(MICRO) FADS IN ASSET PRICES: EVIDENCE FROM THE FUTURES MARKET

GERALD D. GAY
JAYANT R. KALE
ROBERT W. KOLB
THOMAS H. NOE

INTRODUCTION

The formulation and testing of the market-efficiency hypothesis has long been of interest to financial economists. However, only recently have researchers formulated alternative hypotheses to market efficiency [e.g., Shiller (1981); Shleifer and Summers (1990)]. Distinguishing empirically between the market-efficiency hypothesis and its alternatives has proven to be difficult. Testing has followed one of two basic approaches: the variance bounds approach and the direct approach. The approach followed here is in the spirit of the latter. The direct approach attempts to determine whether variables already in the agent's

Helpful comments from Mike Hemler, workshop participants at Virginia Tech, and two anonymous referees are appreciated. The research assistance of Ronald Best, Randy Glover, Janet Payne, and Seksak Jumreornvong is gratefully acknowledged.

- *Gerald D. Gay is Chairman and Professor of Finance at Georgia State University, Atlanta.*
- *Jayant R. Kale is an Assistant Professor of Finance at Georgia State University, Atlanta.*
- *Robert W. Kolb is a Professor, Department of Finance at the University of Miami.*
- *Thomas H. Noe is an Associate Professor of Finance at Georgia State University, Atlanta.*

The Journal of Futures Markets, Vol. 14, No. 6, 637–659 (1994)

CCC 0270-7314/94/060637-23

information set can predict future price changes. If such variables exist, then efficiency is violated. However, as LeRoy (1989) states, there is a fundamental ambiguity in these direct tests because the finding of some predictive variable could mean either that the capital market is inefficient or that the predictive variable is not in the agent's information set. Also, as the relationship between information and asset prices depends on the assumed return-generating process, current prices could differ from future expected prices because of premia for systematic risk and the passage of time. Therefore, to the extent that these two factors are important, misspecification of the return-generating process can lead to the false rejection of the market-efficiency hypothesis.

This article investigates market efficiency by employing a test which substantially mitigates the problems discussed above. Specifically, the impact of select *Wall Street Journal* (*WSJ*) commodity page headlines on subsequent price behavior is investigated. These headlines accompany certain news stories that describe the previous day's price movements of futures contracts that experienced abnormal levels of trading interest. As confirmed by staff reporters with the *WSJ* who have prepared many of the articles, these stories are simply a "market report" on where the "prior day's action was." Thus, as the stories selected report only historic information, they add nothing to the agent's current information set.[1] Hence, there should be no ambiguity as to whether the predictive variable (the story) is in the information set.[2] Also, because futures contracts require no net investment and should contain little, if any, risk premia over the short time intervals for which these tests are conducted, the expected change in futures prices should be virtually nil.

Comparing the opening price on the day of the *WSJ* story with the previous day's closing price indicates that these stories may substantially affect prices, notably for stories expressing bearish sentiment. Interestly, these price effects are short-lived (hence the term "micro") as they reverse over the same trading day, and trading rules may possibly be designed that profitably exploit these anticipated reversals. Additional tests indicate that the magnitude of the opening price change is positively

[1] Typically, two or three writers jointly prepare each day's article with the by-line going to the writer responsible for the introductory paragraphs. Based on the day's trading activity and market interest, the article's format and commodities to be included are typically agreed upon between 2:00 to 2:30 PM as markets begin closing. The completed version of the article is sent to an editor around 4:30 PM who then prepares a headline.

[2] Any economy in which agents are rational and have perfect recall of past prices is weak-form efficient in the sense used here. This definition of efficiency does not imply that conditioning on current prices yields the same expectations of future prices as conditioning on both past and current prices [see Beaver (1980)].

related to trading volume. Taken together, these results may be viewed as providing support for the fad or investor sentiment/limited arbitrage hypothesis of Shleifer and Summers (1990). These authors argue that noise trading causes prices to deviate from fundamental values and that these deviations are corrected by the subsequent arbitrage activities of sophisticated investors. Shleifer and Summers further argue that since arbitrage is costly, prices will not instantaneously realign with fundamental values. In their paradigm, the degree of misalignment and persistence should be proportional to the cost of arbitrage. Because, as in the analysis presented here, arbitrage against bearish noise traders in futures markets involves initiating a short position in the underlying spot commodity, arbitrage subsequent to bearish stories is more costly.[3] Therefore, larger price impacts following bearish stories are consistent with the investor sentiment/limited arbitrage hypothesis.

The remainder of the article is organized as follows: It reviews theories and tests of asset price anomalies and discusses the applicability of these tests to futures markets; describes the test used in this article and delineates alternative hypotheses; describes the data; and presents and interprets the results in light of these alternative hypotheses. The final section presents some concluding remarks.

ANOMALIES IN ASSET PRICES

Competing explanations of asset-price anomalies, or market inefficiencies, can be dichotomized by their assumptions regarding investor rationality. It has been demonstrated that speculative bubbles and sunspot equilibria can exist with rational investors. On the other hand, if investors are irrational, price anomalies can be explained by the overreaction hypotheses and fads.

Rational Anomalies: Speculative Bubbles and Sunspots

Speculative Bubbles

A speculative bubble is an explosive (or persistently cumulative) deviation of an asset price from its fundamental value. The simplest speculative bubble arises in a certainty economy in which traders have a constant discount rate of r per period.[4] A rational expecta-

[3] The higher cost stems from restrictions on the use of short sale proceeds.

[4] For more general theoretical research into speculative bubbles, see Blanchard and Watson (1982).

tions equilibrium requires that the price at time t of an infinitely lived asset with a constant divided D equal the discounted value of the sum of the dividend at time $t + 1$ and the price (P_{t+1}) as follows: $P_t = [D + P_{t+1}]/(1 + r)$, which implies the following difference equation: $(1 + r)P_t - P_{t+1} = D$. The general solution to the above equation can be written as: $P_t = B(1 + r)^t + D/r$. In this solution, whenever B equals zero, the standard expression for valuing a perpetuity obtains. However, there are many other solutions consistent with rationality in which B does not equal zero, implying a bubble component of the asset price of $[B(1 + r)^t]$.[5] The formation of bubbles implies that asset prices deviate from their fundamental value D/r. This is, however, consistent with rational investors anticipating that next period's price will deviate even further from fundamental values.[6]

Empirical evidence on bubbles in asset prices is mixed. West (1987) finds strong evidence for bubbles in the U.S. stock market from the period 1871–1982. Flood, Hodrick, and Kaplan (1986), however, argue that test misspecification may lead to rejecting the null hypothesis of the non-existence of bubbles. Dezhbakhsh and Demirguc-Kunt (1990) employ a procedure that they argue has less misspecification error and find, contrary to West, no support for the existence of bubbles. On the other hand, according to Camerer (1989), the findings by Lo and MacKinlay (1988) of positive autocorrelation in weekly stock returns, and Dusak (1973) and Fama (1976) of kurtosis in futures (wheat, corn, and soybeans) and stock price distributions, respectively, indirectly suggest the existence of bubbles.[7]

Sunspots

Contrary to the belief that random events which do not affect fundamental values should not affect asset prices, Cass and Shell (1983) derive conditions under which random events (sunspots),

[5] Note that the non negativity of asset prices requires that B also be non negative.

[6] This analysis, of course, requires the asset life to be infinite because, for a finite-lived asset, the price at the terminal date must equal its fundamental value and, thus, an investor holding the asset on the next to-last date would expect to earn a capital loss which is inconsistent with rationality. Allen and Gorton (1988) describe an economy in which finite bubbles may exist by showing how the backward induction argument may be ruled out if agents are uncertain of whether any other traders are left after their purchase of the asset.

[7] Bubble phenomena have also been examined in the experimental economics literature. See, for example, Smith, Suchanek, and Williams (1988). In this literature, the experienced trader may be viewed akin to the sophisticated arbitrager used here.

completely unrelated to fundamentals, affect asset prices. They show that when multiple equilibria exist in a certainty-exchange economy, the introduction of a sunspot can lead to equilibria in a "now-stochastic" economy in which the choice between two of the equilibria in the certainty economy is determined by the realization of the sunspot. This occurs because agents conjecture that the sunspot will affect the equilibrium demands for goods and, thus, their equilibrium prices. This effect of sunspots on prices, in turn, affects each agent's own demand, and if all agents hold conjectures of this type, the conjectures will be self-fulfilling. The first implication of this theory is that events irrelevant to market fundamentals can affect asset prices. Second, because the sunspot framework assumes rational agents and no transaction costs, the introduction of a sunspot does not generate an arbitrage opportunity.

Irrational Anomalies: Overreaction and Fads

Overreaction Hypothesis

Several researchers have attempted to explain anomalies in asset prices by relaxing the rationality assumption. Rational investors are assumed to revise their beliefs in the presence of new information using Bayes rule. Using evidence from cognitive psychology, DeBondt and Thaler (1985) argue that, in fact, individuals tend to overadjust their posterior beliefs to new information more than is warranted by Bayes rule. Thus, when investors observe favorable (unfavorable) information affecting an asset's return, they revise upward (downward) their return expectations more (less) than is justified. The overreaction hypothesis suggests that, on average, assets which have performed poorly (well) in one period will earn abnormally high (low) returns in the subsequent period. Thus, contrarian strategies of purchasing losers and selling winners should earn abnormal returns.

DeBondt and Thaler (1985, 1987) investigate the returns from using such strategies and document overreaction in monthly stock returns. Zarowin (1990), however, reexamines the DeBondt and Thaler results and, after controlling for firm size, finds little support for the overreaction hypothesis. Further, Lo and MacKinlay (1990) argue that the profitability of contrarian strategies need not result from stock market overreaction because such strategies inadvertently

benefit from the presence of cross-autocorrelation in asset returns However, Lehmann (1990) designs an interesting contrarian trading rule which has expected negative profit under the null hypothesis of no overreaction. He finds that stock portfolios constructed according to his rule yield positive profits over a one-week horizon. He argues that using a short horizon reduces the need to control for changes in expected security returns attributable to time varying risk premia.[5]

Stein (1989) examines changes in the implied volatility of S&P 100 index options. Because implied volatilities should be mean-reverting, the implied volatilities of longer maturity options should be less elastic than those of shorter maturity options. However, Stein finds that the two volatilities move similarly, suggesting overreaction in longer maturity options. French, Leftwich and Uhrig (1989) analyze the reaction corn, wheat, and soybean futures prices to United States Department of Agriculture (USDA) announcements of crop forecasts. In addition to documenting significant futures price reactions on the day of release, these authors report some evidence of overreaction as prices rebound during the following two days.

Fads

In the overreaction literature, even though the magnitude of investor response to new information may be excessive, in fact, investors are assumed to react to actual relevant information. Shiller and Perron (1985) and Summers (1986) argue that the deviation of prices from market fundamentals can be caused by changes in investor sentiment ("fads") regarding financial assets. In this framework, the deviations may be completely unrelated to information affecting fundamentals. The existence of such fads has been investigated by conducting variance bounds tests on stock returns [see Camerer (1989) for a review]. For example, Shiller (1981) finds that stock prices are more volatile than can be explained by changes in dividends. However, Kleidon (1986) and other authors criticize the use of variance bounds tests by arguing that either time-varying risk premia or small sample bias could explain the results.

One theoretical difficulty with fads is reconciling their existence with the presence of rational investors who may profit from the arbitrage

[5]Using short horizons is important because, as pointed out by Chan (1988), the risk premia on winners and losers are not constant.

opportunities that fads present. DeLong, Shleifer, Summers, and Waldman (1989), hereafter referred to as DSSW, derive conditions under which the arbitrage activities of rational investors do no completely eliminate the effect of the sentiments of irrational investors on asset prices. Arbitrage against irrational investors (noise traders) is risky if their unpredictable mood swings can drive prices even further from fundamental values. Risk averse arbitragers will thus limit the size of their positions to offset the noise traders' positions. Shleifer and Summers (1990) propose a theory of investor sentiment and limited arbitrage to explain asset prices. In contrast to the efficient market theory, they argue that investor sentiment does affect the behavior of some traders. Although sophisticated traders can earn arbitrage profits by taking advantage of noise traders, the arbitrage activity is limited and thus cannot instantaneously realign prices with fundamental values. Shleifer and Vishny (1990) show that the theory of investor sentiment and limited arbitrage implies that short horizon assets will be less mispriced than long horizon assets, as arbitragers will equate the expected rate of return from arbitrage per unit of time across all securities.

Testing Futures Markets for Price Anomalies

Perhaps the most important objection to tests of asset-price anomalies is that the tests fail to distinguish between price changes caused by deviations from fundamental values and those caused by changes in required return. Kleidon (1988) points out that only under the most restrictive assumptions will consumption-based asset pricing models yield risk premia which are constant over time. Time-varying risk premia cause asset prices to vary even in the absence of new information regarding fundamental values. As indicated in Lehmann (1990), the problem of dealing with time-varying risk premia is substantially reduced by designing trading rule tests with short time horizons. For a given time horizon, the bias in the test caused by time-varying returns is a function of the degree to which asset prices in the market reflect risk premia. Several studies, for example, those by Dusak (1973), Bodie and Rosansky (1980), and Fama and French (1987) indicate that many futures contracts exhibit little or no premia. Thus, tests of asset price anomalies in futures markets are less subject to biases caused by time-varying risk premia. Furthermore, since futures positions require no net investment, as they are secured through a system of margins or performance

bonds, there should be no premia simply for the passage of time. Therefore, in an efficient market, trading rules based on futures positions held over short time horizons should generate near zero expected returns.

A common problem with trading rule tests is the inability to control for institutional frictions which hinder the formation of zero net investment arbitrage portfolios. Among these are the presence of short sale restrictions on stock trading such as uptick rules, availability of loanable shares and problems with the availability of proceeds [see Modest and Sundaresan (1983)], and transactions that induce spurious correlations simply because of order flow [see Roll (1984)]. Short selling difficulties, however, should not be a factor in tests of futures prices, as short positions in these contracts are generally not restricted and the markets do no have uptick rules. Furthermore, transaction costs are relatively low and by restricting attention to contracts with nearby maturities, since they have the highest liquidity and lowest bid–ask spreads (often one "tick," the minimum permissible price fluctuation), minimizes the problems of liquidity and spurious correlation induced by order flow.

A TEST FOR FADS IN FUTURES MARKETS

An inherent difficulty with tests of price anomalies is the inability to distinguish between competing models of irrationality. For example, profits from contrarian arbitrage portfolios could stem from market overreaction [DeBondt and Thaler (1985)] or from trading against sentiments of noise traders [DSSW (1989)]. Regardless of one's view of market efficiency, information regarding the past price history of an asset is not "new" information. Therefore, even if investors overreact to new information, the reporting of past price information should not lead to any revision in posteriors. However, if some investors are motivated by sentiment, then the report of previously known information, particularly by a highly reputable source, may affect these investors' investment decisions. If arbitrage by sophisticated traders is imperfect, these changes in noise trader demands will affect prices. Hence, if the investor sentiment/limited arbitrage paradigm is correct, reports of this sort should generate anomalous price behavior.

With the general exception of Mondays the "commodities page" of the *Wall Street Journal* (WSJ) typically features a lead article describing

the previous day's trading activity in a particular commodity market.[9] The headline of this lead article usually focuses on a single commodity or a related group of commodities that experienced an abnormal level of trading interest the previous day. Examples of headlines are:

> "Price of Cocoa Rises After Producers, Consumers Agree on Plan for Surplus" [*WSJ*, January 19, 1988, p. 56], or
>
> "Copper Prices Plunge 7.1 Cents to Close Below $1 A Pound for First Time in 1988" [*WSJ*, January 28, 1988, p. 36].

Such headlines do not convey any information that is not already impounded in the futures settlement price of the previous day. In terms of the vast literature on the response of market prices to new information, these reports contain new information. Thus, in analyzing this non-information, this study is distinctly different from studies exploring the reaction of securities prices to new information. It seeks to determined whether market prices respond to the stories in the *WSJ* columns, even though they convey no new information. Note that the *WSJ* is circulated prior to the start of trading on the publication date and, thus, the "information" in these headlines can be assumed to be a part of the trader's information set prior to trading.

These headlines can be categorized into two groups: those expressing bullish sentiment in that they report price increases or factors related to price increases, and those of a bearish sentiment which report price declines or factors related to price decreases.[10] This categorization permits testing of the four competing price anomaly hypotheses: (a) the efficient market hypothesis, (b) the sunspot hypothesis, (c) the overreaction hypothesis, and (d) the investor sentiment/limited arbitrage (fad) hypothesis.[11]

To distinguish among the competing hypotheses, consider each contract's price movement over the two-day time interval consisting of the day of the headline release and the prior business day. Let t denote the day of the WSJ release, $t - 1$ denote the prior business day, and $O(t)$

[9]While there are a few Monday observations in the sample, the majority of Monday articles discuss issues of educational interest or of impending developments as opposed to providing a market report of the previous trading day's activities. Because of this policy, this study does not explore such issues as the weekend effect.

[10]Those headlines which can not be classified as bullish or bearish are not considered.

[11]As noted previously, the speculative bubble hypothesis should not apply to futures market testing because of the finite life of the contracts.

and $C(t)$ denote the opening and closing contract price, respectively, on day t. Then the competing hypotheses can be stated as follows:

(a) *Efficient Market Hypothesis*

Under this hypothesis the headline should have no impact on subsequent prices. Therefore,

$$E[O(t) - C(t-1)|\text{bull}] = 0 \quad \text{and} \quad E[O(t) - C(t)|\text{bull}] = 0, \quad \text{and} \quad \text{(i)}$$

$$E[O(t) - C(t-1)|\text{bear}] = 0 \quad \text{and} \quad E[O(t) - C(t)|\text{bear}] = 0^{12} \quad \text{(ii)}$$

(b) *Sunspot Hypothesis*

If the *WSJ* headline is interpreted as a sunspot, then prices should adjust to new equilibrium levels. Assuming that bullish headlines cause positive shifts in equilibrium prices and bearish headlines cause negative shifts, then

$$E[O(t) - C(t-1)|\text{bull}] > 0 \quad \text{and} \quad E[O(t) - C(t)|\text{bull}] = 0, \text{ and} \quad \text{(i)}$$

$$E[O(t) - C(t-1)|\text{bear}] < 0 \quad \text{and} \quad E[O(t) - C(t)|\text{bear}] = 0 \quad \text{(ii)}$$

The expression $E[O(t) - C(t)|\text{bull (or bear)}] = 0$ in each instance because no arbitrage opportunities would be expected to develop.

(c) *Overreaction Hypothesis*

Note that during the business day preceding the publication of the headline, there is typically a significant price movement in the referenced commodity. If this price movement impounded a market overreaction, then the closing price on day $t - 1$ should be greater (less) than the expected price on day t in the case of a bullish (bearish)

[12] To see this, let $\mathbf{I}_t$ denote the information available at time t. Also, let $\mathbf{I}_{bull}$ be the indicator function for the appearance of a bullish headline. Next, note that $E[O(t) - C(t-1)|\text{bull}] = E[O(t) - C(t-1)|\mathbf{I}_{bull}] = \text{Probbull}$. Thus, the sign of this expression is equal to the sign of $E[O(t) - C(t-1)|\mathbf{I}_{bull}]$. This study assumes that the occurrence of a bullish headline is determined by the market conditions at time $t - 1$ and random factors introduced by the selection process at the *WSJ*. Hence, one can express $\mathbf{I}_{bull}$ as $\mathbf{I}_{bull} = \mathbf{I}_P\mathbf{I}_R$ where $\mathbf{I}_P$ is a $\mathbf{I}_{t-1}$ random variable representing the price history of the contract up to the close on date $t - 1$ and $\mathbf{I}_R$ is a random variable which is conditionally independent of $\mathbf{I}_P$ given $\mathbf{I}_{t-1}$, representing the random component to the headline selection. Letting $Y(t) = O(t) - C(t-1)$, then $E[\mathbf{I}_{bull}Y(t)] = E[\mathbf{I}_P\mathbf{I}_RY(t)] = E[E[\mathbf{I}_P\mathbf{I}_RY(t)|\mathbf{I}_{t-1}]] = E[\mathbf{I}_PE[\mathbf{I}_RE[\mathbf{I}_PY(t)|\mathbf{I}_{t-1}]|\mathbf{I}_{t-1}]] = E[\mathbf{I}_PE[\mathbf{I}_P|\mathbf{I}_{t-1}]E[Y(t)|\mathbf{I}_{t-1}]] = 0$. The first equality follows from the definition of $\mathbf{I}_{bull}$, the second equality follows from the law of iterated expectations, the third follows from the fact that $\mathbf{I}_P$ is $\mathbf{I}_{t-1}$-measurable, the fourth follows from the conditional independence of $\mathbf{I}_R$ and the fifth follows because the martingale hypothesis implies that $E[Y(t)|\mathbf{I}_{t-1}] = 0$. Similar formal derivations can be developed for bearish headlines and the price change measured from the open to close.

headline. Hence,

$$E[O(t) - C(t-1)|\text{bull}] < 0, \text{ and} \quad \text{(i)}$$

$$E[O(t) - C(t-1)|\text{bear}] > 0 \quad \text{(ii)}$$

(d) *Fad Hypothesis*

Under this hypothesis, the headline temporarily shifts investor sentiment. In the case of a bullish (bearish) headline, this should cause expected prices at the open to rise (fall) from the prior day's close. Following this rise, prices should fall (rise) to their fundamental values, either because of a reversion in investor sentiment or due to arbitrage activity by sophisticated traders. Thus,

$$E[O(t) - C(t-1)|\text{bull}] > 0 \quad \text{and} \quad E[C(t) - C(t-1)|\text{bull}] = 0, \text{ and} \quad \text{(i)}$$

$$E[O(t) - C(t-1)|\text{bear}] < 0 \quad \text{and} \quad E[C(t) - C(t-1)|\text{bear}] = 0. \quad \text{(ii)}$$

Because the fad hypothesis requires that both the sentiment of noise traders and the arbitrage activities of rational traders affect the equilibrium asset price, the theory also makes predictions regarding the magnitude of the price change and trading volume. Trading volume generated by noise traders will cause prices to deviate from fundamental values. In addition, the misalignment of prices caused by noise trading should increase the amount of arbitrage activities by sophisticated traders. Hence, the price change may cause an increase in volume. However, despite the fact that the direction of causation between the price change and volume is indeterminate, there should be a positive empirical relationship between the magnitude of the price change and volume.[13]

DATA DESCRIPTION

For the ten-year period January 1979 through December 1988, each commodity page headline from the *WSJ* is recorded. Headlines pertaining to contracts which experienced a limit move the previous day are eliminated from the sample because the previous day's futures settlement price would not be an equilibrium price, as it would not have fully impounded all relevant information. In addition, those dates on which the headline referred to price movements expected to occur on

[13] For further discussion of the price–volume relationship, see French and Roll (1986).

the publication day are eliminated. For example, if a headline refers to the expected response of futures prices to the pending or actual release of an important announcement such as a key government crop report, it is eliminated. Headlines are then classified according to whether they reflected bearish or bullish sentiment.[14]

Table I summarizes the number of headlines used in the analysis classified by contract and bearish or bullish sentiment. The sample consists of 1591 headlines, of which 747 (47%) are classified as bearish and 844 (53%) as bullish.[15] To facilitate the reporting of results, homogeneous commodities are categorized into eight traditional groups: foodstuffs and softs, grains and oilseeds, livestock, precious metals, industrial metals, energy products, financials, and foreign exchange.[16]

For the commodity featured in the headline, data on opening and closing prices, volume, and open interest are collected for a four-day window (days $t - 2$, $t - 1$, t and $t + 1$) surrounding the date of the *WSJ* publication (day t). Data are from the Dunn and Hargitt commodity price tapes. For each observation, the data are taken for the nearby maturing contract except when the *WSJ* publication date falls in the month of maturity, in which case the next maturity month is chosen.

To verify that the *WSJ* headlines accurately reflect trading in contracts that experienced a high level of trading interest, the changes in the futures price, volume, and open interest on the business day prior to publication are computed. These changes are measured as the natural log of the ratio of the variable's value on day $t - 1$ divided by the ending value on day $t - 2$.[17] These values are reported in Table II. The average price change for all bearish stories is -1.84% and for all bullish stories is 1.87%. Furthermore, each commodity group has significantly negative price changes preceding bearish headlines and

[14]Some stories do not refer to a particular contract, but to a general group. In these instances a list of "default" contracts is selected beforehand. For example, if the headline states that grain futures prices rose, the wheat contract is selected as the default contract. The other default contracts selected are: the live cattle contract to represent cattle futures, crude oil for oil futures, gold for precious metal futures, T-bond for interest rate futures, S&P 500 for index futures, and the Swiss Franc for currency futures.

[15]Since only one story occurs on any given day in the ten-year period, and since each story generally pertains to only a single commodity, the data sample does not exhibit any clustering of data points around a single calendar date or a single event that can lead to a diminution in the true degrees of freedom available in the analysis.

[16]In October 1988, the *WSJ* commodity page experienced a change in format whereby reports of trading activity for foreign exchange and financial futures were moved to other pages. Thus, during the last three months of the period of investigation, no observations pertain to these contracts.

[17]This is done to facilitate comparison across contracts and dates in a standardized manner.

TABLE I

WSJ Commodity News Story Headlines Classified by Commodity according to Bearish/Bullish Sentiment for the Period 1979–1988.

Commodity	*Total*	*Bearish Stories*	*Bullish Stories*
Foodstuffs and Softs			
Cocoa	57	27	30
Coffee	81	30	51
Cotton	30	15	15
Orange juice	37	13	24
Sugar	69	33	36
Lumber	11	5	6
Total	285	123	162
Grains and Oilseeds			
Corn	61	26	35
Wheat	128	65	63
Oats	1	0	1
Soybeans	127	64	63
Soyoil	3	0	3
Total	320	155	165
Livestock			
Live cattle	120	65	55
Feeder cattle	2	0	2
Live hogs	47	28	19
Pork bellies	15	3	12
Total	184	96	88
Precious Metals			
Gold	136	73	63
Silver	50	21	29
Platinum	23	5	18
Total	209	99	110
Industrial Metals			
Copper	114	50	64
Energy Products			
Crude oil	176	84	92
Heating oil	51	22	29
Total	227	106	121
Financials			
Treasury bond	120	62	58
Treasury bill	8	2	6
S&P 500	62	23	39
Total	190	87	103
Foreign Exchange			
British pound	6	3	3
Deutsche mark	3	2	1
Japanese yen	3	0	3
Swiss franc	50	26	24
Total	62	31	31
All Contracts	1591	747	844

TABLE II

Percentage Change in Price, Volume, and Open Interest of Futures Contracts on Day Preceding their Appearance as Subject of *WSJ* Commodity Page Headlines: 1979–1988 (*t*-Values in Parentheses)

	(a) *Bearish Stories*			(b) *Bullish Stories*		
Commodity Group	*Price*	*Volume*	*Open Interest*	*Price*	*Volume*	*Open Interest*
Foodstuffs and softs	−3.12 (−11.99)[a]	8.12 (1.53)	−5.77 (−6.06)[a]	2.72 (15.45)[a]	14.33 (2.61)[a]	−3.17 (−3.52)[a]
Grains and oilseeds	−1.48 (−16.27)[a]	9.82 (2.58)[a]	−0.98 (−0.23)	1.73 (16.39)[a]	17.08 (5.01)[a]	−1.66 (−0.60)
Livestock	−1.33 (−10.76)[a]	20.46 (3.75)[a]	−1.53 (−3.92)[a]	1.15 (10.71)[a]	18.49 (3.15)[a]	−1.10 (−2.14)[b]
Precious metals	−1.70 (−9.45)[a]	20.42 (2.78)[a]	−2.67 (−3.34)[a]	1.96 (10.89)[a]	12.23 (2.14)[b]	−1.89 (−2.41)[b]
Industrial metals	−2.50 (−9.40)[a]	12.70 (2.43)[b]	−4.07 (−5.15)[a]	2.54 (12.11)[a]	6.73 (9.53)[a]	−3.19 (−2.58)[a]
Energy products	−2.06 (−9.43)[a]	23.29 (5.37)[a]	−0.14 (−0.21)	1.96 (12.88)[a]	13.25 (3.43)[a]	−1.22 (−0.58)
Financials	−1.00 (−10.39)[a]	13.85 (3.37)[a]	−4.26 (−1.47)	1.02 (13.07)[a]	21.71 (5.16)[a]	−1.22 (−3.01)[a]
Foreign exchange	−1.03 (−7.11)[a]	20.48 (2.55)[b]	−1.63 (−1.20)	1.14 (9.44)[a]	1.03 (−0.24)	−1.57 (−1.80)[c]
All contracts	−1.84 (−25.82)[a]	15.34 (8.00)[a]	−0.07 (−5.04)[a]	1.87 (31.88)[a]	14.62 (7.96)[a]	−1.24 (−1.88)[c]

Note: The *WSJ* news story is released on day 0. The computed changes are measured as 100 times the natural log of the variable on day 1 − 1 divided by the variable on day 1 − 2.

[a]Significant at the 0.01 level in a two-tailed test.

[b]Significant at the 0.05 level in a two-tailed test.

[c]Significant at the 0.10 level in a two-tailed test.

significantly positive price changes preceding bullish headlines. The group "foodstuffs and softs" experiences the largest changes for both bearish and bullish stories (−3.12% and 2.72%, respectively) while the financial and foreign exchange groups change least (approximately −1% and 1% each, respectively).

With the exception of bearish stories for foodstuffs and softs and bullish stories for foreign exchange, the change in volume on these dates is significantly positive for all commodity groups. On the other hand, there is little discernible pattern in the change in open interest on a disaggregated basis. The average change in open interest across all contracts, however, is negative.

EMPIRICAL RESULTS

Price Effects

Table III presents the price movements of the futures contracts on the publication date of the *WSJ* headlines.[18] The price changes for bearish stories are reported in panel (a). For all commodity groups, the change in price from the close on day $t - 1$ to the open on day t (measured as $\ln[O(t)/C(t-1)]$) is negative, and is significant at least at the 5% level in four of the eight groups: foodstuffs and softs, livestock, precious metals, and energy products.[19] The average price change across all contracts is significantly negative at the 1% level. To put these opening price changes into a relative perspective, the price change is also measured in ticks. For bearish stories, the average opening price change for all contracts is 9.88 ticks.[20]

Next, the price change from the open to the close on the publication date for bearish stories is investigated. This change is positive for all groups and is significantly positive for five groups. Also, the average price change across all contracts is significantly positive at the 1% level. Furthermore, this average price reversal from open to close is 10.83 ticks for all contracts. The combined price change measured from the close on day $t - 1$ to the close on day t (reported in the third column) is insignificant for six of the eight groups suggesting that prices revert to fundamental values by the end of the day. Taken together, these price changes for days of bearish headlines support the investor sentiment/limited arbitrage hypothesis. Under this hypothesis, prices initially would be driven down because of the sentiment of noise traders and then revert because of arbitrage by sophisticated traders. Furthermore, these price changes cannot be explained by any of the other hypotheses discussed in the third section of this article.

The results for bullish headlines are reported in panel (b). On the whole, the results are weaker than those found for bearish headlines.

[18] Since the methodology employed produces at most one observation per date, problems associated with clustering of multiple observations on the same date are avoided.

[19] Two-tailed significance tests are conducted because of the nature of the competing hypotheses.

[20] This price change is considerably greater than estimated bid–ask spreads reported in several studies of futures prices. Ma, Peterson, and Sears (1992) estimate implicit bid–ask spreads for the T-bond, silver, soybeans and corn futures contracts and report a maximum estimated bid–ask spread during any 30-minute trading interval of 1.3 ticks. Jordan, Seale, Dinehart, and Kenyon (1989) report an average serial covariance in soybeans during the first hour of trading which, using Roll's (1984) method, implies a bid–ask spread of approximately 1 tick. Also, Harvey and Huang (1991) report bid–ask spreads of 1 tick in foreign exchange futures.

TABLE III

Futures Price Reaction (%) Following Release of Bearish/Bullish *WSJ* Commodity News Stories: 1979–1988 (*t*-Values in Parentheses)

	(a) Bearish Stories			(b) Bullish Stories		
Commodity Group	*Close (t − 1) to Open (t)*	*Open (t) to Close (t)*	*Close (t − 1) to Close (t)*	*Close (t − 1) to Open (t)*	*Open (t) to Close (t)*	*Close (t − 1) to Close (t)*
Foodstuffs and softs	0.38 (−3.00)[a]	0.43 (2.19)[c]	0.05 (0.25)	0.23 (1.49)	0.09 (−0.58)	0.14 (0.66)
Grains and oilseeds	0.03 (−0.59)	0.09 (0.94)	0.06 (0.59)	0.03 (0.47)	0.12 (−1.17)	0.09 (−0.74)
Livestock	0.19 (−2.35)[c]	0.15 (1.32)	0.04 (−0.28)	0.00 (0.00)	0.13 (−1.02)	0.13 (−0.96)
Precious metals	0.30 (−2.17)[c]	0.48 (4.38)[a]	0.18 (1.16)	0.14 (0.95)	0.11 (0.85)	0.25 (1.31)
Industrial metals	0.25 (1.41)	0.45 (2.03)[c]	0.70 (2.51)[c]	0.10 (0.69)	0.03 (0.13)	0.13 (0.58)
Energy products	0.36 (−2.71)[a]	0.47 (2.26)[c]	0.11 (0.48)	0.26 (2.36)[c]	0.12 (0.78)	0.38 (2.31)[c]
Financials	0.02 (−0.41)	0.04 (0.46)	0.02 (0.20)	0.06 (1.33)	0.06 (−0.72)	0.00 (0.07)
Foreign exchange	0.04 (−0.49)	0.32 (2.24)[c]	0.28 (1.68)[b]	0.01 (−0.09)	0.08 (−0.62)	0.09 (−0.45)
All contracts	0.17 (−4.36)[a]	0.29 (5.15)[a]	0.12 (1.84)[b]	0.12 (2.76)[a]	0.03 (−0.58)	0.09 (1.40)

Note: The *WSJ* news story is released on day *t*. The close (*t* − 1) to open (*t*) change is measured as 100 times the natural log of the opening futures price on day *t* divided by the futures settlement price on day *t* − 1, 100 (ln[Open *t*/Close (*t* − 1)]). Similarly, the open (*t*) to close (*t*) change is measured by 100 (ln[Close *t*/Open *t*]), and the close (*t* − 1) to close (*t*) change is measured by 100 (ln[Close *t*/Close (*t* − 1)]).

[a]Significant at the 0.01 level in a two-tailed test.

[c]Significant at the 0.05 level in a two-tailed test.

[b]Significant at the 0.10 level in a two-tailed test.

Although the average price change across all groups measured from the close on day $t-1$ to the open on day t is significantly positive, it is significant only for one group: energy products. Furthermore, there appears to be no pattern or significance in the subsequent price movement over the open to close interval. On the whole, these findings for bullish stories do not provide sufficient evidence to reject the efficient market hypothesis.

The difference in results for bearish and bullish headlines is somewhat puzzling. A possible explanation is that arbitrage is more difficult when the futures price is below its equilibrium value. In this instance the arbitrage strategy, taking a long futures position and a short position in the underlying commodity, entails greater risk owing to

delivery concerns such as quality and locational differences, and can be more expensive since markets for short positions in many commodities feature high transaction costs. Thus, arbitrage against bearish noise traders will be more costly than arbitrage against bullish noise traders. This would imply that prices subsequent to bearish headlines would deviate more from fundamentals and experience larger reversals than those subsequent to bullish stories.

Next, the relationship between the price change on the open and the subsequent reversal is investigated by regressing the open to close change on day t on the opening price change. Specifically, the following regression is estimated:

$$\mathrm{LN}\left(\frac{C(t)}{O(t)}\right) = \alpha + \beta \mathrm{LN}\left(\frac{O(t)}{C(t-1)}\right) + \epsilon$$

The results for these regressions for each commodity groups as well as for all contracts together are presented in Table IV. For the bearish results reported in panel (a), the β coefficients are negative for six of the eight groups. In addition, the beta for all contracts together is significantly negative at the 1% level. However, only two of the commodity groups, foodstuffs and softs and energy products, have a significantly negative beta. Overall, the evidence provides some support for the hypothesis that the magnitude of the reversal is positively related to the size of the mispricing on the open. Some evidence to support this hypothesis can be found in the bullish results presented in panel (b), notably for energy products, whose beta is significant at the 1% level and for livestock, with a beta significant at the 10% level. However, consistent with the earlier results for bullish stories, the regression results are generally inconclusive.

Trading Rule Tests

To investigate whether arbitrage profits are possible to sophisticated traders, simple trading rule tests are conducted in which a long (short) futures position is taken following the appearance of bearish (bullish) headlines. Positions are selectively entered whenever it appears a faddish price change is impounded in the opening price. Specifically, positions are entered when the opening price moves specific amounts (or screen sizes) from the previous day's closing price. For a bearish (bullish) story, a limit order to buy (sell) at the open is placed at different number of ticks or price increments below (above) the previous day's closing price. The position is held for the trading day and is reversed with a market

TABLE IV

Regression Results for Tests for Price Reversion Following Release of Bearish/Bullish *WSJ* Commodity News Stories: 1979–1988 (*t*-Values in Parentheses)

Commodity Group	(a) Bearish Stories				(b) Bullish Stories			
	Obs.	α	β	R^2	*Obs.*	α	β	R^2
Foodstuffs and softs	122	0.002 (1.03)	−0.430 (−3.26)[b]	0.081	161	0.001 (0.83)	0.031 (0.41)	0.001
Grains and oilseeds	153	0.001 (1.08)	−0.250 (−1.42)	0.013	163	0.001 (1.08)	−0.051 (−0.40)	0.001
Livestock	96	0.002 (1.59)	−0.167 (−1.31)	0.018	87	0.001 (0.96)	−0.309 (−1.68)[c]	0.032
Precious metals	97	0.005 (3.91)[a]	−0.130 (−1.58)	0.026	110	0.001 (0.89)	−0.041 (−0.48)	0.002
Industrial metals	49	0.004 (1.79)[c]	−0.025 (−0.14)	0.000	63	0.001 (0.25)	−0.257 (−1.39)	0.031
Energy products	102	0.004 (1.84)[c]	−0.312 (−2.06)[b]	0.041	119	0.002 (1.46)	−0.334 (−2.66)[a]	0.057
Financials	82	0.000 (0.50)	−0.027 (−0.14)	0.000	103	0.001 (0.62)	−0.131 (−0.71)	0.005
Foreign exchange	31	0.003 (2.18)[b]	−0.042 (−0.14)	0.001	31	0.001 (0.60)	−0.121 (−0.71)	0.017
All contracts	732	0.002 (4.40)[a]	−0.215 (−4.20)[a]	0.024	837	0.000 (0.45)	−0.058 (−1.44)	0.003

Note: The estimated regression model is

$$R_t = \frac{Cl_t - Op_t}{Op_t} = \alpha + \beta \left(\frac{Op_t}{Cl_{t-1}} - 1 \right) + \varepsilon_t$$

where Cl_t and Op_t are closing and opening prices on the day the news story appeared in the *WSJ*, and Cl_{t-1} is the closing price of the previous day.

[a]Significant at the 0.01 level in a two-tailed test.

[b]Significant at the 0.05 level in a two-tailed test.

[c]Significant at the 0.10 level in a two-tailed test.

on close order to sell (buy). To illustrate, consider a bearish story and a predetermined screen size of five ticks. In this case, a limit order to buy at the open would be placed at a price five ticks below the previous day's close. Thus, the order is assumed to be executed if the opening price is five ticks or more below the previous day's close. If the order is executed, then the position is reversed with a market on close order to sell.

Following each news story the above trading strategy is implemented for screen sizes ranging from 1–10 ticks. The profits from trading is measured both in dollars and in the number of ticks. The latter profitability measure is useful for comparing the trading profit with potential

transaction costs related to trading at the open or close.[21] The results for tick sizes of 1, 5, and 10 are presented in panel (a) of Table V for bearish stories. At the 1-tick screen size, the average profit is $100 per roundtrip or 13.5 ticks. In addition, the average trading profit is positive for each of the eight groups and is significantly positive for precious metals and energy products. Generally speaking, for higher screen sizes, the average profit measured in dollars and ticks increases. For screen size of 5 ticks, the average profit is $114 or 15.7 ticks, and for the 10-tick screen the profit is $140 or 19.1 ticks. Given typical clearing fees of approximately $1, available retail roundtrip commissions for day-trades of approximately $30, and bid–ask spreads of often 1 or 2 ticks, these profits appear to be economically significant for both retail traders, as well as seatholders and other low-cost traders. While the trading profits for the bullish stories reported in panel (b) of Table V are generally positive, they are not significant. This finding is consistent with the previous results regarding the price effects for bullish stories.

Volume Effects

As discussed earlier, the investor sentiment/limited arbitrage hypothesis predicts that a positive relationship should exist between the magnitude of the price change and trading volume. To investigate this conjecture, the opening price change is regressed on volume as follows.[22]

$$LN\left(\frac{O(t)}{C(t-1)}\right) = \alpha + \beta LN\left(\frac{V(t)}{V(t-2)}\right) + \epsilon$$

The results from these regressions are presented in Table VI. For bearish stories in panel (a) the β coefficient is significantly negative at the 1% level for all contracts and is significantly negative in two of the groups. Recall that the opening price change for bearish stories is typically negative, implying a positive increase in volume. For the bullish stories reported in panel (b), the β coefficient is significantly positive at the 1% level. These results corroborate the relationship predicted by the fad hypothesis.

[21] Since both opening and closing or settlement futures prices are composite prices taken from the range of prices observed during the beginning and ending moments of trading, respectively, the actual price at which an order is filled could differ from the reported price.

[22] In the following regression model, volume on day t is normalized with respect to volume on day $t-2$ because, as shown in Table II, there is an abnormal increase in volume on day $t-1$.

TABLE V

Trading Rule Profits from Positions Initiated Subsequent to *WSJ* Commodity News Stories for Various Tick Screen Sizes over the Period 1979–1988 (*t*-Values in Parentheses)

	Bearish Stories									*Bullish Stories*								
	One Tick Screen			*Five Tick Screen*			*Ten Tick Screen*			*One Tick Screen*			*Five Tick Screen*			*Ten Tick Screen*		
Commodity Groups	*Obs.*	*SProf*	*Ticks*	*Obs.*	*SProf*	*Ticks*	*Obs.*	*SProf*	*Ticks*	*Obs.*	*SProf*	*Ticks*	*Obs.*	*SProf*	*Ticks*	*Obs.*	*SProf*	*Ticks*
Foodstuffs and softs	71	123 (1.4)	20.0 (1.2)	65	93 (1.5)	22.0 (1.2)	61	99 (1.4)	19.4 (1.2)	82	57 (0.7)	3.9 (0.9)	72	125 (1.9)[c]	22.1 (1.4)	63	139 (1.9)[c]	24.6 (1.4)
Grains and oilseeds	70	9 (0.2)	0.8 (0.2)	42	19 (0.3)	1.6 (0.3)	26	0.0 (0.0)	0.0 (0.0)	69	41 (1.0)	3.3 (0.9)	41	59 (0.9)	4.7 (0.9)	22	96 (0.9)	7.7 (0.9)
Livestock	49	42 (1.1)	4.2 (1.1)	40	33 (0.8)	3.1 (0.7)	32	43 (0.9)	4.0 (0.8)	45	54 (1.0)	5.3 (1.0)	35	45 (0.7)	4.2 (0.7)	24	70 (0.8)	6.6 (0.8)
Precious metals	46	247 (2.6)[c]	38.5 (2.2)[b]	37	263 (2.2)[b]	43.6 (2.0)[b]	31	312 (2.3)[b]	50.8 (2.0)[b]	48	18 (0.3)	−12.0 (0.9)	42	60 (+0.7)	17.0 (+1.1)	38	−83 (0.9)	20.2 (1.2)
Industrial metals	16	182 (1.5)	14.6 (1.5)	14	200 (1.7)[b]	16.0 (1.7)[b]	9	243 (1.3)	19.4 (1.3)	36	20 (0.3)	1.6 (0.3)	26	47 (0.5)	3.7 (0.5)	20	8 (0.1)	0.7 (0.1)
Energy products	55	123 (2.3)[c]	15.7 (2.0)[c]	48	132 (2.2)[b]	17.1 (1.9)[c]	41	137 (2.0)[c]	18.3 (1.8)[c]	65	6 (0.1)	5.0 (0.5)	57	0 (0.0)	5.0 (0.4)	46	24 (0.4)	−8.7 (−0.6)
Financials	36	13 (0.1)	1.2 (0.3)	22	54 (0.3)	2.8 (0.4)	14	101 (0.4)	4.9 (0.5)	52	108 (1.2)	3.9 (1.1)	40	65 (0.6)	2.2 (0.5)	23	87 (0.7)	3.4 (0.7)
Foreign exchange	14	184 (1.5)	14.8 (1.5)	11	204 (1.4)	16.3 (1.4)	8	278 (1.4)	22.3 (1.4)	10	10 (0.1)	0.8 (0.1)	9	−44 (−0.4)	3.6 (+0.4)	9	−44 (0.4)	3.6 (0.4)
All contracts	357	100 (3.5)[c]	13.5 (3.1)[c]	279	114 (3.3)[c]	15.7 (2.9)[c]	222	140 (3.3)[c]	19.1 (2.8)[c]	407	37 (1.4)	0.4 (0.1)	322	43 (1.5)	3.4 (0.7)	245	41 (1.2)	3.1 (0.5)

Note. Profits are measured in dollars and in number of trading ticks. Positions are initiated with a limit order to buy (sell) at the open for bear (bull) stories and reversed with a market on close order. Limit orders are placed below (above) the prior day's closing price by the amount of indicated screen sizes.

[a] Significant at the 0.01 level in a two-tailed test.

[b] Significant at the 0.05 level in a two-tailed test.

[c] Significant at the 0.10 level in a two-tailed test.

TABLE VI

Regression Results of the Effect of Trading Volume on the Price Change Following Release of Bearish/Bullish *WSJ* Commodity News Stories: 1979–1988 (*t*-Values in Parentheses)

Commodity Group	(a) Bearish Stories				(b) Bullish Stories			
	Obs.	α	β	R^2	*Obs.*	α	β	R^2
Foodstuffs and softs	122	0.004 (3.40)[a]	−0.005 (2.45)[b]	0.048	161	0.002 (1.14)	0.006 (2.15)[b]	0.028
Grains and oilseeds	153	0.000 (0.59)	0.002 (2.51)[b]	0.040	163	0.000 (0.22)	0.001 (0.95)	0.006
Livestock	96	0.002 (2.23)[b]	0.001 (0.28)	0.001	87	0.001 (0.16)	0.001 (0.69)	0.006
Precious metals	95	0.003 (2.22)[b]	0.002 (1.03)	0.001	109	0.001 (0.74)	0.005 (1.70)[c]	0.026
Industrial metals	48	0.002 (1.16)	0.001 (0.21)	0.001	62	0.001 (0.69)	0.002 (0.71)	0.008
Energy products	102	0.004 (2.59)[b]	0.001 (0.32)	0.001	121	0.002 (2.14)[b]	0.003 (1.44)	0.017
Financials	81	−0.000 (−0.62)	0.001 (1.46)	0.026	100	0.001 (1.25)	0.001 (0.88)	0.008
Foreign exchange	31	0.000 (0.32)	0.001 (0.38)	0.005	31	0.000 (0.26)	0.005 (1.30)	0.055
All contracts	728	0.002 (4.47)[a]	0.002 (2.86)[a]	0.011	834	0.001 (2.16)[b]	0.003 (3.17)[a]	0.012

Note: The estimated regression model is

$$\ln\left[\frac{Op_t}{Cl_{t-1}}\right] = \alpha + \beta \ln\left[\frac{Vl_t}{Vl_{t-2}}\right] + \varepsilon$$

where Op_t and Vl_t are opening price and trading volume on the day the news story appeared in the *WSJ*, and Cl_{t-1} is the closing price of the previous day, and Vl_{t-2} is the trading volume on the second day prior to day of release of the news story.

[a]Significant at the 0.01 level in a two-tailed test.

[b]Significant at the 0.05 level in a two-tailed test.

[c]Significant at the 0.10 level in a two-tailed test.

CONCLUSION

This study examines the reaction of futures prices following the appearance of news stories that report on commodities experiencing abnormal levels of trading interest during the previous trading day. Notably, the price impact is greater following headlines reflecting bearish sentiment than those of bullish sentiment. Following bearish headlines, prices fall on the open and then reverse during the trading day. Furthermore, the size of the reversal is positively related to the magnitude of the opening price change. The magnitude of the opening price change, in turn, is positively related to trading volume. Additionally, the results

indicate that trading rules may have been profitably implemented to exploit the mispricing of the contract at the open. Thus, the results may be viewed as providing support for the investor sentiment/limited arbitrage hypothesis of Shleifer and Summers (1990).

BIBLIOGRAPHY

Allen, F., and Gorton, G. (1988): "Rational Finite Bubbles," Wharton School Working Paper, forthcoming *Economic Studies*.

Beaver, W. (1980): "Information Efficiency," *Accounting Review*, 56:23–27.

Blanchard, O., and Watson, M. (1982): "Bubbles, Rational Expectations, and Financial Markets," in *Crises in the Economic and Financial Structure*, Wachtel, P. (ed.), Lexington, MA: Lexington Books.

Bodie, Z., and Rosansky, V. (1980): "Risk and Return in Commodity Futures," *Financial Analysts Journal*, 36:27–39.

Camerer, C. (1989): "Bubbles and Fads in Asset Prices: A Review of Theory and Evidence," *Journal of Economic Surveys*, 3:3–41.

Cass, D., and Shell, K. (1983): "Do Sunspots Matter?" *Journal of Political Economy*, 91:193–227.

Chan, K.C. (1988): "On the Contrarian Investment Strategy," *Journal of Business*, 61:147–163.

DeBondt, W., and Thaler, R. (1985): "Does the Stock Market Overreact?" *Journal of Finance*, 40:793–805.

DeBondt, W., and Thaler, R. (1987): "New Evidence on Investor Overreaction and Stock Market Seasonality," *Journal of Finance*, 42:557–581.

DeLong, B., Shleifer, A., Summers, L., and Waldman, R. (1989): "The Size and Incidence of the Losses from Noise Trading," *Journal of Finance*, 44:681–696.

Dezhbakhsh, H., and Demirguc-kunt, A. (1990): "On the Presence of Speculative Bubbles in Stock Prices," *Journal of Financial and Quantitative Analysis*, 25:101–112.

Dusak, (1973): "Futures Trading and Investor Returns: An Investigation of Commodity Market Risk Premiums," *Journal of Political Economy*, 81:1387–1406.

Fama, E. (1976): *Foundations of Finance*, New York: Basic Books.

Fama, E., and French, K. (1987): "Commodity Futures Prices: Some Evidence on Forecast Power, Premiums, and the Theory of Storage," *Journal of Business*, 60:55–73.

Flood, R., Hodrick, R., and Kaplan, P. (1986): "An Evaluation of Recent Evidence on Stock Market Bubbles," NBER Working Paper No. 1971.

French, K., Leftwich, R., and Uhrig, W. (1989): "The Effect of Scheduled Announcements on Futures Markets," CRSP Working Paper No. 273, University of Chicago.

French, K., and Roll, R. (1986): "Stock Return Variances: The Arrival of Information and the Reaction of Traders," *Journal of Financial Economics*, 17:6–26.

Harvey, C., and Huang, R. (1991): "Volatility in the Foreign Currency Futures Market," *Review of Financial Studies*, 4:542–569.

Jordan, J., Seale, W., Dinehart, S., and Kenyon, D. (1988): "The Intraday Variability of Soybean Futures Prices: Information and Trading Effects," *Review of Futures Markets*, 7:97–108.

Kleidon, A. (1986): "Bias in Small Sample Tests of Stock Price Rationality," *Journal of Business*, 59:237–261.

Kleidon, A. (1988): "Discussion," *Journal of Finance*, 43:656–660.

Lehmann, B. (1990): "Fads, Martingales, and Market Efficiency," *Quarterly Journal of Economics*, 105:1–28.

LeRoy, S. (1989): "Efficient Capital Markets and Martingales, *Journal of Economic Literature*, 28:1583–1621.

Lo, A., and MacKinlay, C. (1988): "Stock Market Prices Do Not Follow Random Walks: Evidence from a Simple Specification Test," *The Review of Financial Studies*, 1:41–66.

Lo, A., and MacKinlay, C. (1990): "When are Contrarian Profits Due to Stock Market Overreaction?" *Review of Financial Studies*, 3:175–205.

Ma, C., Peterson, R., and Sears, S. (1992): "Trading Noise, Adverse Selection and the Intraday Bid–Ask Spreads in Futures Markets," *The Journal of Futures Markets*, 12:519–538.

Modest, D., and Sundaresan, M. (1983): "The Relationship Between Spot and Futures Prices in Stock Index Futures Markets: Some Preliminary Evidence," *The Journal of Futures Markets*, 3:15–41.

Roll, R. (1984): "A Simple Implicit Measure of the Effective Bid–Ask Spread in an Efficient Market," *Journal of Finance*, 39:1127–1139.

Shiller, R. (1981): "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?" *American Economic Review*, 71:421–436.

Shiller, R., and Perron, P. (1985): "Testing the Random Walk Hypothesis: Power versus Frequency of Observation," *Economics Letters*, 18:381–386.

Shleifer, A., and Summers, L. (1990): "The Noise Trader Approach to Finance," *Journal of Economic Perspectives*, 4:148–153.

Shleifer, A., and Vishny, R. (1990): "Equilibrium Short Horizons of Investors and Firms," *American Economic Review*, 80:148–153.

Smith, V., Suchanek, G., and Williams, A. (1988): "Bubbles, Crashes, and Endogenous Expectations in Experimental Spot Asset Markets," *Econometrica*, 56:1119–1151.

Stein, J. (1989): "Overreactions in the Option Market," *Journal of Finance*, 44:1011–1023.

Summers, L. (1986): "Does the Stock Market Rationally Reflect Fundamental Values?" *Journal of Finance*, 41:591–601.

West, K. (1987): "A Specification Test for Speculative Bubbles," *Quarterly Journal of Economics*, 102:553–580.

Zarowin, P. (1990): "Size, Seasonality, and Stock Market Overreaction," *Journal of Financial and Quantitative Analysis*, 25:113–125.