	2.26*
Energy	Crude Oil	5	0.07	2.10	-0.0117	-0.26
	Heating Oil	3	0.02	1.39	-0.0038	-0.15
	Unleaded Gasoline	5	0.14	3.24*	-0.0163	-0.22
Food & Fiber	Cocoa	2	0.00	1.00	-0.0103	-0.71
	Coffee	2	0.33	14.21*	0.0109	0.43
	Cotton	1	0.01	1.29	-0.0029	-0.19
	Lumber	1	-0.02	0.02	-0.0012	-0.18
	Orange Juice	1	0.18	9.73*	0.0462	1.25
	Sugar	1	0.00	1.10	0.0030	0.09
Grain	Corn	1	-0.01	0.60	-0.0075	-0.15
	Soybean Oil	2	0.01	1.37	0.0107	0.54
	Soybeans	1	-0.02	0.14	-0.0842	-0.53
	Wheat, CHI	2	0.07	2.95*	-0.0236	-0.58
	Wheat, KC	1	0.00	0.89	0.0210	0.57
Interest Rate	5-year Treasury Notes	1	-0.02	0.24	0.0020	0.50
	Eurodollars	2	0.06	2.63	-0.0008	-0.16
	Municipal Bonds	1	0.00	0.99	0.0049	0.62
	US Treasury Bills	2	-0.01	0.68	-0.0001	-0.06
	US Treasury Bonds	1	-0.01	0.78	-0.0061	-0.30
Livestock	Feeder Cattle	3	0.02	1.52	0.0172	1.21
	Live Cattle	1	-0.01	0.60	-0.0078	-1.00
	Live Hogs	1	-0.01	0.56	0.0047	0.82
	Pork Bellies	14	0.18	2.20*	0.0512	1.48
Metal	Copper	2	0.05	2.43	-0.0064	-1.85
	Gold	1	-0.02	0.24	-0.0076	-0.51
	Palladium	2	0.17	6.68*	0.0285	0.44
	Platinum	1	0.01	1.23	0.0340	1.40
	Silver	1	-0.02	0.28	-0.0006	-0.03
Stock Index	NYSE Composite	2	0.00	1.04	-0.0017	-0.10
	S&P 500	2	0.07	2.91*	-0.0412	-2.55*

Note: A star indicates statistical significance at the five percent level.

Figure 1. Composition of Long Commodity Pool Trading Volume, December 1, 1988 - March 31, 1989

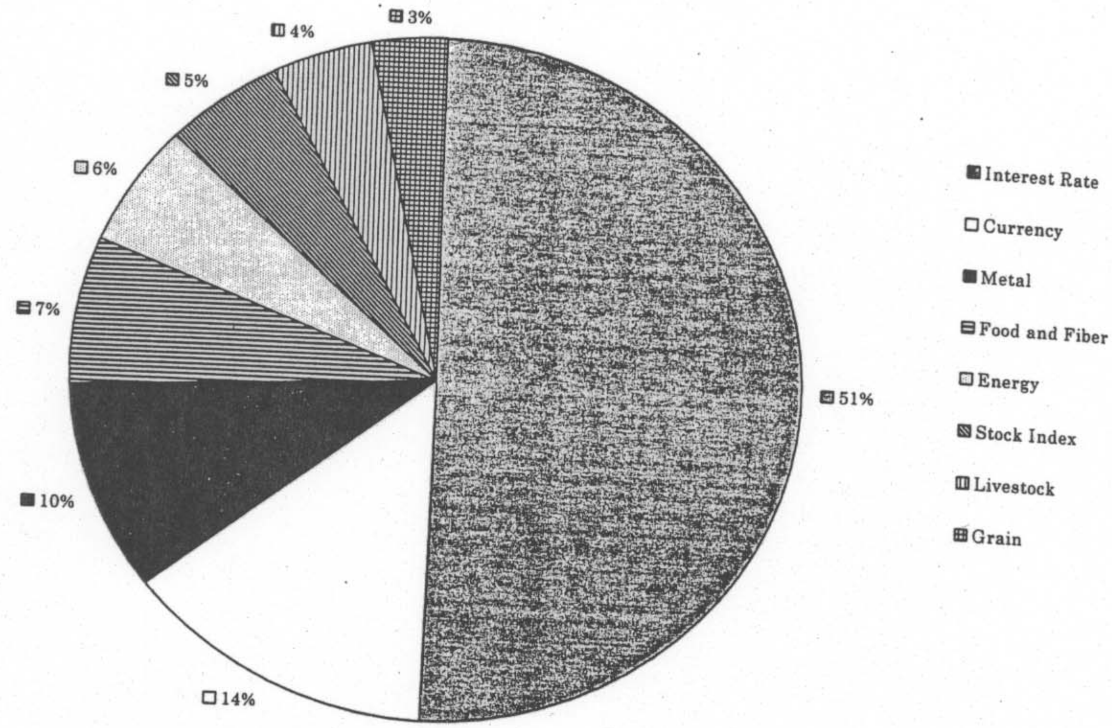

Figure 2. Composition of Short Commodity Pool Trading Volume, December 1, 1988 - March 31, 1989

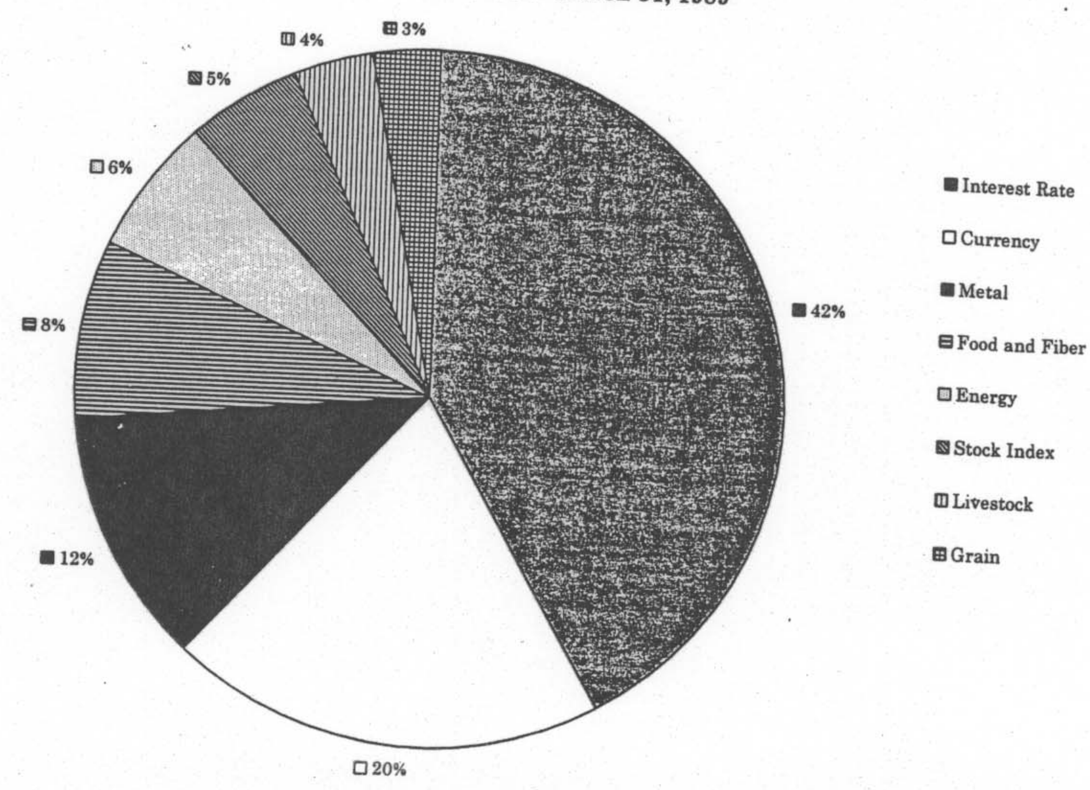

Figure 3. Commodity Pool Trading Volume in the Japanese Yen Futures Market, Long plus Short, December 1, 1988 - March 31, 1989

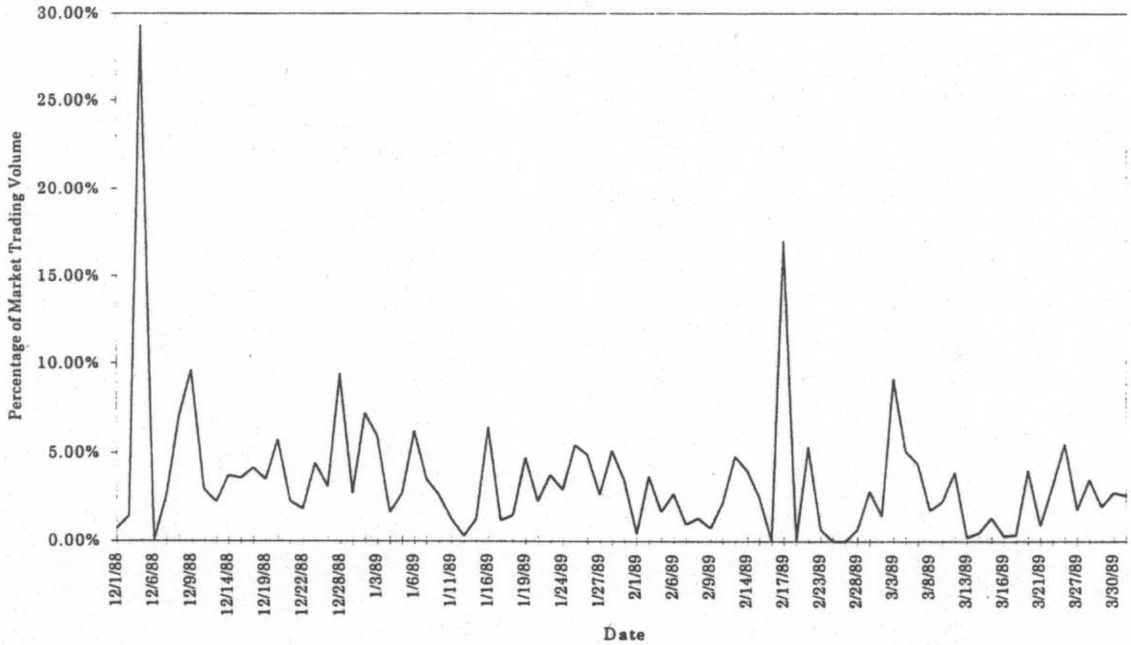

Figure 4. Commodity Pool Trading Volume in the Crude Oil Futures Market, Long plus Short, December 1, 1988 - March 31, 1989

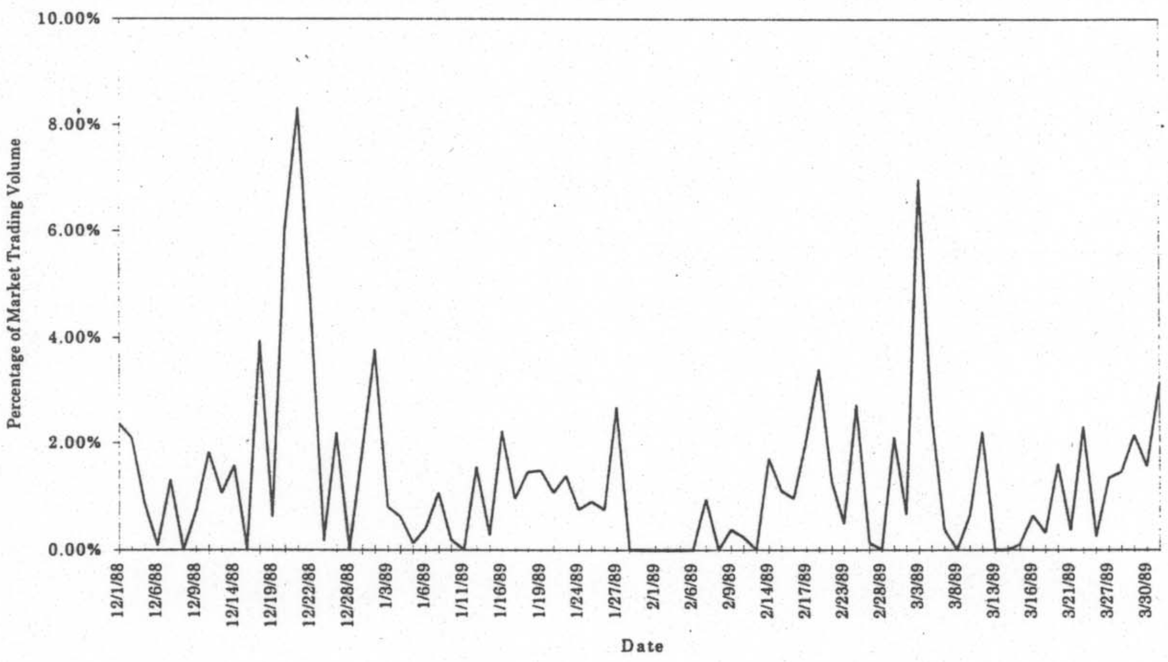

Figure 5. Commodity Pool Trading Volume in the Cocoa Futures Market, Long plus Short, December 1, 1988 - March 31, 1989

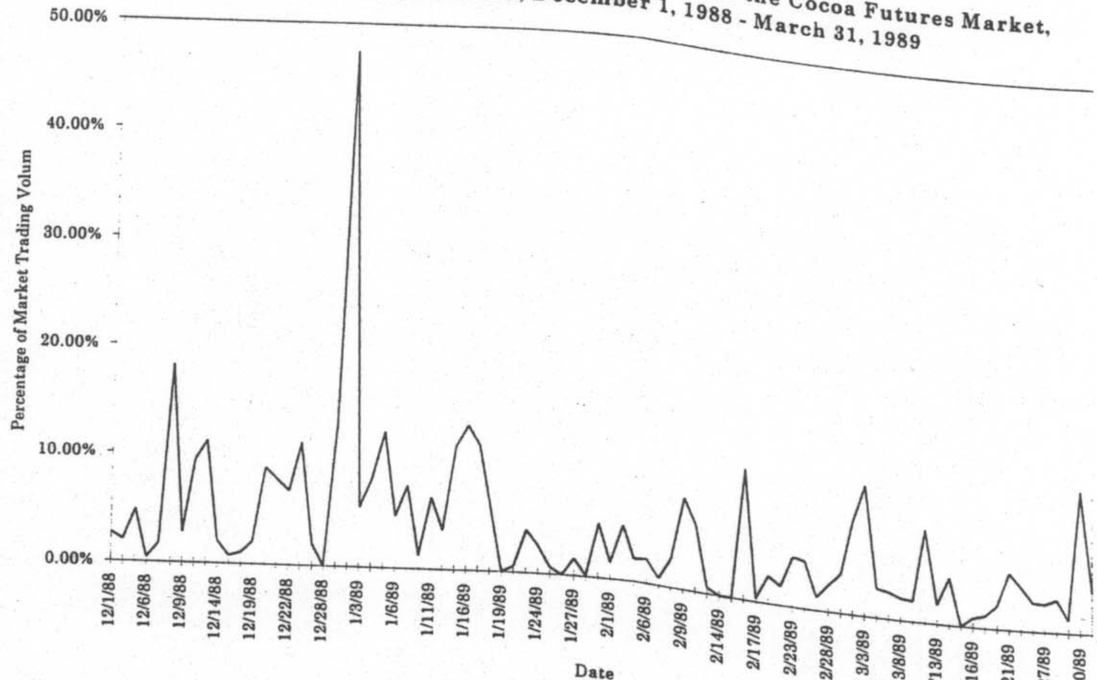

Figure 6. Commodity Pool Trading Volume in the Chicago Wheat Futures Market, Long plus Short, December 1, 1988 - March 31, 1989

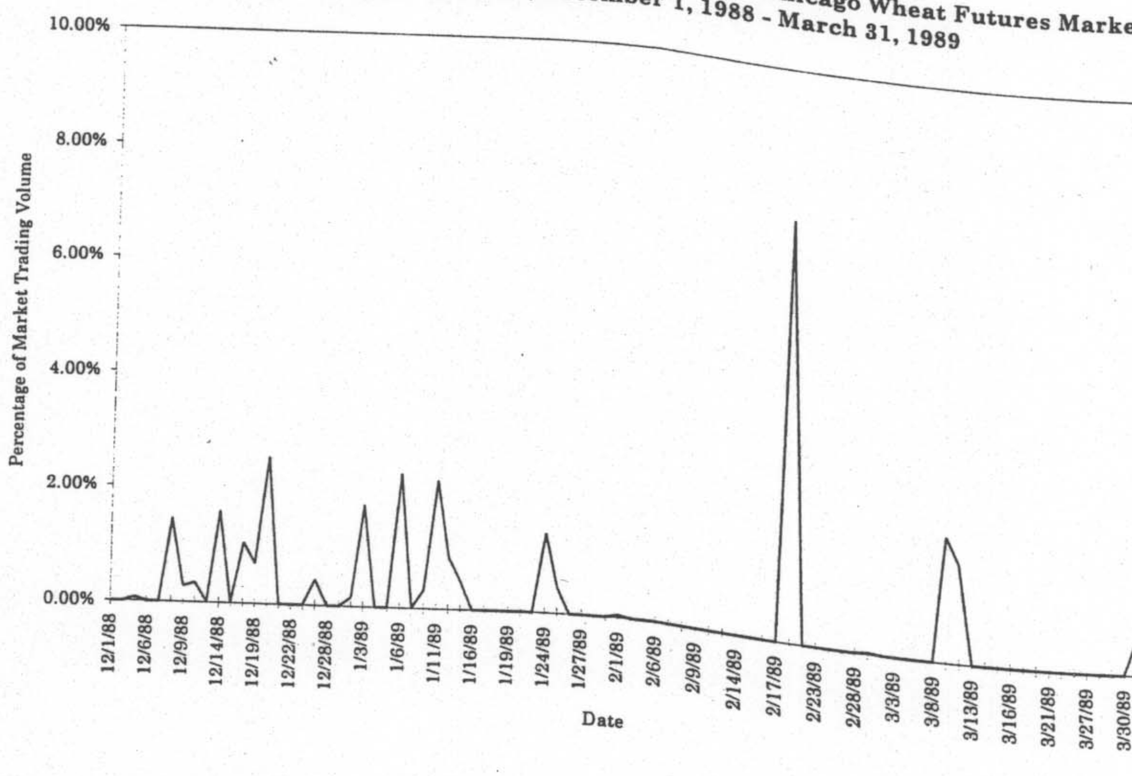

Figure 7. Commodity Pool Trading Volume in the US Treasury Bond Futures Market, Long plus Short, December 1, 1988 - March 31, 1989

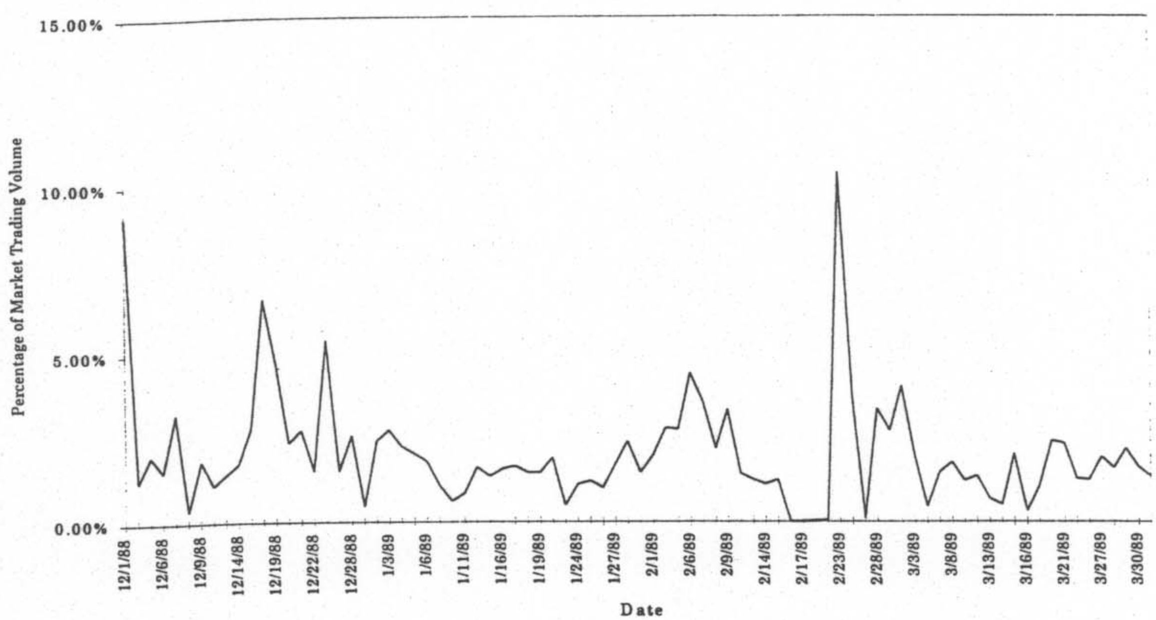

Figure 8. Commodity Pool Trading Volume in the Live Hog Futures Market, Long plus Short, December 1, 1988 - March 31, 1989

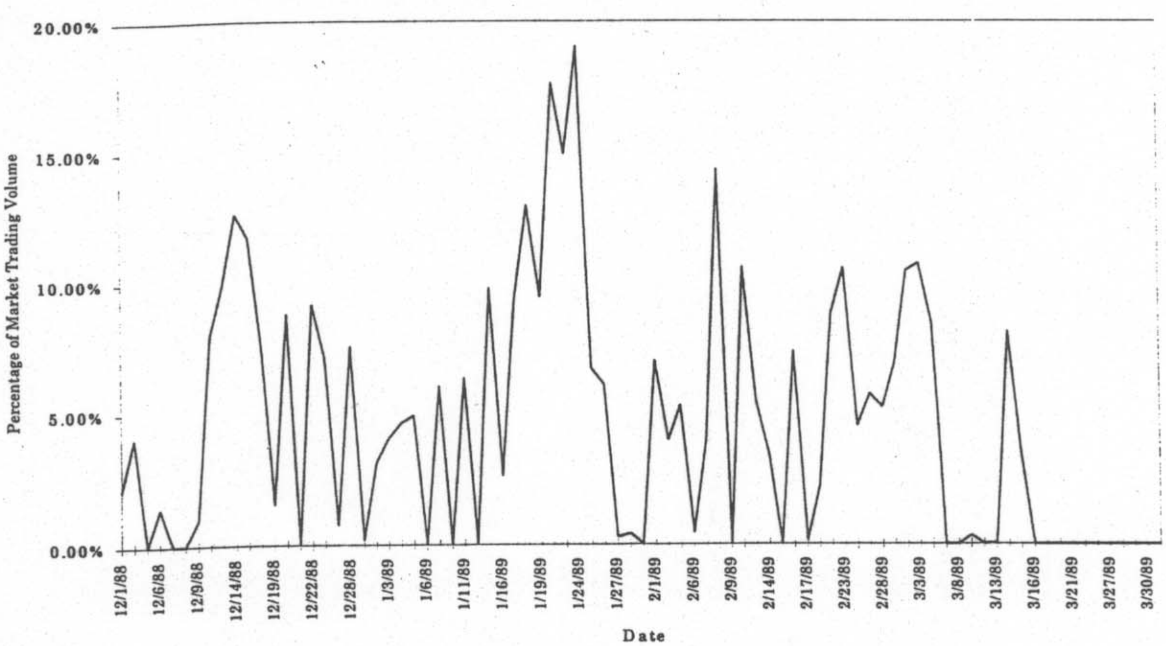

Figure 9. Commodity Pool Trading Volume in the Gold Futures Market, Long plus Short, December 1, 1988 - March 31, 1989

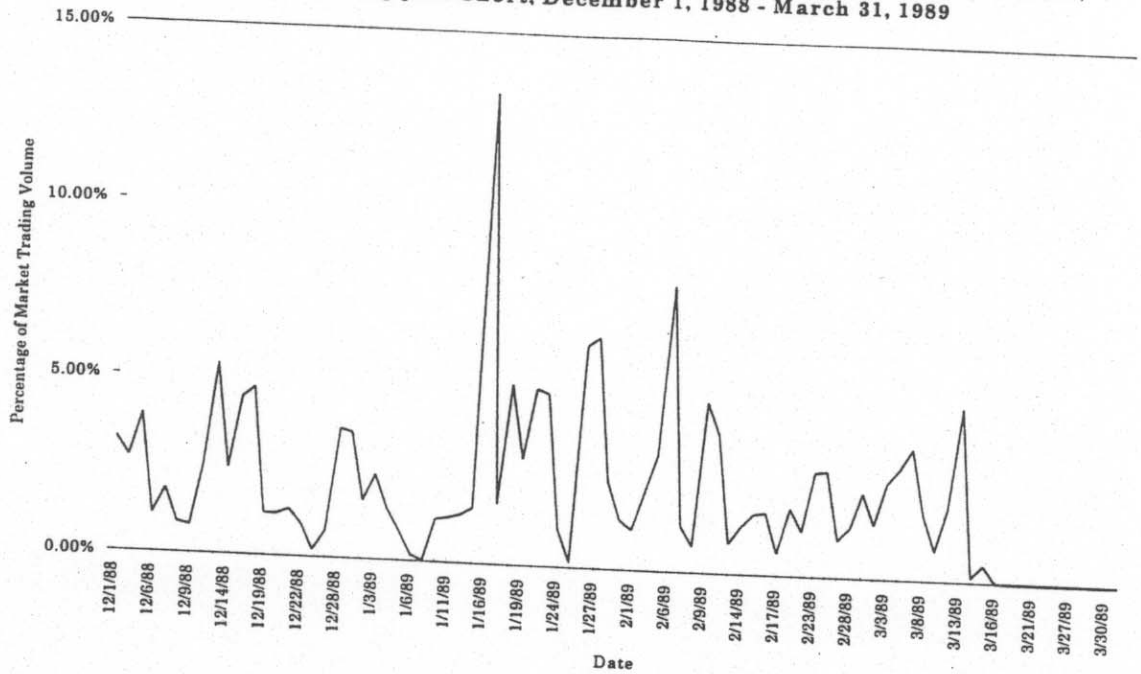

Figure 10. Commodity Pool Trading Volume in the S&P 500 Futures Market, Long plus Short, December 1, 1988 - March 31, 1989