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Overreaction in futures markets

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Overreaction in futures markets

by

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CHAPTER I: INTRODUCTION TO MARKET EFFICIENCY

> I believe there is no other proposition in economics which has more solid empirical evidence supporting it than the Efficient Market Hypothesis... In the literature of finance, accounting, and the economics of uncertainty, the Efficient Market Hypothesis is accepted as a fact of life. (Jensen, 1978)

> The efficient-market hypothesis is the most remarkable error in the history of economics. (Shiller, 1987)

Whenever prices of assets or commodities change dramatically, the fortunes of some market participants are made while the fortunes of others are lost. For centuries the lure of these changes in wealth have driven some people, like gamblers to a roulette wheel, to try their hand at predicting the next price change hoping to profit from it. From astrology to tea leaves, from the value analysis of the 1930s to the candlestick charting of today, many methods of price forecasting have tried to unlock the secrets of the future. Can price forecasts be used as the key to limitless wealth and abundance? The theory of efficient markets answers a resounding "No."

The Efficient Market Hypothesis (EMH) holds that capital asset prices fully and correctly reflect all relevant public information. Given appropriate assumptions[1], when prices "fully reflect" relevant information, all asset expected returns will be equal. Prices "correctly reflect" information if agent expectations are rational. This definition is embodied in the following mathematical model:

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[1]Typical assumptions include: 1)a large number of homogeneous, profit-maximizing agents with rational expectations, 2)all information is costlessly available and arrives at the market randomly, and 3)agents rapidly adjust prices to reflect new information.

$$(1.1)\quad E(R_{i,t+1}|I_t) = r$$

with r a constant, E the expectations operator, I_t an information set available at the start of period t, and $R_{i,t+1}$ the return to asset i realized at the end of period t. Return is defined as:

$$(1.2)\quad R_{i,t+1} = \left(\frac{P_{i,t+1}+D_{i,t+1}-P_{i,t}}{P_{i,t}}\right)$$

with $P_{i,t}$ the price of asset i at the beginning of period t, and $D_{i,t+1}$ the dividend paid by asset i at the end of period t. Recursive solution techniques for P_t after substituting (1.2) into (1.1) together with the transversality condition that price grows at a rate less than $1+r$[2], yield the familiar model of price as the discounted sum of future dividends:

$$(1.3)\quad P_t = \sum_{i=1}^{\infty} B^i E_t D_{t+i}$$

where B is the discount factor 1/(1+r). For an asset with no dividends, the measure of return would just be the capital gain:

$$(1.2')\quad R_{i,t+1} = \frac{P_{i,t+1}}{P_{i,t}} - 1$$

Solving recursively, one obtains:

$$(1.3')\quad P_{i,t} = BE_t P_{i,t+1}$$

[2]This assumption rules out speculative bubbles. Bubbles are inconsistent with an efficient market.

Its Beginnings

Efficient market theory began with the random walk hypothesis developed in the 1950s. In a study of stock market advice from twenty insurance companies, sixteen financial services, twenty-five publications, and one highly regarded financial editor, Cowles (1933) found investment results no better than with random portfolios. In a similar vein, Working (1934) noted that a time series of successive changes in wheat prices was indistinguishable from a random-difference series. While these early researchers hinted at problems with the current investment theory of fundamental and technical analysis, Kendall (1953) had the first major statistical study of serial correlation. He failed to find significant serial correlation in price changes of selected British stocks and U.S. commodities. Kendall concluded that successive price changes were independent and random behavior was vastly more important to price than systematic effects. While much of the early random walk research focused on commodity prices, Fama (1965) studied stock price behavior. Although the data series were rather short, Fama found that first-differences of daily stock prices in the Dow-Jones Industrial Average looked like a sequence of drawings of independent, identically distributed random variables. Price changes mimicked a random walk. Fama (1965, page 90) first used the phrase "efficient market."

Fama (1970), LeRoy (1989) and others credit Samuelson (1965) and Mandelbrot (1966) with giving economic content to efficient market theory. The random walk hypothesis (RWH) was an ad hoc approach used to explain the apparently random moves of prices. With a simple agricultural model of weather and prices, Mandelbrot showed how prices could be generated by a martingale process[3]. The martingale model was considered a substantial improvement in efficient market theory because it can be derived from assumptions of preferences and returns (LeRoy, 1989).

Fama et al. (1969) had one of the first empirical studies to examine how information was reflected into stock prices. Fama found that stock prices adjusted very rapidly to information about stock splits. Because of this speedy price adjustment once information on splits became public, no excess returns obtain based on that information. Fama (1970) also had the seminal survey in the efficient market literature. There, he delineated three forms of efficiency[4], recognized the martingale model as the standard for efficient markets, and reviewed current empirical tests of the RWH and the martingale.[5]

The zenith of the EMH occurred during the 1970s after Fama's lengthy survey about the time of Jensen (1978) from which the first introductory

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[3]A stochastic process is a martingale if $E(X_{t+1}|I_t) = X_t$. The martingale model is less restrictive than the random walk model since the latter requires complete statistical independence of successive price changes while the former needs only the mean of the distributions of each price change variable (e.g., $P_{t+1}-P_t$) to be independent of information available at t.

[4]Weak form efficiency: all past price information was reflected in current price; semi-strong form: all public information was reflected in current price; strong form: all public and private information was reflected in current price.

[5]The primary evidence against the RWH was the empirical finding that "large daily price changes tend to be followed by large changes, but of unpredictable sign" (Fama, 1970, page 415). If the second moment of the return distributions was predictable and non-constant through time, independence was violated and the random walk model was inappropriate.

quote comes. By the late 1970s, most conclusions of broad international research were consistent with the EMH. Some anomalous evidence, though, had been found. Small but significant excess returns were uncovered using information in public announcements of dividends and earnings, Jensen (1978). This small crack in the foundation of efficient market theory was the harbinger of a vast literature documenting numerous anomalies of and other problems with the EMH. This literature is described in the next section.

The intuitive idea of market efficiency is that agents make optimal use of all available information in bidding for assets. If "fundamental value" is defined as the discounted sum of optimal expectations of future earnings (cash flow, dividends, etc.), there are two implications of both the model of market efficiency and the intuition: a) price will always equal fundamental value, and b) future returns will not be forecastable with information available at the time price is observed. Extending current research in finance by testing the second implication in a futures market setting is the goal of this study.

CHAPTER II: EFFICIENT MARKET ANOMALIES

Even as the EMH received broad academic support through the mid-1970s, several first-order questions or contradictions remained. First, if asset prices fully reflect all information, any analysis of public information would be useless. Yet, investment traditionalists of the Graham and Dodd school believe that careful analysis of public information will consistently produce above average portfolio returns. Technical analysts study chart patterns of past prices for insight into future price direction. For decades, legions of analysts have been employed by financial companies and advisory services hoping to consistently out-perform market averages by expert stock picking and market timing. Since the efficient market price is an optimal estimate of fundamental value and returns are unforecastable, this employment is clearly inappropriate and yet it occurs.

The large volume of trade on security exchanges is a second anomaly. Rational sellers must realize that buyers choose to buy based on the buyers' interpretation of the buyers' own information which may differ from the sellers'. Since both buyers and sellers cannot have positive expected gain, risk-averse agents would not trade. Current trade volume is much too large to be motivated solely by new purchases or portfolio rebalancing for risk as the EMH suggests.

A third contradiction involves the assumption that information is costlessly available to all agents. In reality, information is difficult and costly to acquire and once acquired may be even harder to interpret.

Grossman and Stiglitz (1980) point out that only the opportunity for arbitrage profits gives traders the incentive to gather information. The inherent contradiction between these incentives and market efficiency results in an inability to maintain capital market equilibrium. Once equilibrium is established, arbitrage possibilities and the consequent incentives to acquire information disappear. Soon, prices will no longer fully and correctly reflect information. If more people believed in semi-strong form efficiency, fewer would gather information.

Other questions arose. Why do closed-end mutual funds typically sell at substantial discounts? Arbitragers should buy the mutual fund and sell the individual stocks for a riskless profit. Buffett (1985) pointed to four investors of the Graham and Dodd school of fundamental analysis who consistently outperformed market averages during the 1960s and 1970s each in his own separate business.[6] Neither would be observed if the market was strictly efficient.

By the early 1980s, research began to uncover second-order or more technical evidence questioning the unpredictability implication of the EMH. This literature is well surveyed by LeRoy (1989, 1990), Fortune (1991) and Jacobs and Levy (1988). Small firms tended to experience greater returns than large firms. On average, investment returns for January outpaced those of any other month, while weekends were far worse for stocks than other days. Stocks that paid large dividends were punished with smaller

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[6]While it is statistically possible for individuals to outguess the market on occasion, Buffett's point is the number and consistency of his group cannot be reconciled with the EMH.

than average total returns, implying that investors value high dividend stocks and keep their prices bid high. Returns were also negatively correlated with various proxies for price to value ratios, e.g., price to earnings or price to book value. Investors could earn abnormal profits buying stocks with low ratios. Then there was the Value Line enigma. For several consecutive years, stocks with a "1" rating by Value Line Investment Survey substantially outperformed stocks rated "5" giving credence to the existence of stock picking ability.

In response to this accumulated evidence, Jensen (1978) redefined an efficient market by linking it with transaction and information gathering costs. "A market is efficient with respect to an information set, if it is impossible to make economic profits by trading on the basis of that information set"[7]. This change allowed limited price change predictability to coincide with these stylized facts but not enough predictability for abnormal profits. The link of efficiency with the absence of excess profits has endured to the present day.

Prior to the early 1980s, research focused on specific deviations from market efficiency for small portfolios of selected stocks and relatively short time periods. The excess volatility studies of Shiller (1981) and LeRoy and Porter (1981) that followed large groups of stocks with very long price series inaugurated a new era in efficient market research. Mean reversion and overreaction were later branches of this new approach. The EMH assumes agents are rational in their decision-making.

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[7]Jensen (1978) page 96.

Negating this assumption has been suggested as a unifying explanation of the results of this new research. These four areas will be discussed next beginning with excess volatility.

Excess Volatility

A decade of excess volatility research began with the studies by Shiller (1981) and LeRoy and Porter (1981). With hindsight their intuition is amazingly simple. If price is the optimal forecast of discounted future dividends as postulated by the EMH, then price should be less variable[8] than dividends. If we define P^*_t as the fundamental value of the asset, that is, the price that would obtain if dividends were perfectly forecastable, and $\epsilon_t = P^*_t - P_t$ is the forecast error, then from (1.3) we have

$$(2.1) \quad P_t = E_t(P^*_t)$$

and

$$(2.2) \quad P^*_t = P_t + \epsilon_t \ .$$

P_t is an optimal forecast of P^*_t since it is made using all available information. This implies that P_t and ϵ_t are uncorrelated so that $var(P_t+\epsilon_t) = var(P_t) + var(\epsilon_t)$. Variance is a nonnegative number, so taking the variance of both sides of (2.2) yields the inequality

$$(2.3) \quad var(P^*_t) \geq var(P_t) \ .$$

Thus, the variance of the fundamental value of the asset should be at least

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[8]Less variable in a clearly defined and measurable way.

as large as the variance of the optimal forecast. Shiller found just the opposite. The variance of price was significantly greater than a mathematically derived variance bound based on the realized dividend stream. LeRoy and Porter reported a similar variance bound violation. Even though Shiller's work was questioned on econometric grounds such as small sample bias of variance estimates (Flavin, 1983) and flawed stationarity assumptions (Kleidon, 1986), his paper began a revolution in market efficiency research.

Rationality in Decision-Making

Along with the martingale model described in Section I, the EMH assumes each agent's preferences correspond to the axioms of expected utility theory such that choices are determined by maximizing expected utility. Expectations are rational, i.e. agents know and use the correct distribution of possible outcomes in forming expectations. In reality, assessing probabilities and assigning values to potential choices is a highly complex judgmental process. Kahneman and Tversky (1982) suggest that people use a few heuristic principles or "rules of thumb" to simplify this effort. Three such rules identified to reduce the complexity of processing information are: anchoring and adjustment, representativeness, and availability.[9] "These heuristics are quite useful, but sometimes they lead to severe and systematic errors" (page 2). The representativeness rule of thumb is used when agents take recent events to be more

[9]See Kahneman and Tversky (1982) and other referenced works by these authors for explanations of anchoring and adjustment and availability.

representative of the true probability distribution than distant past events. In other words, people tend to put more subjective weight on recent events than is warranted by objective probabilities. This violates Bayes' Theorem for updating probabilities and can lead to systematic overreaction in financial markets. Camerer (1987), though, suggests that the small violations observed in practice may not be economically significant and probably disappear with experience.

Much research on violations of rationality comes from psychology and is performed in experimental settings. Tversky and Kahneman (1981) and Tversky, Slovic and Kahneman (1990) discuss the preference reversal phenomenon. The manner in which a decision or problem is framed can change the preferred solution and often can affect that choice in a predictable way. Weinstein (1980) uses surveys and a controlled experiment in two studies to show that people believe their own chances for receiving good luck and avoiding misfortune are greater than the average person's chances. Weinstein labels this error in judgement "unrealistic optimism." This could explain why many people attempt to beat the market and continue the attempts even after initial loss and disappointment. Martin (1985) surveys these and other anomalous behaviors that do not correspond to the EMH model. In a lengthy and detailed overview, Thaler (1987) points out that economic theory has two roles: normative and descriptive. While expected utility theory may be considered the ideal for how agents should choose (normative), there is ample evidence that it does not adequately describe how agents in fact do choose.

Economic modelling in response to suggestions of market irrationality allowed some agents to be irrational. Traditional theory dating from Freidman (1953) assumed that smart money arbitragers would soon take advantage of the resulting profit opportunities and correct all market inefficiencies. Newer models with quasi-rational agents or noise traders, however, show that markets cannot guarantee that only rational behavior will survive (Russell and Thaler, 1985, and DeLong, Shleifer, Summers and Waldmann (DSSW), 1991). With noise traders in a model other studies conclude that speculation can be destabilizing[10] rather than serve to reduce price variance.[11]

Overreaction

The application of this work in psychology to economics is straightforward. If agents make systematic errors in decision-making or probability assessment, then asset prices, which presuppose a forward-looking assessment of probabilities, contain systematic errors and the EMH would fail. An example of overweighing recent information is myopic extrapolation of a recent trend--a sure way to produce price overreaction. "Prices have risen recently so they must keep rising" or the "greater fool theory" outline phenomena described many times. Financial lore is replete

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[10]For examples of models with destabilizing speculation, see Stein (1987), DSSW (1989), Cutler, Poterba and Summers (1990) and Hart and Kreps (1986).

[11]The results in many noise trader models are driven by the creation of an additional risk for investors--risk that price will diverge further from or never return to fundamental value. Thus, agents can never be certain that the inefficiencies they might be tempted to arbitrage against will ever be corrected.

with legendary examples of such past investment manias, from the Tulip Bulb mania in Holland in the 1600s to Florida land speculation in the 1920s.[12]

Overreaction research began with Beaver and Landsman (1980). They form a portfolio of winners (losers) based on a positive (negative) immediate past residual return (CAPM-type residual) and observe subsequent portfolio return. They find some abnormal returns associated with the method of portfolio formation. DeBondt and Thaler (1985) refined this strategy and asked whether past stock price returns could predict future returns. Past extreme returns were used as a proxy for overreaction and two portfolios of stocks were formed on that basis. The winner (loser) portfolio was comprised of stocks whose previous three year returns were in the top (bottom) ten percent of all stocks considered. The EMH implies both portfolios have the same expected return, i.e., past returns offer no clue to future performance. From 1926 to 1982, winner portfolios under-performed the market by 5.0% but loser portfolios beat the market averages by 19.6%. This difference in cumulative average returns of 24.6% was statistically significant. It appears that returns were predictable for that period. Shiller (1984, 1988), Summers (1986), and Black (1986), among others, had discussed fashions, fads, bubbles and noise as explanations of Shiller's excess volatility in the broader framework of violations of rationality suggested by the research in psychology. But DeBondt and Thaler (1985) moved directly from the systematic cognitive error to an empirical study of the systematic failure of the EMH. A large literature

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[12]These are well documented by Kindleberger (1989).

on overreaction followed that is well summarized in DeBondt (1988).

Strong evidence of short term stock price reversals were found by Howe (1986) and Brown and Harlow (1988). Brown, Harlow and Tinic (1988) studied stock price reaction to announcements of specific events and found overreaction to new negative information. In Lehmann (1990), winner and loser portfolios experience sizeable weekly return reversals even after accounting for bid-ask spreads. Similar conclusions are drawn from Bremer and Sweeney's (1991) study of extremely large negative ten day returns for specific stocks. Price moved up in subsequent days. Overreaction to information was also discovered in S&P 100 index options by Stein (1989) and in the forecasts of security analysts by DeBondt and Thaler (1990). So much research has focused on this subject that some academicians have named it the Overreaction Hypothesis (ORH).

Mean Reversion

If asset prices are excessively volatile, they would be too high at some times, be too low at others, and gravitate to the fundamental or mean value in between. If prices do revert to a mean value, returns would be serially correlated. Returns would therefore be predictable, negating market efficiency. This suggests testing asset prices for mean reversion and returns for autocorrelation. Fama (1970) documents early research finding very small serial correlation in daily and weekly stock returns. However, he concludes that after accounting for transaction costs, the near-zero autocorrelations imply this predictability of returns is not economically significant. Summers (1986) questions this conclusion. With a simple model of price containing a slowly decaying, autoregressive component (fads), Summers shows that small serial correlations allow substantial divergence from fundamental value for long periods that will neither be detected by econometricians nor arbitraged away.

While studying differences in variance of daily versus weekend or holiday stock returns, French and Roll (1986) discover small but significant negative correlation of daily returns at lags up to six days. Fama and French (1988) model price as the sum of random walk and stationary components. Their evidence from sixty years of stock returns matches the prediction of the model: a U-shaped pattern of negative autocorrelations, from zero at short lags, becoming more negative, than decaying slowly back to zero at longer horizons. Evidence from variance ratio tests by Poterba and Summers (1988) shows positive (negative) serial correlation of monthly stock returns at short (long) horizons. Similar results are found in equity returns in seventeen other countries. Using a Markov chain model with postwar U.S. stock prices, McQueen and Thorley (1991) also find reversal of returns such that "low (high) returns tend to follow runs of high (low) returns."

Other Evidence of Inefficiency

Financial practitioners have long believed that price-earnings or price-dividend ratios contain information about future price changes. A ratio substantially below some market average would indicate an "out of favor" stock with a high reward to risk potential. Shiller (1988), Campbell and Shiller (1988) and Fama and French (1988) document the success of this strategy. Dividends and earnings both predict long horizon stock returns.

An efficient market price is the optimal forecast of the asset's fundamental value. Any change in that price must reflect new information about current and future fundamentals and economic conditions. Utilizing this implication, a wholly different line of research seeks to explain the price variation ex post by referring to changing economic conditions and firm-specific events. In his orange juice study, Roll (1984) failed to find any explanatory variable besides cold weather that had enduring effect on returns of frozen concentrated orange juice futures. Applying this methodology to the stock market, Roll (1988) could explain no more than one-third of the variability of monthly stock returns. Fama (1990) combined proxies for "shocks to expected cash flows, time-varying expected returns, and shocks to expected returns" and was able to explain up to 59% of the variation of total annual stock return. Roll concluded that a market influenced by fads, fashions or psychological factors was consistent with his findings. Fama left conclusions to the reader.

The last efficient market anomaly is more anecdotal than academic. A few investors have consistently and spectacularly beaten market averages. Warren Buffett of Berkshire Hathaway, George Soros of Quantum Fund and Peter Lynch of Fidelity's Magellan Fund are three such people. Marcus (1990) develops a methodology to assess the performance of winners selected ex post. His conclusion is that the Magellan Fund's superlative record was due to more than luck. Finally, even though the decisions of one person may not be indicative of the feelings of a larger group, it is interesting that one of the fathers of modern portfolio theory, Nobel laureate William Sharpe, has left academia to counsel pension funds and private clients in asset allocation and market timing (Berss, 1990).

Because of their intuitive similarities, excess volatility, overreaction and mean reversion are likely all part of the same market phenomenon. Call it the "return reversal" effect: prices overshoot and then correct back. This price action would explain both the negative autocorrelations found in empirical research and the failure of orthogonality tests between future price and proxies for fundamental value--price/earnings, price/book value, etc. Practitioners Jacobs and Levy (1988, 1989) used multivariate regression of monthly stock returns on proxies for twenty-five different market anomalies to disentangle the interwoven effects of the anomalies. Return reversal had the strongest pure effect of any of the anomalies they studied.[13] The point of these comments is to note that if all this varied research is only measuring different forms of the same effect then the evidence against market efficiency is not necessarily so weighty.

Return reversals can arise from systematic overweighing of new information and were identified in the psychology literature discussed above. Reversals can also be a reflection of "noise"--the confusion added to asset prices by agents' uncertainty, misperception, or misinterpretation of random daily events. Positive feedback loops accentuate the reversal

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[13]Other market anomalies with strong pure effects were low price-earnings ratios, small size, trends in analyst's earnings estimates and relative strength.

and are part of this effect. Cutler, Poterba, and Summers (1990) and DSSW (1989) discuss and model the role of feedback traders who base their demand for assets on realized returns. Soros (1987) admits his investment success was largely an exploitation of what he calls "reflexivity" or grand feedback loops on a broad macroeconomic scale. "The trend is your friend", "get on the bandwagon" and "buy relative strength" are common descriptions of feedback effects. Reversals occur when these feedback loops break.

Evidence Against Inefficiency

As the evidence against the EMH accumulated, two rebuttal strategies followed. One strategy showed that the modern supposed inefficiencies (excess volatility, overreaction and mean reversion) were either nonexistent, weak, or subsumed by already well-known anomalies. The early statistical criticism of Shiller's volatility tests is well-publicized. Flavin (1983) noted possible small sample bias while Marsh and Merton (1986) and Kleidon (1986) attacked the tests on grounds of non-stationarity. Mankiw et al. (1991) test market efficiency with stock price and a naive forecast of the perfect foresight price. Their test with "superior statistical qualities" rejects the EMH but only at marginal significance levels.

In a reappraisal of mean reversion evidence, Kim, Nelson, and Startz (1991) decompose the sample of Fama and French (1988) into two subperiods: 1926 to 1946 and 1947 to 1986 or pre- and post-World War II. While mean reversion was found in the former and highly volatile period, the post-war period exhibits significant positive rather than negative serial correlation or "mean aversion." They conclude the market underwent a fundamental change in structure after the war. Jagadeesh (1991) finds mean reversion only in January with no serial correlation in any other month.

Overreaction is criticized in a number of papers. Contrary to the ORH, Davidson and Dutia (1989) find positive serial correlation of annual returns in their large sample of stocks over twenty-one years. The portfolio formation technique and the time span of Davidson and Dutia are quite different from DeBondt and Thaler (1985) (D&T). According to Zarowin (1989), the overreaction of D&T is just another example of the "small stock" anomaly since losers are clearly companies of smaller market capitalization than winners. By individually analyzing the size characteristics of companies in the seventeen different portfolios, he shows that returns from portfolios of equal size winners and losers are almost identical. Chan (1988) assumes company size matters and finds that portfolio betas change from rank to test period. Betas of loser (winner) portfolios increase (decrease) significantly from rank to test period indicating that portfolio risk and the consequent expected return increases (decreases). Risk changes result from changes in company debt to equity ratios. After accounting for this change in risk overreaction returns become economically insignificant. D&T (1987) respond to these criticisms by noting that winner (loser) portfolio betas are higher (lower) in down markets than in up markets. This contradicts Chan's conclusion that loser stocks are riskier than winner stocks.

Another potential problem of overreaction research is survival bias. Long term studies of reversals require companies to remain in business for the duration of the portfolio period. Excluding companies that file bankruptcy biases the study in favor of return reversal by eliminating one possibility: that extreme losers continue to be extreme losers during the test period. New or acquired companies may also be excluded. Phillips (1988) found bias of this type by comparing sample distributions of firms both inside and outside the universe from which research selections are commonly made. Only in-sample conclusions were deemed appropriate.

The second general rebuttal to rejections of market efficiency notes that predictable stock returns can be consistent with efficient markets if the inefficiency arises from time-varying expected returns. A typical reformulation of the present value model is

$$(2.4) \quad P_t = \sum_{i=1}^{\infty} D_{t+i} \left(\prod_{j=1}^{i} \frac{1}{1+r_{t+j}} \right)$$

where r_t is the expected return for period t. If expected returns are nonrandom, asset returns can be predicted from information available at t. Further, if arbitragers cannot profit from that predictability, e.g., because of risk aversion or opportunity costs, serially correlated returns would be consistent with an equilibrium model of asset-pricing. Balvers, Cosimano and McDonald (1990) and Cecchetti, Lam and Mark (1990) present a theoretical model in which agents' desire to smooth consumption leads to negative serial correlation of returns. In Balvers, et al, stock returns can be predicted to the extent that aggregate output is serially correlated. For example, anticipation of a shortage next period leads to a demand for assets to carry wealth forward thereby increasing asset prices and lowering expected returns. Attanasio (1991) acknowledges the evidence that stock returns in excess of treasury bill rates are predictable, but notes that if the variables (dividends, earnings, inflation, and bill rates) that predict these returns also predict return variance, they merely proxy for risk and the EMH is not rejected. His results are mixed; heteroscedasticity eliminates the predictive power of dividends and treasury rates but not of inflation. Extensive work by Cutler, Poterba and Summers (1991) showing serial correlation in many asset markets in thirteen countries find evidence for several reasons to discount the expected returns explanation of market inefficiencies. Three such reasons are alternating autocorrelation sign at short versus long horizons, the size of the risk premium found in Mehra and Prescott (1985), and the similarity of observed autocorrelation in many different markets where vastly different risk factors are assumed to be operating. They conclude that observed patterns "are best explainable as a consequence of the speculative process itself" with fad or feedback models.

A key problem of interpretation of all empirical tests of market efficiency is the joint nature of the hypothesis being tested. The EMH assumes agents are rational, homogeneous and use rational expectations. In addition, every hypothesis includes a specific mathematical model. Any test which rejects efficiency may only be rejecting one of these joint hypotheses.

The next section looks at the efficiency testing literature in futures markets.

CHAPTER III: FUTURES MARKET EFFICIENCY AND ANOMALIES

> I take it as axiomatic that the markets are not informationally efficient. (Leistner, 1987)

Futures markets, particularly of agricultural commodities, have been an integral part of the U.S. economy for many years. With the recent advent of futures markets in financial instruments, the volume of trading on futures exchanges has skyrocketed. These futures contracts based on non-physical assets such as stock and commodity indices, U.S. bills, bonds and notes, Eurodollars and foreign currencies, unimagined just a few years ago, now trade on organized exchanges all around the world. The routine daily volume of S&P 500 index futures substantially exceeds that of the New York Stock Exchange (Stein, 1987). While much economic research and complex statistical testing has addressed the question of financial market efficiency, application of these methodologies to futures markets has lagged. The surging volume of futures trading indicates it is time to catch up.

A futures contract is a legal sales contract in which the seller promises to deliver a specified quantity of an asset of a certain quality to the buyer at one of several defined places within a small range of delivery dates. An exchange clearing-house insures the transaction so actual contact between the parties is not necessary. The contracts expire on the final date with either physical delivery of the underlying asset or cash settlement based on contract price at expiration. Markets for futures contracts fulfill several valuable economic services. Hedging the risk of inventory price fluctuation is one of the most important roles. Futures markets also aggregate diverse information from traders and the resulting "consensus" price conveys that information to other market participants. This price discovery role helps establish cash prices in the underlying market. Futures markets also provide a physical place to trade open to all, offer liquidity for quick and easy market entry and exit, and help spread seasonal production throughout the calendar year with the use of diverse contract maturities (Scholes, 1981 and Grossman, 1986).

Futures market efficiency is commonly defined in terms of the fair game model. Let $F_{t,s}$ be the futures price at time t of an asset to be delivered during period s and C_s be the "spot" or cash price of the asset at time s. Neglecting basis problems, the futures price for a contract in the delivery period will equal the spot price of the underlying asset or $F_{s,s} = C_s$. With risk neutral agents, a constant interest rate and price equality in the delivery period, the fair game model implies

$$(3.1)\quad E_t(F_{t,s} - C_s \mid I_t) = 0$$

or

$$(3.2)\quad F_{t,s} = E(C_s \mid I_t)\ .$$

Risk aversion could be added to the model in equation (3.2) by an additive risk premium[14] or by a multiplicative factor[15]. Intuitively, equation

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[14]This was shown in Koppenhaver (1983), e.g., $F_{t,s}=C_s-R_{t,s}$, where $R_{t,s}$ is the risk premium.

[15]Bigman, Goldfarb, and Schechtman use the marginal rate of intertemporal substitution as the risk factor: e.g.,

(continued...)

(3.2) means today's futures price is a rational estimate of tomorrow's spot price. As is true in the financial markets described above, no current information should help predict the change in the spot or futures price from one period to the next.

Two methods have traditionally been employed to test for futures market efficiency. The first method operationalizes (3.2) to yield the regression equation

$$(3.3) \quad C_s = \alpha_i + \beta_i \cdot F_{s-i,s} + \epsilon_{s-i}$$

where i is the number of days or weeks before delivery, (α_i, β_i) are the regression coefficients and ϵ_s is the independent, identically distributed (iid) regression error. Efficiency implies the testable restriction $(\alpha,\beta)=(0,1)$, with an F-statistic to test the joint hypothesis. An alternative of this method regresses the forecast error on a vector of current information variables, Y_{s-i}.

$$(3.4) \quad C_s - F_{s-i,s} = \mu_i + \theta_i \cdot Y_{s-i} + \tau_{s-i}$$

Significant coefficients in the θ_i vector would reject market efficiency. Variations of these tests have been often used to study futures efficiency with inconsistent results depending on the underlying asset and the sample.

One minor problem with this test is the inclusion of C_s in (3.3)

[15](...continued)

$$F_{t,s} = E_t\left(\frac{dU_s(\cdot)}{dU_t(\cdot)} \cdot C_s \cdot \prod_{k=t}^{s-1} R_{k,k+1} | \Omega_t\right)$$

where dU() is the marginal utility function evaluated at s and t, respectively, and $R_{k,k+1}$ is a measure of ownership risk for period k to k+1.

which adds data to the regression that was not available ex ante (at time s-i) to forecasting agents.[16] Ideally, a test of efficiency would be based on only current information. However, a more fundamental problem is the nonstationarity of both price series. Elam and Dixon (1988) show that certain futures prices are nonstationary and the theoretical infinite variance of such series invalidates the standard F-tests.[17] Shen and Wang (1990) present a cointegration technique to surmount these statistical problems. Lai and Lai (1991) strongly reject efficiency in four London metal futures with this method. Chowdbury (1991) finds cointegration of spot and futures prices in five foreign currencies which is a necessary condition for efficiency but rejects the unbiasedness restrictions on equation (3.3).

The second research method used to test futures market efficiency studies market timing ability and trading rule profitability. Profits above transactions costs from trading rules or market timing are evidence of inefficiency. Research indicates that test results depend on the rule, the asset and the sample period, so the evidence against efficiency lacks persuasiveness. Taylor (1983, 1985) and Taylor and Tari (1988) uncover limited profitability from filter rules based on observed small

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[16]This was pointed out in Chowdbury (1991). A model is estimated over the whole sample and then used for prediction within the sample. If the underlying processes are stationary, this may not be a serious problem.

[17]Elam and Dixon point out that Dickey-Fuller tables are inappropriate when both sides of the regression equation have different series, as in (3.3). Their solution is to use the following: $C_s = a_i+b_i*C_{s-i}+e_i$. If C_s has a unit root, the distribution of the OLS estimator of b skews left while the critical value moves right and the test rejects too often. In this case the Dickey-Fuller tables provide the proper adjustment.

autocorrelations of futures prices or price trends. So some information must be reflected slowly by the market. Cumby and Modest (1987) develop and employ a new test for market timing ability but find variable success for foreign exchange advisory services. Similar inconsistent results are found by Irwin (1984), Lukac, Brorsen and Irwin (1988), Lukac and Brorsen (1989) and Ward, Irwin and Zulauf (1991). Using end-of-day reports of large traders by the Commodity Futures Trading Commission, Hartzmark (1991) demonstrates that "fortunes of individual futures traders are determined by luck, not forecast ability" (page 49). Also, trading rule tests are likely biased toward findings of efficiency. Anyone uncovering successful trading rules would probably use them for profit rather than for publication.

If trading rules can be used profitably, some commodity funds, pools or trading advisors should perform very well. However, no definitive results were found in a survey of public fund studies. Elton, Gruber and Rentzler (1990) offer strong conclusions based on public records from 1980 to 1988. Fund returns are extremely variable and generally less than rates on treasury bills. They conclude that predicting superior performance is not possible and investment portfolios should not include commodity funds. On the other hand, Irwin and Brorsen (1985), Irwin and Landa (1987) and Schneeweis, Savanayana and McCarthy (1991) all conclude that a small benefit may accrue to some diversification into commodities.

Newer techniques that look for overreaction or mean reversion are more conclusive. Arbitraging the soybean crush (taking opposite positions in soybeans versus its crush products, oil and meal expecting the spread to revert to the "mean" cost of production) produces significant profits according to Johnson, Zulauf, Irwin and Gerlow (1991). Ma and Soenen (1988) find a relationship between gold and silver prices that can be profitably exploited: buy silver and sell gold, then reverse at appropriate times. Using the Cumby-Modest timing test, Jackson, Zulauf and Irwin (1991) find mean reversion in seven agricultural commodities and spreads between them. Excess profits are significant but depend on the commodity, the sample period and the lag length. In a study of the effects of daily price limits, Ma, Rao and Sears (1989) note decreased volatility consistent with the hypothesis that futures prices overreact. If price limits are a stabilizing influence, then noise, fads or overreaction must be present. Ma, Dare and Donaldson (1990) estimate ARIMA models for several futures contracts to be proxies for market expectations. They find price reversals following significant price changes when prices diverge far from the level predicted by the ARIMA model.

While these newer studies offer more consistent conclusions about futures market efficiency, much more work needs to be done. The next two sections discuss interpretations of risk as applied to futures and present the methodology for the current study of futures.

CHAPTER IV: METHODOLOGY

This research examines two questions. The first, whether past extreme returns have any potential to predict future returns, is studied by extending the methodology of DeBondt and Thaler (1985) to the futures market. They found that past extreme returns did have predictive power for future stock market returns. As noted in Section II, they ranked stocks by previous three year returns and formed winner (loser) portfolios of stocks having the highest (lowest) ten percent of returns. Contrary to the EMH, these two portfolios had significantly different realized returns. If results in futures are similar to results in stocks, futures prices may be responding to fads or fashions and at times diverge widely from some fundamental value. If that value for commodities is the cost of production, price will vary above or below it to encourage or discourage extra production as demand dictates. Production cost or profits would be the impetus causing price to revert to fundamental value. If that reversion is systematic, than prior extreme returns may have predictive power just as in stocks.

The second question researched in this study concerns the existence of risk premiums in futures markets. It will be discussed at the end of Section V. The rest of this section describes the data and methodology used here and considers two possible objections to this extension into futures markets.

Data

Monthly data was gathered on all futures contracts traded on North American futures exchanges between January, 1964 and April, 1992. There were fifty-three such contracts that traded on fourteen exchanges during that time. The contracts and exchanges are listed in Appendix A in Tables A.1 and A.3 respectively. Natural spreads between specific futures will also be studied as though a separate market existed for them.[18] While spreads are simply linear combinations of two or more futures contracts, the difference or ratio between two futures prices contains relative information not available in either price alone. For producers, it is often the relative prices of two commodities that precipitate production decision. Thirteen widely followed and significant spreads are followed in this research and are listed in Appendix A, Table A.2. Most of the historical data was obtained from Technical Tools, Inc. and Dunn & Hargitt, two data service companies from Los Altos, California and Lafayette, Indiana, respectively.[19] Futures markets include agricultural commodities, metals, interest rate futures, index futures, currencies, petroleum and food products.

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[18]A spread investment is a portfolio that is long the first contract and short the second. For the cattle feeding and soybean crush spreads, the portfolio is long feeder cattle and corn and short live cattle, and long soybean oil and soybean meal and short soybeans, respectively. The return on the spread is the return on the spread portfolio.

[19]Additional data was gleaned from statistical annuals of the Chicago Board of Trade, Chicago Mercantile Exchange, Commodity Exchange, Inc., New York Cotton Exchange, International Money Market, and Minneapolis Grain Exchange.

Methodology

To test for predictive power of past extreme returns in futures markets, monthly data on the futures contracts described above will be used. Long, continuous time series of monthly returns will be formed using these sixty-six price series. Since these investments have no dividends or other cash flows, investment return is simply the price change over the time period.[20] Define monthly return for futures market i and month t+1 as the ratio:

$$(4.1) \quad R_{i,t+1} = \frac{P_{i,j,t+1}}{P_{i,j,t}}$$

where j is the contract delivery month.[21] Monthly price is the closing price on the last Wednesday of non-delivery months.[22] If that price is the consequence of a limit move, the next day's price is used. Four of the futures markets ceased trading for lack of volume during the sample period. Returns are used in those markets until trading becomes so sparse that there could be difficulty completing transactions. Similarly, the series of returns do not begin until open interest reaches

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[20] The term "returns" is really a misnomer in futures markets. While margin must be deposited to assure contract fulfillment, Treasury Bills can be used with the depositor retaining the interest income so the opportunity cost is zero. Since no investment is required, returns have a zero divisor.

[21]Index i=1,2,3,...,66 for the 53 futures plus 13 spreads. Index j ranges from January to December and varies for different i. Index t=1,2,3,...,340 or January, 1964 to April, 1992.

[22]This close was chosen to avoid any potential price disruptions on Mondays, Fridays or during delivery months. Monthly returns also overwhelm any common bid or ask price discrepancies.

several hundred and volume is at least several contracts per day. Such low volume and open interest, though, occur in only a few of the data series studied.

On each portfolio selection or rank date, previous returns of all traded contracts are calculated[23] and are ranked in order from largest to smallest. D&T (1985) used three years for their rank period for portfolio selection. The shorter duration of futures contracts and the shorter horizon of commodity production cycles suggest that overreaction, if present, would appear after a rank period of twelve to eighteen months. Rank dates used are January and July of each year.[24] After ranking, about the top eighteen percent are put in a winner portfolio (W) and the bottom eighteen percent in a loser portfolio (L). All portfolio investments are purchase or "long" commitments and are equally dollar-weighted, i.e., each portfolio is considered to have purchased a one dollar interest in the appropriate markets. Results of this study come from a comparison of post-selection returns[25] of these two portfolios.

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[23]For any rank period of k months, the rank period return is calculated as:

$$R_{i,k,t} = \prod_{g=0}^{k} \left(\frac{P_{i,j,t-g}}{P_{i,j,t-1-g}} \right) .$$

Rank periods studied were k=6,12,15,18,24 and 36 months.

[24]Rank date index d=1,2,3,...56 or July, 1964 to January, 1992. For a six month rank period, d has 56 observations. Longer rank periods imply fewer observations.

[25]Test returns are calculated every three months beginning the third month and ending at month thirty. The index is S where S=3,6,9,...,30 months and s=0,1,...,S. Test period return for each future contract i

(continued...)

Now, for every rank period k, rank date d and test period s, there are paired observations of portfolio test period returns, $W_{k,d,s}$ for winners and $L_{k,d,s}$ for losers. Define:

$$(4.2)\quad D_{k,d,s} \equiv W_{k,d,s} - L_{k,d,s}$$

and

$$(4.3)\quad DBAR_{k,s} \equiv \frac{1}{D}\left(\sum_{d=1}^{D} D_{k,d,s}\right).$$

No matter how portfolios W and L are formed, the EMH implies that the expected return of both portfolios should be the same or the expected average difference be zero.[26] So, ${}_{emh}E_t\{DBAR_{k,s}\} = 0$. But if D&T overreaction obtains, then ${}_{orh}E_t\{DBAR_{k,s}\} < 0$ and statistically significant. The series, $D_{k,d,s}$, d=1,2,...,N where N is the number of rank periods possible between January, 1964 and April, 1992, can be divided into non-overlapping subperiods so statistical tests can be

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[25](...continued)
is:

$$R_{i,d,s} = \prod_{s=0}^{S}\left(\frac{P_{i,j,t+1+s}}{P_{i,j,t+s}}\right).$$

The portfolio return, $W_{k,d,s}$ or $L_{k,d,s}$, is the arithmetic average of the test period returns where I is the number of future contracts in each portfolio and R^W and R^L are the returns to the winning and losing contracts respectively.

$$W_{k,d,s} = \frac{1}{I}\left(\sum_{i=1}^{I} R^W_{i,d,s}\right) \qquad L_{k,d,s} = \frac{1}{I}\left(\sum_{i=1}^{I} R^L_{i,d,s}\right)$$

[26]This must be true since no current information can be used to predict future returns.

performed.[27] The Student's t-statistic will test the hypothesis of no difference between portfolio means.

Special Considerations

Whether futures contracts can even be considered assets subject to financial modelling has been debated in the literature. Such contracts differ from customary investment vehicles in several ways. First, they are short-lived securities whose endogenous price and quantity can vary dramatically from day to day. Quantities of other assets are fixed in the short run. Furthermore, trading in futures markets is a closed, zero-sum process; neglecting commissions, the total money received by winners exactly equals the total given up by losers. Also, at the end of every trading session, losers must deposit additional margin and winners may receive their profit since the contract value is marked to zero at that time.[28] In addition, the CAPM market portfolio will contain no futures contracts since the net investment in them is zero at all times. CAPM assumptions are not met by these characteristics (Stein, 1986). In spite of these differences, Black (1976), Scholes (1981) and Cox,

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[27]For tests using the Student's t distribution each pair of observations must be statistically independent. If the rank periods overlap, obvious statistical dependence occurs. If only the rank and test periods overlap, the independence assumption is not strictly met. But with mostly different futures contracts in the winner and loser portfolios after each rank date, the assumption of independent observations is not unreasonable. Tests are performed on both the full series and smaller series with less overlaps.

[28]The price of every futures contract is zero at the beginning of every period. Returns need to be redefined and the CAPM model must be modified. See the next section.

Ingersoll and Ross (1981) all conclude that "futures prices are equal to the value of particular assets, even though they are not in themselves asset prices" (Cox et al. 1981, page 321). Futures prices should satisfy models of asset-pricing like the CAPM or the APT. This research treats futures prices as asset prices.

Intrinsic to this study is the formation of long time series of futures prices. Since most contracts trade actively for only a year or less, long price series cannot be created without splicing successive contracts. Assets that differ in time of delivery but are otherwise identical may be equally as different as stocks and bonds.[29] Is this splicing appropriate? It could certainly add noise to the data and prevent definitive conclusions. Actively traded real assets, though, with long price series underlie every futures contract[30] and futures prices must approach that cash price in every delivery month. In addition, most of the assets studied can be stored at least into the next delivery period and often beyond. The storage potential and long cash price series validate splicing from contract to contract. In reality, companies also change dramatically from period to period. For example, General Motors stock in 1970 represented a quite different asset than General Motors stock today, but all economic research still uses the long

[29]For example, corn for July delivery in a tight carryover year may be priced much differently than the same corn for December delivery if a large crop looms for the fall.

[30]This is true even though some futures are two or three steps removed from real assets. Even with index or currency futures, real assets form the basis for their existence.

price series of stocks. This essay will also use the long price series.

One problem remains. As discussed above, time-varying expected returns or risk premiums could be one explanation for supposed market inefficiencies. If previous losers were substantially riskier than previous winners, significantly higher returns would be expected from the former portfolio as a reward to bearing risk. Since differential risk could account for such significantly different portfolio returns, economic research should only compare risk-adjusted returns. To account for differential risk, it must be measured. What is the risk of the winner and loser portfolios and how is the risk of each to be compared? These questions will be addressed in the next section.

CHAPTER V: RISK

There is considerable controversy in the economic literature about risk and the existence of risk premiums when applied to a futures market. Capital market theory hypothesizes that risky investments need higher expected returns to compensate for extra risk. Risk is defined in terms of the covariance of an asset's return with the market return where large covaraiances imply high risk. Only this systematic or market risk will be priced by investors in equilibrium. Returns from individual futures markets often have large variances which imply large non-systematic or individual risk. In theory, however, this risk will not earn a return in equilibrium as it can be diversified away.

The Capital Asset Pricing Model

The usual capital asset pricing model (CAPM) expresses an asset's expected return as the sum of a risk-free rate and a risk premium:

$$(5.1)\quad E_t(R_i) = R+\beta_i\cdot[E_t(R_m)-R]\ .$$

R is the risk-free rate, R_i is the return on asset i, R_m is the return to a market portfolio of all assets, and β_i or beta is the measure of systematic risk unique to each asset such that

$$(5.2)\quad \beta_i = \frac{Cov(R_i,R_m)}{Var(R_m)}\ .$$

The risk (or beta) of each asset's return is proportional to its covariance with the return of the market portfolio. Most authors modify equation (5.1) for futures since P_t=0 in equation (1.2').[31] Expressing R_i in levels rather than percent yields

$$(5.1') \quad E(P_{i,t+1}-P_{i,t}) = \beta'_i \cdot [E(R_m)-R]$$

and

$$(5.2') \quad \beta'_i = \frac{Cov([P_{i,t+1}-P_{i,t}], R_m)}{Var(R_m)}.$$

$P_{i,t}$ refers to the actual price of a futures contract and β_i' is the customary beta for measuring risk of specific futures markets.

The CAPM may not apply to futures markets because of inherent zero net investment. A positive and significant beta for some asset in equation (5.1') implies a positive expected price change. Rational sellers would account for that by adjusting the price at which they are willing to trade. Conversely, a "short" investment would then have a negative beta implying a negative correlation with the market return. Short positions would be less risky than purchases since the former could be diversified by investments in the market portfolio. Increasing open interest[32] means willing new buyers and willing new sellers. Why would an agent short a contract of an asset whose price was known to rise on average? Could the diversification value of a negative beta be enough to offset the adverse price change? This could be possible only if

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[31]This follows Black (1976), Scholes (1981) and Cox et al. (1981).

[32]Open interest is the total number of outstanding contracts of a particular commodity at any given time. Each contract has a buyer (a long) who promises to deliver the commodity and a seller (a short) who promises to accept delivery of the commodity. The number of purchased contracts must equal the number of sold contracts.

different hedging needs or market forces operate on the long side than on the short side of futures.

Normal Backwardation and Risk Premiums

An alternative intuition to describe risk in futures markets (or another rationale for a positive risk premium) is the theory of "normal backwardation," a concept first introduced by Keynes. Keynes theorized most hedgers were sellers of commodities. For speculators to accept the ownership risk from the hedgers, the former would demand a risk premium or a positive expected return. If this occurred, a buy-and-hold strategy would produce a small return. Many of the following studies searched for evidence of such a risk premium.

In a study of commodity trader profits, Houthakker (1957) concludes that small speculators who take advantage of the risk premium and stick to the long side of the market can do well. Dusak (1973) conducted an early application of CAPM theory to commodity futures. She examined corn, wheat and soybean futures and found no significant systematic risk.[33] If $B_i'=0$ in equation (5.1'), the expected price change must also equal zero. This fits with intuition regarding zero-sum markets since both longs and shorts cannot have positive expected returns in an efficient market.[34] Bodie and Rosansky (1980) found returns

[33]She found betas close to zero for all the commodities studied.

[34]The expected return for traders is a return to information. Positive expectations on both sides of a transaction would imply that some information was not reflected in market price.

comparable to stocks[35] with a buy-and-hold strategy on a benchmark portfolio of commodities from 1950 to 1976 and concluded this was evidence of Keynes' risk premium. Their conclusion could also stem from an inadvertent yet judicious choice of beginning and ending dates considering the huge increase in grain prices during the early 1970s.

Carter, Rausser and Schmitz (1983) (CRS) include the Dow Jones commodity index equally weighted with the S&P 500 index as the market portfolio for their CAPM investigation of commodities. They find a systematic risk premium and conclude that normal backwardation has merit. In a response, Marcus (1984) suggests the CRS weighting is too heavily on commodities since many S&P 500 companies own and deal in commodities. When the market portfolio is restructured to what they consider a more appropriate one-tenth futures, and nine-tenths Dow, the risk premium disappears. Baxter, Conine and Tamarkin (1985) suggest using the Dow Jones Commodity Cash Index in conjunction with the S&P 500 index as the market barometer. The betas of all the commodities studied were still close to zero. With an approach that takes nonstationarity of price series into account, So (1987) also finds insignificant betas and small systematic risk in wheat, corn and soybean futures. Elam and Vaught (1988) find low systematic risk in hog and cattle futures. However, Chang, Chen and Chen (1990) study copper, platinum and silver futures and find significant betas indicating the existence of systematic risk.

Hartzmark (1987) studies the normal backwardation theory through

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[35]And well in excess of the risk-free rate.

actual trading histories of individual futures traders. He finds that commercial hedgers on average earn profits while noncommercial speculators lose money. If there is a risk premium, the trader who accepts the hedger's risk doesn't get it. Opposite conclusions are drawn from public records of Commitments of Traders reports of the Commodity Futures Trading Commission by Yoo and Maddala (1991). They find that large hedgers consistently lose money and large speculators consistently profit, implying that a systematic risk premium is paid by hedgers.

The Potential for Risk Premiums

Evidence of risk premiums is the second subject of this research. Since returns from a buy-and-hold strategy may provide evidence of a risk premium if one exists, this large and diverse group of futures markets provide an ideal place to study risk premiums. On each rank date, a buy-and-hold (BH) portfolio will take a long position in every available futures market including spreads. A positive and significant mean return to the BH portfolio could be interpreted as evidence for an overall risk premium in futures markets.

However, prices also rise from inflationary influences. So a second interpretation of a positive return to the BH portfolio would be unexpected inflation. Any systematic inflation component in prices would soon be anticipated by agents and prices would not rise on average. Can a risk premium be differentiated from unanticipated price inflation? Technically, probably not. An intuitive argument follows: as stated above, US Treasury bills can be used by traders in place of non-earning margin deposits. If the average nominal return to these Treasury bills (R_f) exceeds the average inflation rate (I), then any positive return to traders from the BH portfolio (R_{bh}) would be in addition to the risk-free return which is already greater than realized inflation. If we think of a risk premium (R_p) as having two components:

$$(5.3) \quad R_p = R_{bh} + (R_f - I),$$

then R_p is certainly positive if both components are positive. If R_p is significantly positive, it is surely greater than a return to unexpected inflation. So, if the risk-free rate has averaged above inflation over the time period studied[36], any positive and significant mean return to the BH portfolio would be evidence of a risk premium. Existence of a risk premium would negate market efficiency.[37] The EMH implies that once the existence of any systematic return like a risk premium is known, agents will arbitrage that opportunity away. The null hypothesis of this study will be no risk premium.

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[36]See Table B.12 and Chapter VII of the text.

[37]This follows since buy-and-hold portfolios would receive a greater return than sell-and-hold portfolios.

CHAPTER VI: EVIDENCE FOR OVERREACTION

To test the extension of overreaction from stocks to futures, the data was gathered and the methodology was followed as outlined in Chapter IV. Previous returns for each futures market and spread portfolio were calculated every January and July for holding periods of six, twelve, fifteen, eighteen, twenty-four and thirty-six months. Winner and loser portfolios were formed with about the top and bottom eighteen percent of futures returns respectively (EP). In addition, a second group of winner and loser portfolios, each containing all the winners and all the losers respectively (AP), were formed to see if the extremes of past returns affected future returns differently. In all the tables of Appendix B, the series label of extremes has an "E" in the second position; the series label representing portfolios of all winners and all losers has an "A" in the second position. After portfolio formation, average returns were calculated for each portfolio for holding periods of multiples of three months from three months to thirty months.[38] Since these were paired observations and the number of interest is the difference between the mean average portfolio return, a new series was formed, $D_{k,d,s}$, and statistics were calculated for that series. Statistics from a Student's-t distribution were used to test the null hypothesis that the mean difference, $DBAR_{k,s}$, is zero. This is the relevant implication of the EMH.

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[38]These winner and loser portfolio returns were labeled respectively $W_{k,d,s}$ and $L_{k,d,s}$.

Possible statistical dependence when the rank periods overlap was noted above in footnote 25. The tables in Appendix B that contain a "b" in the table number present results for rank and test periods that do not overlap. The RATS Version 3.10 computer software package developed by Thomas A. Doan of VAR Econometrics was used for the return calculations and statistics; Lotus 1-2-3 Release 3.1 by Lotus Development Corporation was used for portfolio formation and manipulation. All the tabular results referred to in this section are presented in Appendix B. For all of the results presented, the tables contain the series label, the number of observations, the mean or $DBAR_{k,s}$, the standard deviation of the mean and the t-statistic that represents the significance level of the conclusion that the mean is not zero. A description of the labeling system precedes the tables in Appendix B.

Empirical Results

Evidence of overreaction would be a $DBAR_{k,s}$ significantly less than zero. A $DBAR_{k,s}$ not statistically different from zero would fail to reject the combined hypothesis of efficient markets and the martingale model.

Six month rank period

Table B.1.a shows significantly positive means. The t-statistics for test periods of three to twenty-one months are significant at the ten percent level and for test periods of six to fifteen months are significant at the one percent level. The t-statistics for test periods of twenty-four to thirty months are not statistically different from zero. The results are even more striking for the AP, the second group of results in Table B.1.a. The t-statistics are higher and only the twenty-seven and thirty month means are not different from zero. This difference in t-statistics is related to the lower standard deviation of the series of mean differences for the AP. More contracts are in each portfolio so the average portfolio return should be less variable possibly resulting in a higher t-statistic if the mean is not too different.

As noted above, overlap of the test and rank periods may cause statistical problems. Table B.1.b contains results of series with less overlap.[39] The same overall trend of significantly positive mean differences (MDs) can be noted except in all series labelled DE__J2 where no means are significant.

This result is unexpected. Positive test period MDs imply returns to the winner portfolios are significantly greater than returns to loser portfolios. Winners keep on winning or at least lose less than previous losers. There is persistence of returns. The ORH implies significant and negative test period mean differences. D&T found significant overreaction out to three years in stocks using three year rank returns.

[39]The "J" ("D") suffix on the series label represents portfolios formed with a July (January) rank date. Neither series overlaps rank periods or test periods of three and six months. The "J1" ("J2") suffix represents portfolios first formed at the end of July, 1964 (1965) and every second July afterwards. Similarly, "D1" (D2") portfolios were first formed in January, 1965 (1966) and every second January afterwards. The latter four series do not overlap from rank period to eighteen month test period.

Early expectations for this study were to find overreaction with twelve to eighteen month rank periods.

Twelve month rank period

While not as striking as the previous results, Tables B.2.a and B.2.b show similar return persistence for EPs at short horizons. The three month test period t-statistic is significant at the ten percent level and the six and nine month ones at five percent. The APs have significant mean differences in seven of the eleven test periods with three at the one percent level. There are four negative mean difference point estimates at longer horizons although none are significant. Table B.2.b shows some overreaction emerging at distant horizons. Two of the four portfolios ranked every other year, DE__J1 and DE__D2, have significant negative differences at twenty-seven months indicating the overreaction result--losers outperforming winners. The latter series begins the test period with significant persistence or "underreaction," which reverses later.

Fifteen month rank period

The trend of less persistence and slightly increasing though insignificant overreaction continues during test periods of fifteen month rank portfolios. In Table B.3.a, positive MDs are significant at only two short horizons. Five MDs have negative though insignificant point estimates in later test periods. The APs exhibit similarly decreasing persistence although all of the point estimates are positive. Two of the four non-overlapped series in Table B.3.b, DE__J1 and DE__D2, have significantly negative MDs for longer holding periods. The other two series show continued persistence early in the test period.

Longer holding periods

By the eighteen month rank period, all of the significant persistence in the full series of MDs has disappeared; all the t-statistics in Table B.4.a are small except for two in the APs. Only the rank period and the first two test period lengths are not overlapping for the series in Table B.4.b, so the significantly negative test statistics at longer horizons may be suspect. Both the DE__J2 and DE__D1 series exhibit slight early persistence.

The longer rank periods represented in Tables B.5.a and B.6.a have lost all significant persistence and any trace of overreaction for both the EPs and the APs. Also, no hints can be gleaned from the subseries in Tables B.5.b and B.6.b. For the most part the MDs are small, the standard deviations are large and the t-statistics are not significant. The overlapping periods could be adding noise to the data precluding definitive conclusions, but a more likely scenario has t-statistics rejecting too often. Since the latter is not the case here, failure to reject efficiency using longer rank periods seems proper. With only twenty-eight years of data and a maximum four and one-half year total test period, a non-overlapping series has only six observations, too few for testing. No other way to generate significant results is available within this methodology for this sample.

Testing for Robustness

Three methods were used to test the robustness of the persistence result. First, November and May were used as rank months besides July and January for rank periods of six and twenty-four months. If the persistence had something to do with the crop year or production cycle, other rank dates might negate the finding. Second is the outlier problem. World sugar had the third highest unconditional variance, was present in the EPs far more often than other commodities and seemed to be have the most persistent moves. For example, 80.4% of the extreme portfolios contained sugar contracts with several consecutive rank dates in one or the other. The same methodology was followed with sugar removed from the sample to be sure its persistence and variance were not driving the result. Since one possible objection to this study is the inclusion of spread portfolios, the third test for robustness removes them from the sample. Spreads are simply linear combinations of other sample observations, so their addition may be redundant and could be driving the persistence result. Forming extreme portfolios without spreads will check for that possibility.

Other rank dates and sugar

The results of using November and May as rank dates with rank periods of six and twenty-four months are in Tables B.7.a, B.7.b, B.8.a, and B.8.b. Comparing the t-statistics in Table B.7.a with those in Table B.1.a shows some reductions. Significant persistence in Table B.1.a continues through the twenty-one month holding period but ends after fifteen months in Table B.7.a. The MDs are mostly smaller in Table B.7.a explaining the reduced t-statistics. Comparing results in Tables B.1.b and B.7.b show similar small differences. Two main differences are exhibited in the latter. Persistence is more evident in the once per year rank date series, DE__J and DE__D, but less evident in the bi-yearly series. DE__J1 shows strong overreaction at longer horizons not extant in other series.

Results for rank dates May and November for a twenty-four month holding period in Tables B.8.a and B.8.b are very similar to those for rank dates July and January. Neither persistence nor overreaction shows itself in any of the findings and efficiency cannot be rejected. In general, the persistence finding is robust to changes of rank date.

Removing world sugar from the sample of futures contracts studied produces little change in the results. The longer horizon MDs are much smaller without sugar which is expected considering its high volatility. But the standard deviation is similarly reduced so the t-statistics remain essentially unchanged. Except for smaller MDs and standard deviations, Table B.9.b results are very comparable to Table B.1.b so the persistence result is still verified and is robust to removal of at least one outlier.

<u>Removal of spread portfolios</u>

Spread portfolios are a combination of two or three futures contracts and so are less volatile than individual contracts. So variances for the EPs formed without spreads would likely be higher than with them and Tables B.10.a, B.10.b and B.11 reflect this difference. For the six month rank period results in Tables B.10.a and B.10.b, no change in conclusions is warranted. MDs of Table B.10.a are comparable with earlier results but, as noted, standard deviations of portfolio MDs are larger so the t-statistics are slightly smaller. Persistence is evident, too, in the series in Table B.10.b.

The greater volatility of MDs without spread portfolios created a small difficulty; during one fifteen month rank period, all futures contracts were winners so the loser portfolio was empty. The test strategy utilizing paired observations was changed and the t-statistic was calculated using pooled standard deviations. This combination of much larger variances and smaller MDs resulted in insignificant t-statistics, so no persistence or overreaction is observed in Table B.11.

Overall, the persistence result is robust to these three changes in strategy. Portfolios of winners formed by past returns from six or twelve month holding periods continue to outperform comparably created portfolios of losers at horizons of up to fifteen months. Point estimates of longer horizon MDs do turn negative indicating some evidence of overreaction, but are statistically significant in only a few cases.

Figures C.1, C.2 and C.3 in Appendix C offer a more graphic representation of the persistence result and its decay with longer rank periods. They depict the mean (solid line) and a 90% and 98% confidence interval (CI)[40] about the mean for all the return horizons. Figure C.1 shows the 90% CI to be completely positive for the first seven test horizons. The 98% CI is also completely positive for holding periods two through six so the persistence result is very significant. Figures C.2 and C.3 depict continued persistence but at decaying significance. Distant horizons in Figure C.3 show some evidence of the overreaction phenomenon but neither CI becomes completely negative at any horizon.

Measuring Portfolio Risk

As discussed in Chapter 4, the biggest challenge to proper interpretation of these findings is measuring the risk of winner and loser portfolios. If the former continues to outperform the latter because previously winning contracts are inherently riskier, the persistence finding is appropriate. Capital market theory predicts that risky assets will have high expected returns to reward holders of those assets for bearing risk. Return risk has customarily been associated with the variance of returns, such that higher variance implies greater risk.[41] A complete approach to risk measurement would look at the conditional portfolio variance as estimated by the sample variance of daily returns for some weeks or months prior to formation of each

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[40]A $(1-\alpha)\cdot 100\%$ confidence interval for mean μ using sample mean ū is

$$\bar{u}-t_{\frac{\alpha}{2}}\cdot\frac{\sigma}{\sqrt{n}} < \mu < \bar{u}+t_{\frac{\alpha}{2}}\cdot\frac{\sigma}{\sqrt{n}}$$

[41]The third and fourth moments of the return distribution are probably also related to risk but that has not been researched very completely.

portfolio. If the return performance was directly related to prior volatility, the persistence result would be expected. Daily returns were not available for this study.

The strategy of choosing only contracts with extreme past returns may accentuate the risk problem; this observation is the basis for the simple manner in which risk is measured here. If the distribution of returns is skewed to the right as many analysts believe and if a risk premium is paid to holders of volatile contracts, risky futures contracts would be found more often in winner than in loser portfolios. Just counting the number of times each contract shows up in winner and loser portfolios could indicate the extent of this particular problem.

Counting winners and losers

Tables B.13, B.14 and B.15 present the results of this analysis. Each contract was counted in one of four portfolios: extreme winner, extreme loser, other winner or other loser. Many contracts have different beginning trading dates so percentages of total observations were used rather than raw counts. Tables B.13 and B.15 list the percentages and standard deviations for individual commodities[42] from portfolios formed with a six and twelve month rank period

[42]The table results are sorted in order decreasing percentage of times spent in either extreme portfolio--times in winner plus times in loser divided by total observations.

respectively.[43] It is not immediately evident from the tables that the more variable futures are in either the winner or loser category more than the other. It is very evident, though, from cursory inspection that highly variable futures are more often in the extreme portfolios than not.

Table B.14 offers additional perspective. To obtain some measure of the relation between variance and percentage in specific portfolios, regressions were run with a constant and the standard deviation of each future as the independent variables and four different dependent variables: percentage of times in either extreme category, in winner portfolio, in loser portfolio, and in either winner category. R-square is the statistic of interest. In the six month rank period regression shown in Table B.14, 55.5% of the variance in the percentage in an extreme portfolio is explained by the unconditional standard deviation of the individual commodity. This is expected--the more widely dispersed the returns the more times the returns will be extreme. From the second and third regressions, almost twice as much variance in extreme winner percentage as extreme loser percentage is explained by standard deviation. So, highly volatile contracts are more likely to be losers than winners. The last regression further verifies that standard deviation is related to extreme returns and not to whether the returns are winners or losers. Similar, though not as striking results are

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[43]In Table B.15, the first ten futures in order are sugar, Winnipeg rye, unleaded gas, Winnipeg oats, palladium, crude oil, coffee, orange juice, soybean oil, and pork bellies.

presented in the lower half of Table B.14 for portfolios formed from a twelve month rank period.

While this simple analysis does not offer a detailed picture of portfolio risk, it shows that winner portfolios are probably not grossly more risky than loser portfolios. Granted this, returns from the two portfolios can be compared and the persistence result holds.

CHAPTER VII: EVIDENCE FOR RISK PREMIUMS

Along with the data calculations of earlier chapters, a fifth portfolio was formed. This buy-and-hold portfolio (BHP) includes both long positions of every futures contract and one unit of each spread portfolio. As noted in Chapter V, any significant returns to these holdings could be evidence of that elusive risk premium in futures markets. Using the definition in Equation (4.1), returns could be significantly greater or less than one. Either positive or negative returns would suffice. If the return was positive (negative) and significant, long traders (short traders) would earn the premium. From Keynes, longs are customarily thought to receive the return to risk but the theory is the same if the reverse happens. For either to occur, the futures market would be inefficient. If a systematic return exists anywhere, efficiency demands that agent arbitrage eliminates that possibility. If longs receive a systematic risk premium as Keynes suspected, rational sellers would account for that by a higher reservation price. Table B.17 contains four sets of grand total return statistics to the BHPs. All of the returns except for the three month test period are significantly greater than one. For example, the mean of series GRNB6 in the second group[44] is 1.0517. If this sample is

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[44]Series GRNB6 in the second group is the rank period return for a holding period of one year. This particular series covers almost all of the whole sample. The other grand total series include slightly different parts of the whole sample but essentially they all measure the same thing.

representative, on average the return from investing one dollar in the BHP would be 5.17 cents per year or a 5.17% return. This return to the BHP is also robust to the three different strategies described in Chapter VI. Table B.17 contains BHP returns with spread positions and sugar excluded from the sample to test for robustness. The GRN12 series mean return is positive and significant at the five percent level for both groups. The mean of series GRN12 with no spreads is 1.0762 or a 7.62% return for each dollar invested which is higher, but not significantly, than the mean of similar series with spreads.

The question posed in Chapter V remains: how can this BHP return be called a risk premium and be differentiated from unexpected inflation? Table B.12 lists one measure of low risk interest rates and one measure of inflation.[45] A trader who deposits US Treasury bills with the futures exchange to cover his margin will earn the risk-free rate in addition to the return on the BHP. With Shiller's average low-risk rate substantially above the average inflation rate, the extra return of the BHP is much above and beyond total inflation and so should certainly be greater than unexpected inflation. The definition of return used in this study should exclude all expected inflation. Successive period prices

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[45]The second column contains inflation returns comparable to the BHP returns using the Consumer Price Index (1983=100). The returns are CPI_{t+1}/CPI_t. The nominal interest rate series (1.0 + the interest rate) is from Shiller (1989) and is the total return to investing in prime commercial paper. The original source is the Federal Reserve Bulletin. The mean interest return is 1.0814 (or 8.14%) and the mean inflation return over the same time period is 1.0566 (or 5.66%). This 2.48% difference should be more than enough to account for the difference between prime commercial paper and US Treasury rates.

$P_{i,t,s}$ and $P_{i,t+1,s}$ are both prices of futures i for delivery in period s. If inflation is expected, it will be built equally into both prices and Equation (4.1) will eliminate it from the return.[46]

Figures C.4 and C.5 from Appendix C depict the risk premium and CI graphically. In Figure C.4, the 98% CI is completely above one at the twelve month test return horizon and beyond. The 90% CI moves above one at the six month horizon. Figure C.5 shows the returns to BHP formed with no spread portfolios. The CIs become all positive quicker since the BHP mean return point estimates without spreads are higher than those with spread positions.

[46]The return will include any change in inflation expectations from period t to t+1 but that is what unexpected inflation means.

CHAPTER VII: CONCLUSIONS

Summary of Major Goals and Findings

This study had several goals. The first was to assemble a large historical database of daily and/or monthly futures prices in a wide and diverse group of markets back twenty-five or thirty years. Several different sources had to be used to accomplish this. A second goal required researching the broad literature of market efficiency for a reference list of the major works dealing with efficiency theory and market anomalies.

The first major empirical goal was to examine this new database for evidence of overreaction by extending the DeBondt and Thaler (1985) strategy. Selection bias would not be a problem in this environment, nor would data mining be a problem as this database has not been studied as extensively as has stock market data.

Gathering evidence of potential risk premiums was the second empirical goal. Since positive risk premiums are very difficult to differentiate from unexpected inflation, a simple-minded but effective check on test results is to be sure the database used for the examination includes later periods of commodity deflation in addition to the well-known periods of inflation. The current database accomplishes that by sampling the commodity deflationary 1980s as well as the huge price rises of grain, metals and livestock in the 1970s.

A final goal is to extend other research in market efficiency to this database. This will be discussed more fully in the last section.

Persistence

Persistence in returns was the first phenomenon uncovered by this study. Portfolios of previous extreme winners outperform portfolios of extreme losers many months after the ranking date. In addition, portfolios of all previous winners continue to outperform all losers up to two years after ranking. Finally, while ranking periods of up to three years were used to form portfolios, no significant overreaction was identified. Some point estimates of MDs of distant return horizons were negative but significance levels could not reject zero MDs. Apparently, DeBondt and Thaler's finding of overreaction does not extend to futures markets. The joint hypothesis of market efficiency and the martingale model is still rejected by the persistence finding at medium horizons. However, the null hypothesis was market efficiency, so ORH was not rejected but was unsubstantiated. The persistence at shorter horizons in no way precludes an additional finding of overreaction at longer horizons. In fact there was some distinct evidence for it but it was not overwhelming.

First order evidence trends toward efficiency. Average returns to portfolios in the rank period were very significantly different from one.[47] MDs for the rank period ranged from 0.49 for a three month holding period to 1.27 for thirty-six months. The largest test period MDs were not much over 0.10--almost an order of magnitude difference.

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[47]See Table B.16. The longer the rank period, the greater (smaller) the mean return of the extreme winner (loser) portfolio.

Risk premium

The risk premium finding was the second major result of this study. It is very clear that a positive and significant return ranging from five to seven percent per year accrues to a buy-and-hold portfolio. While the unexpected inflation interpretation of this return is economically valid, the unique zero investment feature of futures markets points to a risk premium conclusion. Some suggestions to differentiate between the two will be made in the paper's final section.

Explanations for Phenomena

What kind of economic interpretation can be placed on the observation that winner portfolios continues to outperform loser portfolios at medium horizons? Ultimately, the ORH is still one explanation. Non-rational overweighting of recent information when agent probability distributions are updated could cause the observed short term persistence as well as DeBondt and Thaler's overreaction when the trend finally changes. While some evidence of overreaction was found, it was not pervasive enough to verify its presence. But this failure to observe overreaction does not reject it. Other established methods of financial research could be employed to examine the potential for negative serial correlation which is necessary for overreaction. Many market traders believe prices follow trends and this study has provided evidence for that belief.

A second interpretation for the persistence concerns how agents reflect information into asset prices. Some information is highly complex with ramifications that are not obvious and consequences that take a long time to unfold. In reality, market agents have different abilities and may be unwilling or unable to adjust prices to account for those consequences and prices would be slow to reflect them. Models of asymmetric information may be appropriate in this context.

Unequal risk for the winner and loser portfolios is a third possible explanation. Return is a reward for risk and if winner portfolios are more risky than losers, expected returns would be higher. While it was shown that highly volatile contracts are not on average more often in the winner portfolio, this study needs to be extended with more detailed examination of risk. At a minimum, conditional variances should be contrasted with test period returns. Perhaps variances would fall into ARCH or GARCH model categories.

There are two interpretations for the positive returns to the BH portfolio: inflation and risk premium. The final section presents some ideas to distinguish between them.

Limitations of this Research

There are several areas of potential problems with this study. Four of the areas have been discussed thoroughly above and will be briefly alluded to here. Whether futures contracts are really assets is one concern. The real question is whether futures prices behave like asset prices and most research has answered yes. A more difficult problem is the splicing of series of monthly contract prices together. Each different contract of one commodity represents different assets.[48] Storage costs and production expectations may add noise to the spliced series. There is no alternative to splicing for this kind of long term study, but it may obscure the real evidence. Similarly, the results of the empirical work may be built in the data by the series splicing or by the way the study was constructed.

Measurement of portfolio risk is a third concern. As mentioned above, the proper risk analysis would look at conditional variances at the date of portfolio formation. If there is a correlation between these conditional variances and test period returns then a reward for risk may be a factor in the persistence of positive returns. A fourth factor is the inability to differentiate between a positive risk premium and unexpected inflation. Both interpretations of the BH portfolio return are plausible.

Another potential pitfall is the inclusion of spread portfolios and how they are calculated. It could be argued they are redundant since all the underlying series are included. Several research papers have dealt exclusively with spreads, so the idea is not new. The relative price of two related commodities is the information added by the spreads. A positive aspect to spreads is their counter to inflation; being long and short related commodities inflation effects would not be noticed.

Transaction costs are not a part of this research. Following Jensen (1978), markets are efficient if there is no arbitrage return above

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[48]They may differ in delivery time, crop year and production cycle.

transaction costs. It is not known whether the persistence return or the risk premium is greater than economic costs of trading.

The last problem is part of the series splicing objection but from a different angle. Each time the splice occurs, real agents would have to sell one contract and buy another. Every time a transaction takes place there may be a liquidity risk--a risk of not being able to enter or exit the market. The two observed returns may be a response to this risk.

Directions for Future Research

There are two categories for potential research projects. The first sorts through the above questions to determine the validity of the objection and, if valid, refines the strategy to deal with it. The second applies other research methods to this database thereby extending those papers.

Refining the strategy

Transaction costs could be calculated and deducted from observed returns to see if the same findings obtain. If only contracts in which a very large trade volume and open interest are used, liquidity risk should not be a factor. If spreads positions are a concern, the entire project could be done without the spread portfolios and with only the spread positions.

Fourth, using this strategy with cash price series should avoid the splicing pitfalls and allow some differentiation between inflation and risk premium. Cash prices do not jump from contract to contract, do not have limit moves and do not have volume and open interest problems. Could there be overreaction or underreaction in cash prices? Another way to distinquish inflation from risk premium is to divide the series top to bottom. Follow the same methodology with series from January, 1964 to January, 1981 and series from February 1981 to the present. The former contained huge price rises in grains, metals and livestock. The latter was more of a deflationary time. If the risk premium surfaced in both of these subseries, the inflation interpretation could be discarded.

Other areas of research

It would be very interesting to look at long horizon returns in the same manner as Fama and French (1988) to test directly for negative serial correlation rather than indirectly as in this study. Another method with a similar end is variance ratio testing as in Poterba and Summers (1988). Other research methods in the finance literature could be applied to this database.

Futures contracts could be separated into groups and examined for overreaction within the groups. Grains, currencies, metals, meats, index futures, petroleum products, interest rate futures, and soft or food commodities are possible categories.

The biggest potential research area which crosses both of these categories is risk--definition, measurement and application. Most past examinations of risk have focused on the CAPM definition, where the only risk priced in equilibrium is market risk defined as correlation with the market return which cannot be diversified away. If markets are not strictly efficient, risk must be redefined. Risk is defined differently in continuous time models which may have application here. The Black-Scholes option pricing model is very widely used by financial traders and practitioners. Noise trader models show that the risk of price diverging from fundamental value is priced in equilibrium. Risk analysis in new directions offers vast potential for future research.

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APPENDIX A:

LIST OF FUTURES, SPREADS AND FUTURES EXCHANGES

Table A.1. List of futures contracts and exchanges

#	Code	Futures contract	Beginning date	Ending date	Exchange
1	CZ	Corn	Jan-64		CBOT
2	CT	Cotton	Jun-67		NYCTE
3	OZ	Oats	Jan-64		CBOT
4	SM	Soybean meal	Jan-64		CBOT
5	SO	Soybean oil	Jan-64		CBOT
6	SZ	Soybeans	Jan-64		CBOT
7	WZ	Wheat-Chicago	Jan-64		CBOT
8	KW	Wheat-Kansas City	Mar-76		KCBT
9	MW	Wheat-Minnesota	Jul-70		MGE
10	WB	Barley-Winnipeg	Nov-80		WCE
11	WF	Flaxseed-Winnipeg	Nov-80		WCE
12	RS	Rapeseed-Winnipeg	Oct-80		WCE
13	WR	Rye-Winnipeg	Nov-80		WCE
14	WW	Wheat-Winnipeg	Nov-80		WCE
15	WO	Oats-Winnipeg	Nov-80		WCE
16	FC	Feeder cattle	Oct-72		CME
17	LC	Live cattle	Nov-69		CME
18	LH	Live hogs	Jan-69		CME
19	PB	Pork Bellies	Jan-64		CME
20	BL	Broilers	Oct-68	Dec-78	CBOT
21	HG	Copper	Jan-64		COMEX
22	GC	Gold	Jan-75		COMEX
23	PA	Paladium	Jan-77		NYMEX
24	PL	Platinum	Mar-68		NYMEX
25	SI	Silver	Jan-64		COMEX
26	CD	Canadian dollar	Apr-76		IMM
27	BP	British pound	Mar-75		IMM
28	DM	German mark	Nov-74		IMM
29	JY	Japanese yen	Feb-77		IMM
30	SF	Swiss franc	Oct-74		IMM
31	CC	Cocoa	Jan-64		CSCE
32	KC	Coffee	Aug-73		CSCE
33	LB	Lumber	Aug-70		CME
34	JO	Orange juice	Feb-67		NYCTE
35	SB	Sugar-world	Jan-64		CSCE
36	SE	Shell eggs	Jan-64	Nov-79	CME
37	ED	Eurodollar time deposit	Feb-82		IMM
38	TB	T-bills: 90 day	Jan-76		IMM
39	TY	T-notes: 10 year	May-82		CBOT
40	FY	T-notes: 5 year	May-88		CBOT
41	US	T-bonds: 30 year	Sep-77		CBOT

Table A.1. continued

#	Code	Futures contract	Beginning date	Ending date	Exchange
42	CL	Crude oil	Apr-83		NYMEX
43	HO	Heating oil	Nov-79		NYMEX
44	HU	Unleaded gasoline	Jan-85		NYMEX
45	CR	CRB index	Aug-86		NYFE
46	MB	Muni-bond index	May-85		CBOT
47	SP	S&P 500 index	Apr-82		IOM-CME
48	DX	US dollar index	Nov-85		FINEX
49	YX	NYSE composite index	Apr-82		NYFE
50	KV	Value-line index	Feb-82		KCBT
51	GN	Ginnie Mae interest	Feb-76	Dec-86	CBOT
52	PW	Plywood	Jan-70	Jun-84	CBOT
53	NR	Rough rice	Aug-86		CRCE

Table A.2. Description of spread portfolios

#	Code	Spread description	Beginning date
54	GCSI	Gold-silver	Feb-75
55	CZSZ	Corn-soybeans	Jan-64
56	CZWZ	Corn-wheat	Jan-64
57	SZCT	Soybeans-cotton	Jun-67
58	LHPB	Live hogs-pork bellies	Feb-69
59	LCLH	Live cattle-live hogs	Feb-69
60	CZLC	Corn-live cattle	Nov-64
61	CZFC	Corn-feeder cattle	Oct-72
62	CZLH	Corn-live hogs	Feb-69
63	FCCZLC	Cattle feeding margin	Oct-72
64	SZSMSO	Soybean crush margin	Jan-64
65	TBED	T-bill-Eurodollar rate	Feb-82
66	TBUS	Term structure of rates	Sep-77

Table A.3. List of all futures exchanges

Code	Name of exchange
CBOT	Chicago Board of Trade
CME	Chicago Mercantile Exchange
CRCE	Chicago Rice & Cotton Exchange
CSCE	Coffee, Sugar, & Cocoa Exchange
COMEX	Commodity Exchange, Inc.
FINEX	Financial Instrument Exchange
IOM	Index & Option Market
IMM	International Monetary Market
KCBT	Kansas City Board of Trade
MGE	Minneapolis Grain Exchange
NYCTE	New York Cotton Exchange
NYFE	New York Futures Exchange, Inc.
NYMEX	New York Mercantile Exchange
WCE	Winnipeg Commodity Exchange

APPENDIX B:

TABLES OF RESULTS

This appendix contains all the tables for the research. This page provides a list of all the series names and a description of the labelling system.

"D" at the label beginning refers to "difference" between winner and loser means. "E" in second position refers to "extreme" portfolios. "A" in second position refers to portfolios of "all" the futures. "B6" at the end refers to the rank period or "before" ranking. This can refer to any length rank period. The "Z" at the end is a filler and is meaningless. The "3" or "6" or ... refer to months and is the test holding period length. The "J", "D", "J1", "J2", "D1", and "D2" suffixes are explained in footnote thirty-nine on page forty-four.

For Tables B.16 and B.17, the only difference is the prefix. These are not differences, but are the actual means. "EX" refers to "extreme" portfolios. "AL" refers to portfolios of "all" futures contracts. The "GRN" prefix refers to means of buy-and-hold portfolios.

Table B.1.a. Statistics for a six month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	56	0.49132	0.21419	17.166***
DE3Z	56	0.24634E-01	0.10973	1.6800*
DE6Z	55	0.70911E-01	0.16267	3.2330***
DE9Z	55	0.10058	0.19151	3.8949***
DE12	54	0.13250	0.28403	3.4280***
DE15	54	0.10540	0.26710	2.8997***
DE18	53	0.10026	0.32034	2.2785**
DE21	53	0.10034	0.42589	1.7152*
DE24	52	0.47791E-01	0.49695	0.69348
DE27	52	-0.18309E-01	0.63133	-0.20913
DE30	51	-0.40111E-01	0.65760	-0.43560
DAB6	56	0.26015	0.14171	13.738***
DA3Z	56	0.32264E-01	0.11415	2.1152**
DA6Z	55	0.63655E-01	0.14392	3.2802***
DA9Z	55	0.80363E-01	0.13508	4.4122***
DA12	54	0.98588E-01	0.19068	3.7995***
DA15	54	0.81166E-01	0.19148	3.1149***
DA18	53	0.85676E-01	0.22884	2.7256***
DA21	53	0.87741E-01	0.25517	2.5033**
DA24	52	0.62784E-01	0.26343	1.7186*
DA27	52	0.20282E-01	0.27000	0.54168
DA30	51	0.26411E-01	0.28703	0.65712

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.1.b. Statistics for a six month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	28	0.46002	0.22605	10.768***
DE3ZJ	28	0.33325E-01	0.10481	1.6825*
DE6ZJ	28	0.55502E-01	0.17722	1.6572
DE9ZJ	28	0.64820E-01	0.19072	1.7984*
DE12J	27	0.86131E-01	0.24732	1.8096*
DE15J	27	0.66813E-01	0.24921	1.3931
DE18J	27	0.32740E-01	0.26059	0.65284
DE21J	27	-0.53372E-02	0.35515	-0.78088E-01
DE24J	26	-0.87647E-01	0.53162	-0.84067
DE27J	26	-0.14450	0.82294	-0.89537
DE30J	26	-0.15554	0.83789	-0.94657
DEB6D	28	0.52263	0.20080	13.772***
DE3ZD	28	0.15943E-01	0.11569	0.72920
DE6ZD	27	0.86891E-01	0.14772	3.0565***
DE9ZD	27	0.13767	0.18867	3.7913***
DE12D	27	0.17886	0.31435	2.9566***
DE15D	27	0.14399	0.28326	2.6414**
DE18D	26	0.17038	0.36441	2.3841**
DE21D	26	0.21009	0.47065	2.2761**
DE24D	26	0.18323	0.42782	2.1839**
DE27D	26	0.10789	0.32054	1.7162*
DE30D	25	0.79938E-01	0.37437	1.0677

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.1.b. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	14	0.43995	0.14453	11.390***
DE3ZJ1	14	0.71189E-01	0.99340E-01	2.6813***
DE6ZJ1	14	0.97059E-01	0.16500	2.2010**
DE9ZJ1	14	0.99155E-01	0.22877	1.6217
DE12J1	14	0.99392E-01	0.24726	1.5040
DE15J1	14	0.53446E-01	0.22927	0.87223
DE18J1	14	0.40404E-01	0.28178	0.53651
DE21J1	14	-0.21749E-01	0.42400	-0.19193
DE24J1	13	-0.15753	0.67326	-0.84362
DE27J1	13	-0.28950	1.1128	-0.93803
DE30J1	13	-0.27247	1.0950	-0.89719
DEB6J2	14	0.48008	0.29047	6.1841***
DE3ZJ2	14	-0.45386E-02	0.99284E-01	-0.17104
DE6ZJ2	14	0.13945E-01	0.18516	0.28180
DE9ZJ2	14	0.30484E-01	0.14377	0.79338
DE12J2	13	0.71850E-01	0.25665	1.0094
DE15J2	13	0.81208E-01	0.27782	1.0539
DE18J2	13	0.24485E-01	0.24691	0.35755
DE21J2	13	0.12337E-01	0.27908	0.15938
DE24J2	13	-0.17765E-01	0.35344	-0.18123
DE27J2	13	0.48936E-03	0.35651	0.49491E-02
DE30J2	13	-0.38614E-01	0.48372	-0.28782
DEB6D1	14	0.50058	0.16921	11.069***
DE3ZD1	14	0.16337E-01	0.11974	0.51050
DE6ZD1	14	0.91690E-01	0.15979	2.1470**
DE9ZD1	14	0.99632E-01	0.21209	1.7577*
DE12D1	14	0.18463	0.39792	1.7361*
DE15D1	14	0.15803	0.32898	1.7974*
DE18D1	13	0.20775	0.44697	1.6758
DE21D1	13	0.30136	0.59732	1.8190*
DE24D1	13	0.23227	0.49239	1.7008*
DE27D1	13	0.13221	0.31302	1.5229
DE30D1	13	0.17182	0.35793	1.7308*
DEB6D2	14	0.54467	0.23252	8.7647***
DE3ZD2	14	0.15549E-01	0.11602	0.50145
DE6ZD2	13	0.81722E-01	0.13986	2.1068**
DE9ZD2	13	0.17862	0.15778	4.0818***
DE12D2	13	0.17264	0.20610	3.0203***
DE15D2	13	0.12886	0.23689	1.9613*
DE18D2	13	0.13301	0.27175	1.7649*
DE21D2	13	0.11882	0.29434	1.4555
DE24D2	13	0.13419	0.36557	1.3235
DE27D2	13	0.83563E-01	0.33880	0.88929
DE30D2	12	-0.19604E-01	0.38109	-0.17820

Table B.2.a. Statistics for a twelve month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	55	0.76925	0.38265	14.909***
DE3Z	55	0.31075E-01	0.13452	1.7131*
DE6Z	54	0.66926E-01	0.19021	2.5856**
DE9Z	54	0.61569E-01	0.19205	2.3559**
DE12	53	0.49638E-01	0.22971	1.5732
DE15	53	0.32305E-01	0.26996	0.87118
DE18	52	0.13076E-01	0.30797	0.30617
DE21	52	-0.10855E-01	0.31225	-0.25068
DE24	51	-0.54780E-01	0.38193	-1.0243
DE27	51	-0.42646E-01	0.38106	-0.79922
DE30	50	-0.36727E-01	0.39653	-0.65493
DAB6	55	0.38478	0.16977	16.808***
DA3Z	55	0.18476E-01	0.58875E-01	2.3273**
DA6Z	54	0.45607E-01	0.92964E-01	3.6051***
DA9Z	54	0.51371E-01	0.11426	3.3037***
DA12	53	0.61358E-01	0.15676	2.8495***
DA15	53	0.53798E-01	0.17574	2.2286**
DA18	52	0.56069E-01	0.20199	2.0017*
DA21	52	0.49025E-01	0.19226	1.8388*
DA24	51	0.44567E-01	0.21537	1.4778
DA27	51	0.31077E-01	0.20698	1.0722
DA30	50	0.35110E-01	0.23071	1.0761

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.2.b. Statistics for a twelve month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	28	0.75577	0.33152	12.063***
DE3ZJ	28	0.14859E-01	0.12830	0.61283
DE6ZJ	27	0.63960E-01	0.16223	2.0487*
DE9ZJ	27	0.78119E-01	0.21596	1.8796*
DE12J	27	0.59715E-01	0.24622	1.2602
DE15J	27	0.19187E-01	0.28649	0.34800
DE18J	26	-0.19159E-02	0.33435	-0.29218E-01
DE21J	26	0.10795E-02	0.34742	0.15844E-01
DE24J	26	-0.23872E-01	0.37710	-0.32279
DE27J	26	-0.54342E-02	0.37583	-0.73728E-01
DE30J	25	-0.35327E-01	0.39082	-0.45196
DEB6D	27	0.78323	0.43540	9.3471***
DE3ZD	27	0.47891E-01	0.14112	1.7634*
DE6ZD	27	0.69892E-01	0.21774	1.6679*
DE9ZD	27	0.45019E-01	0.16726	1.3986
DE12D	26	0.39174E-01	0.21559	0.92652
DE15D	26	0.45928E-01	0.25662	0.91259
DE18D	26	0.28068E-01	0.28501	0.50214
DE21D	26	-0.22789E-01	0.27912	-0.41632
DE24D	25	-0.86925E-01	0.39199	-1.1088
DE27D	25	-0.81347E-01	0.39030	-1.0421
DE30D	25	-0.38127E-01	0.41022	-0.46471

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.2.b. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	14	0.73628	0.22921	12.019***
DE3ZJ1	14	0.10851E-01	0.15109	0.26872
DE6ZJ1	14	0.49455E-01	0.19193	0.96414
DE9ZJ1	14	0.10488E-01	0.21423	0.18317
DE12J1	14	0.13592E-01	0.25715	0.19776
DE15J1	14	-0.47055E-01	0.31696	-0.55548
DE18J1	13	-0.91956E-01	0.38789	-0.85474
DE21J1	13	-0.90887E-01	0.40261	-0.81393
DE24J1	13	-0.15024	0.40678	-1.3317
DE27J1	13	-0.16071	0.35767	-1.6201
DE30J1	13	-0.13613	0.40785	-1.2034
DEB6J2	14	0.77526	0.41821	6.9361***
DE3ZJ2	14	0.18867E-01	0.10643	0.66330
DE6ZJ2	13	0.79580E-01	0.12886	2.2266**
DE9ZJ2	13	0.15095	0.20062	2.7130***
DE12J2	13	0.10939	0.23359	1.6884*
DE15J2	13	0.90524E-01	0.24158	1.3511
DE18J2	13	0.88124E-01	0.25469	1.2475
DE21J2	13	0.93046E-01	0.26653	1.2587
DE24J2	13	0.10250	0.31014	1.1916
DE27J2	13	0.14984	0.33778	1.5995
DE30J2	12	0.73876E-01	0.35604	0.71879
DEB6D1	14	0.80484	0.52890	5.6938***
DE3ZD1	14	-0.17631E-01	0.13982	-0.47182
DE6ZD1	14	0.28768E-01	0.24937	0.43165
DE9ZD1	14	0.32849E-01	0.15301	0.80326
DE12D1	13	0.29807E-01	0.22952	0.46823
DE15D1	13	0.56479E-01	0.28718	0.70911
DE18D1	13	0.10406E-01	0.29913	0.12543
DE21D1	13	-0.84143E-02	0.33751	-0.89889E-01
DE24D1	13	-0.15516E-01	0.44714	-0.12511
DE27D1	13	0.40698E-01	0.41225	0.35594
DE30D1	13	0.10940	0.40410	0.97609
DEB6D2	13	0.75996	0.32646	8.3932***
DE3ZD2	13	0.11845	0.10755	3.9709***
DE6ZD2	13	0.11418	0.17681	2.3284**
DE9ZD2	13	0.58124E-01	0.18679	1.1219
DE12D2	13	0.48541E-01	0.20966	0.83474
DE15D2	13	0.35378E-01	0.23342	0.54646
DE18D2	13	0.45729E-01	0.28121	0.58632
DE21D2	13	-0.37164E-01	0.21897	-0.61193
DE24D2	12	-0.16429	0.32340	-1.7597*
DE27D2	12	-0.21356	0.33209	-2.2277**
DE30D2	12	-0.19794	0.36802	-1.8632*

Table B.3.a. Statistics for a fifteen month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	54	0.90864	0.49442	13.505***
DE3Z	54	0.11078E-01	0.10833	0.75147
DE6Z	53	0.45901E-01	0.16123	2.0726*
DE9Z	53	0.59296E-01	0.19326	2.2337**
DE12	52	0.54812E-01	0.27555	1.4344
DE15	52	0.97401E-02	0.22743	0.30883
DE18	51	-0.11666E-01	0.24917	-0.33434
DE21	51	-0.20904E-01	0.24002	-0.62197
DE24	50	-0.39022E-01	0.29025	-0.95065
DE27	50	-0.65136E-01	0.32264	-1.4275
DE30	49	-0.49088E-01	0.36570	-0.93961
DAB6	54	0.45427	0.20428	16.341***
DA3Z	54	0.69091E-02	0.59921E-01	0.84730
DA6Z	53	0.29475E-01	0.91678E-01	2.3406**
DA9Z	53	0.32693E-01	0.11380	2.0915*
DA12	52	0.41191E-01	0.15823	1.8773*
DA15	52	0.25068E-01	0.16755	1.0789
DA18	51	0.27561E-01	0.17958	1.0961
DA21	51	0.20590E-01	0.15940	0.92250
DA24	50	0.30627E-01	0.22375	0.96786
DA27	50	0.26318E-01	0.26837	0.69343
DA30	49	0.26635E-01	0.26683	0.69875

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.3.b. Statistics for a fifteen month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	27	0.89805	0.53334	8.7494***
DE3ZJ	27	0.19352E-01	0.11034	0.91132
DE6ZJ	27	0.43613E-01	0.19442	1.1656
DE9ZJ	27	0.33062E-01	0.21204	0.81018
DE12J	26	0.41679E-01	0.33916	0.62661
DE15J	26	0.97361E-03	0.25993	0.19099E-01
DE18J	26	-0.21113E-01	0.25531	-0.42166
DE21J	26	-0.62019E-01	0.22502	-1.4054
DE24J	25	-0.86326E-01	0.27620	-1.5627
DE27J	25	-0.11275	0.26578	-2.1211**
DE30J	25	-0.85827E-01	0.30648	-1.4002
DEB6D	27	0.91923	0.46220	10.334***
DE3ZD	27	0.28037E-02	0.10772	0.13525
DE6ZD	26	0.48276E-01	0.12143	2.0271*
DE9ZD	26	0.86540E-01	0.17150	2.5731**
DE12D	26	0.67945E-01	0.19875	1.7432*
DE15D	26	0.18507E-01	0.19440	0.48542
DE18D	25	-0.18403E-02	0.24749	-0.37180E-01
DE21D	25	0.21855E-01	0.25208	0.43350
DE24D	25	0.82808E-02	0.30175	0.13721
DE27D	25	-0.17521E-01	0.37036	-0.23653
DE30D	24	-0.10817E-01	0.42200	-0.12557

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.3.b. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	14	0.87215	0.53016	6.1553***
DE3ZJ1	14	-0.31245E-01	0.10114	-1.1560
DE6ZJ1	14	0.25456E-02	0.19663	0.48441E-01
DE9ZJ1	14	-0.86986E-02	0.11308	-0.28784
DE12J1	13	-0.32394E-01	0.18254	-0.63985
DE15J1	13	-0.53439E-01	0.21436	-0.89885
DE18J1	13	-0.10332	0.16383	-2.2740**
DE21J1	13	-0.11739	0.16400	-2.5808**
DE24J1	13	-0.11327	0.19719	-2.0711**
DE27J1	13	-0.81711E-01	0.21472	-1.3721
DE30J1	13	-0.28167E-01	0.29340	-0.34614
DEB6J2	13	0.92595	0.55695	5.9944***
DE3ZJ2	13	0.73841E-01	0.95369E-01	2.7917***
DE6ZJ2	13	0.87840E-01	0.18954	1.6710*
DE9ZJ2	13	0.78034E-01	0.28168	0.99886
DE12J2	13	0.11575	0.44095	0.94649
DE15J2	13	0.55386E-01	0.29732	0.67167
DE18J2	13	0.61098E-01	0.30711	0.71730
DE21J2	13	-0.66522E-02	0.26823	-0.89419E-01
DE24J2	12	-0.57138E-01	0.34963	-0.56612
DE27J2	12	-0.14638	0.31852	-1.5920
DE30J2	12	-0.14829	0.32070	-1.6018
DEB6D1	14	0.92800	0.51061	6.8002***
DE3ZD1	14	0.22833E-01	0.10186	0.83869
DE6ZD1	13	0.83633E-01	0.13023	2.3154**
DE9ZD1	13	0.18071	0.15565	4.1861***
DE12D1	13	0.13489	0.19596	2.4820**
DE15D1	13	0.90250E-01	0.19937	1.6321
DE18D1	13	0.10081	0.26780	1.3573
DE21D1	13	0.11458	0.24607	1.6788*
DE24D1	13	0.11777	0.29886	1.4209
DE27D1	13	0.85265E-01	0.36628	0.83932
DE30D1	12	0.25641E-01	0.36019	0.24660
DEB6D2	13	0.90978	0.42453	7.7268***
DE3ZD2	13	-0.18766E-01	0.11370	-0.59509
DE6ZD2	13	0.12919E-01	0.10513	0.44310
DE9ZD2	13	-0.76320E-02	0.13353	-0.20608
DE12D2	13	0.99634E-03	0.18489	0.19430E-01
DE15D2	13	-0.53237E-01	0.16683	-1.1506
DE18D2	12	-0.11304	0.17163	-2.2817**
DE21D2	12	-0.78591E-01	0.22676	-1.2006
DE24D2	12	-0.11034	0.26779	-1.4273
DE27D2	12	-0.12887	0.35624	-1.2532
DE30D2	12	-0.47275E-01	0.48961	-0.33448

Table B.4.a. Statistics for an eighteen month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	54	1.0401	0.62421	12.244***
DE3Z	54	0.11414E-01	0.10177	0.82415
DE6Z	53	0.23368E-01	0.15010	1.1334
DE9Z	53	0.21911E-01	0.17222	0.92624
DE12	52	0.80622E-02	0.20601	0.28221
DE15	52	-0.12814E-01	0.20152	-0.45852
DE18	51	-0.35293E-01	0.24605	-1.0244
DE21	51	-0.15023E-01	0.24854	-0.43167
DE24	50	-0.16616E-01	0.31904	-0.36828
DE27	50	-0.44257E-01	0.35880	-0.87221
DE30	49	0.28199E-02	0.44012	0.44851E-01
DAB6	54	0.50885	0.24413	15.317***
DA3Z	54	0.77697E-02	0.57563E-01	0.99187
DA6Z	53	0.26144E-01	0.87295E-01	2.1804**
DA9Z	53	0.24851E-01	0.10410	1.7379*
DA12	52	0.28137E-01	0.13546	1.4979
DA15	52	0.18292E-01	0.16002	0.82431
DA18	51	0.13548E-01	0.17718	0.54606
DA21	51	0.77228E-02	0.16934	0.32569
DA24	50	0.18851E-01	0.22366	0.59600
DA27	50	0.70504E-02	0.21035	0.23700
DA30	49	0.30119E-01	0.28345	0.74381

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.4.b. Statistics for an eighteen month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	27	1.0068	0.66751	7.8375***
DE3ZJ	27	0.20536E-01	0.10438	1.0223
DE6ZJ	27	0.17998E-01	0.16881	0.55400
DE9ZJ	27	-0.41687E-02	0.15213	-0.14238
DE12J	26	-0.26231E-01	0.20584	-0.64978
DE15J	26	-0.22700E-01	0.22015	-0.52577
DE18J	26	-0.46013E-01	0.26387	-0.88917
DE21J	26	-0.35625E-01	0.26551	-0.68417
DE24J	25	-0.52736E-01	0.35646	-0.73972
DE27J	25	-0.75341E-01	0.38648	-0.97470
DE30J	25	-0.12476E-01	0.43312	-0.14403
DEB6D	27	1.0733	0.58856	9.4761***
DE3ZD	27	0.22926E-02	0.10023	0.11886
DE6ZD	26	0.28944E-01	0.13101	1.1265
DE9ZD	26	0.48994E-01	0.19006	1.3144
DE12D	26	0.42356E-01	0.20435	1.0569
DE15D	26	-0.29280E-02	0.18487	-0.80757E-01
DE18D	25	-0.24143E-01	0.23096	-0.52268
DE21D	25	0.64029E-02	0.23307	0.13736
DE24D	25	0.19503E-01	0.27934	0.34910
DE27D	25	-0.13174E-01	0.33385	-0.19730
DE30D	24	0.18754E-01	0.45605	0.20146

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.4.a. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	14	0.96737	0.58017	6.2388***
DE3ZJ1	14	-0.26370E-01	0.92227E-01	-1.0698
DE6ZJ1	14	0.22367E-02	0.17500	0.47822E-01
DE9ZJ1	14	-0.12539E-01	0.93652E-01	-0.50097
DE12J1	13	-0.32101E-01	0.19531	-0.59262
DE15J1	13	-0.22198E-01	0.23748	-0.33702
DE18J1	13	-0.49540E-01	0.23202	-0.76985
DE21J1	13	-0.28485E-01	0.26990	-0.38053
DE24J1	13	0.50332E-01	0.34226	0.53022
DE27J1	13	0.72323E-01	0.27804	0.93787
DE30J1	13	0.13384	0.42058	1.1474
DEB6J2	13	1.0493	0.77264	4.8965***
DE3ZJ2	13	0.71049E-01	0.95193E-01	2.6910***
DE6ZJ2	13	0.34972E-01	0.16723	0.75403
DE9ZJ2	13	0.48454E-02	0.20118	0.86840E-01
DE12J2	13	-0.20361E-01	0.22373	-0.32814
DE15J2	13	-0.23202E-01	0.21112	-0.39625
DE18J2	13	-0.42486E-01	0.30198	-0.50727
DE21J2	13	-0.42765E-01	0.27187	-0.56716
DE24J2	12	-0.16439	0.35112	-1.6219
DE27J2	12	-0.23531	0.43344	-1.8806*
DE30J2	12	-0.17099	0.40450	-1.4644
DEB6D1	14	1.0893	0.73811	5.5217***
DE3ZD1	14	0.31460E-01	0.84643E-01	1.3907
DE6ZD1	13	0.63406E-01	0.14983	1.5258
DE9ZD1	13	0.13191	0.21050	2.2594**
DE12D1	13	0.10258	0.20797	1.7784*
DE15D1	13	0.70589E-01	0.19541	1.3024
DE18D1	13	0.78463E-01	0.25497	1.1096
DE21D1	13	0.96957E-01	0.24349	1.4357
DE24D1	13	0.12366	0.29411	1.5160
DE27D1	13	0.76521E-01	0.34472	0.80038
DE30D1	12	0.85077E-01	0.43083	0.68406
DEB6D2	13	1.0562	0.39963	9.5290***
DE3ZD2	13	-0.29118E-01	0.10928	-0.96071
DE6ZD2	13	-0.55184E-02	0.10362	-0.19201
DE9ZD2	13	-0.33924E-01	0.12669	-0.96546
DE12D2	13	-0.17867E-01	0.18944	-0.34005
DE15D2	13	-0.76445E-01	0.14598	-1.8882*
DE18D2	12	-0.13530	0.13979	-3.3529***
DE21D2	12	-0.91697E-01	0.18343	-1.7317*
DE24D2	12	-0.93338E-01	0.22173	-1.4582
DE27D2	12	-0.11034	0.30616	-1.2485
DE30D2	12	-0.47570E-01	0.48954	-0.33662

Table B.5.a. Statistics for a twenty-four month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	53	1.2392	0.83221	10.840***
DE3Z	53	0.82947E-03	0.11803	0.51164E-01
DE6Z	52	0.21356E-01	0.18195	0.84638
DE9Z	52	0.11878E-01	0.19122	0.44793
DE12	51	0.60781E-02	0.24115	0.18000
DE15	51	-0.21341E-01	0.24436	-0.62369
DE18	50	-0.14850E-01	0.28363	-0.37023
DE21	50	-0.34628E-01	0.30341	-0.80700
DE24	49	0.20010E-02	0.38867	0.36038E-01
DE27	49	0.17321E-01	0.40230	0.30138
DE30	48	0.73394E-01	0.56100	0.90641
DAB6	53	0.60973	0.31122	14.263***
DA3Z	53	0.10545E-01	0.57254E-01	1.3408
DA6Z	52	0.21879E-01	0.89024E-01	1.7722*
DA9Z	52	0.21475E-01	0.11556	1.3401
DA12	51	0.21658E-01	0.15153	1.0207
DA15	51	0.16737E-01	0.15794	0.75680
DA18	50	0.22472E-01	0.21477	0.73987
DA21	50	0.13632E-01	0.19818	0.48638
DA24	49	0.36065E-01	0.29424	0.85798
DA27	49	0.38249E-01	0.33502	0.79920
DA30	48	0.50538E-01	0.38440	0.91087

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.5.b. Statistics for a twenty-four month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	27	1.2156	0.74719	8.4533***
DE3ZJ	27	-0.82133E-02	0.13174	-0.32395
DE6ZJ	26	0.19230E-01	0.15252	0.64290
DE9ZJ	26	0.32762E-01	0.17683	0.94472
DE12J	26	0.22802E-01	0.21283	0.54630
DE15J	26	-0.89659E-02	0.22879	-0.19982
DE18J	25	-0.21355E-02	0.29680	-0.35976E-01
DE21J	25	-0.19989E-01	0.31023	-0.32217
DE24J	25	0.20621E-01	0.41355	0.24931
DE27J	25	0.13632E-01	0.33774	0.20180
DE30J	24	0.91395E-01	0.59254	0.75563
DEB6D	26	1.2638	0.92666	6.9539***
DE3ZD	26	0.10220E-01	0.10365	0.50276
DE6ZD	26	0.23483E-01	0.21040	0.56911
DE9ZD	26	-0.90070E-02	0.20595	-0.22301
DE12D	25	-0.11315E-01	0.27084	-0.20888
DE15D	25	-0.34211E-01	0.26369	-0.64870
DE18D	25	-0.27565E-01	0.27535	-0.50056
DE21D	25	-0.49266E-01	0.30210	-0.81539
DE24D	24	-0.17394E-01	0.36884	-0.23104
DE27D	24	0.21164E-01	0.46766	0.22170
DE30D	24	0.55393E-01	0.53975	0.50277

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.5.b. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	14	1.1806	0.68723	6.4277***
DE3ZJ1	14	0.76353E-02	0.11889	0.24031
DE6ZJ1	13	0.39263E-01	0.15617	0.90648
DE9ZJ1	13	0.86035E-01	0.17559	1.7667
DE12J1	13	0.49965E-01	0.21756	0.82807
DE15J1	13	0.43645E-01	0.25737	0.61143
DE18J1	13	0.10429	0.31880	1.1795
DE21J1	13	0.11788	0.29466	1.4424
DE24J1	13	0.17058	0.44940	1.3686
DE27J1	13	0.88812E-01	0.30971	1.0339
DE30J1	12	0.20808	0.66669	1.0812
DEB6J2	13	1.2532	0.83369	5.4201***
DE3ZJ2	13	-0.25281E-01	0.14726	-0.61900
DE6ZJ2	13	-0.80391E-03	0.15232	-0.19029E-01
DE9ZJ2	13	-0.20510E-01	0.16782	-0.44064
DE12J2	13	-0.43616E-02	0.21315	-0.73779E-01
DE15J2	13	-0.61577E-01	0.19188	-1.1571
DE18J2	12	-0.11743	0.23116	-1.7598*
DE21J2	12	-0.16935	0.26165	-2.2421**
DE24J2	12	-0.14184	0.31218	-1.5739
DE27J2	12	-0.67814E-01	0.36101	-0.65072
DE30J2	12	-0.25287E-01	0.50986	-0.17180
DEB6D1	13	1.3276	1.1696	4.0928***
DE3ZD1	13	0.56674E-01	0.10174	2.0086*
DE6ZD1	13	0.30443E-01	0.20581	0.53333
DE9ZD1	13	0.23313E-01	0.27100	0.31018
DE12D1	13	0.55381E-01	0.30901	0.64620
DE15D1	13	0.28516E-01	0.27595	0.37258
DE18D1	13	0.27262E-01	0.28178	0.34883
DE21D1	13	-0.34179E-01	0.32368	-0.38073
DE24D1	12	-0.50324E-01	0.37714	-0.46224
DE27D1	12	0.61649E-02	0.60554	0.35268E-01
DE30D1	12	-0.12309E-02	0.57220	-0.74520E-02
DEB6D2	13	1.1999	0.64206	6.7381***
DE3ZD2	13	-0.36234E-01	0.85774E-01	-1.5231
DE6ZD2	13	0.16522E-01	0.22307	0.26705
DE9ZD2	13	-0.41327E-01	0.11251	-1.3244
DE12D2	12	-0.83569E-01	0.21197	-1.3657
DE15D2	12	-0.10216	0.24279	-1.4577
DE18D2	12	-0.86961E-01	0.26720	-1.1274
DE21D2	12	-0.65610E-01	0.29029	-0.78293
DE24D2	12	0.15535E-01	0.37397	0.14390
DE27D2	12	0.36163E-01	0.30020	0.41729
DE30D2	12	0.11202	0.52416	0.74031

Table B.6.a. Statistics for a thirty-six month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	51	1.2659	1.1563	7.8182***
DE3Z	51	0.54099E-02	0.97307E-01	0.39703
DE6Z	50	0.33331E-01	0.15656	1.5054
DE9Z	50	0.36244E-01	0.20500	1.2502
DE12	49	0.62194E-01	0.30148	1.4441
DE15	49	0.64765E-01	0.30175	1.5024
DE18	48	0.64043E-01	0.41219	1.0765
DE21	48	0.85122E-01	0.44780	1.3170
DE24	47	0.11236	0.63995	1.2037
DE27	47	0.15733	0.79503	1.3567
DE30	46	0.19101	0.79831	1.6228
DAB6	51	0.77589	0.39249	14.117***
DA3Z	51	0.59822E-02	0.64368E-01	0.66371
DA6Z	50	0.17248E-01	0.88527E-01	1.3777
DA9Z	50	0.11256E-01	0.11506	0.69174
DA12	49	0.20915E-01	0.16542	0.88504
DA15	49	0.21053E-02	0.16336	0.90215E-01
DA18	48	0.16872E-01	0.22946	0.50943
DA21	48	0.14148E-01	0.22324	0.43908
DA24	47	0.29796E-01	0.28933	0.70600
DA27	47	0.24177E-01	0.31202	0.53121
DA30	46	0.34742E-01	0.33428	0.70488

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.6.b. Statistics for a thirty-six month rank period

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	26	1.2461	1.0612	5.9876***
DE3ZJ	26	-0.47668E-02	0.10186	-0.23863
DE6ZJ	25	0.14013E-01	0.15526	0.45129
DE9ZJ	25	0.15013E-01	0.18966	0.39580
DE12J	25	0.27315E-01	0.22474	0.60771
DE15J	25	0.28665E-01	0.22779	0.62921
DE18J	24	0.47473E-01	0.34116	0.68170
DE21J	24	0.48698E-01	0.42614	0.55983
DE24J	24	0.35402E-01	0.44833	0.38685
DE27J	24	0.78629E-01	0.34415	1.1193
DE30J	23	0.14250	0.61435	1.1125
DEB6D	25	1.2865	1.2695	5.0668
DE3ZD	25	0.15994E-01	0.93225E-01	0.85780
DE6ZD	25	0.52650E-01	0.15863	1.6595
DE9ZD	25	0.57475E-01	0.22111	1.2997
DE12D	24	0.98526E-01	0.36645	1.3172
DE15D	24	0.10237	0.36468	1.3752
DE18D	24	0.80613E-01	0.47982	0.82306
DE21D	24	0.12155	0.47477	1.2542
DE24D	23	0.19266	0.79559	1.1614
DE27D	23	0.23946	1.0881	1.0554
DE30D	23	0.23951	0.95981	1.1967

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.6.b. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	13	1.2544	1.1769	3.8432***
DE3ZJ1	13	-0.14989E-01	0.11771	-0.45909
DE6ZJ1	13	0.17884E-01	0.16856	0.38253
DE9ZJ1	13	-0.19261E-01	0.14809	-0.46895
DE12J1	13	0.23491E-01	0.23222	0.36474
DE15J1	13	0.30774E-01	0.23730	0.46757
DE18J1	12	0.21312E-01	0.37603	0.19633
DE21J1	12	0.91690E-01	0.57146	0.55580
DE24J1	12	0.71870E-01	0.48206	0.51646
DE27J1	12	0.46370E-01	0.25725	0.62440
DE30J1	12	0.67601E-01	0.26132	0.89611
DEB6J2	13	1.2378	0.98022	4.5529***
DE3ZJ2	13	0.54549E-02	0.86777E-01	0.22665
DE6ZJ2	12	0.98201E-02	0.14683	0.23169
DE9ZJ2	12	0.52143E-01	0.22730	0.79468
DE12J2	12	0.31457E-01	0.22656	0.48098
DE15J2	12	0.26381E-01	0.22752	0.40167
DE18J2	12	0.73633E-01	0.31696	0.80476
DE21J2	12	0.57055E-02	0.22160	0.89191E-01
DE24J2	12	-0.10659E-02	0.43009	-0.85849E-02
DE27J2	12	0.11089	0.42332	0.90742
DE30J2	11	0.22422	0.86089	0.86381
DEB6D1	13	1.2999	1.2331	3.8009
DE3ZD1	13	-0.18640E-01	0.88976E-01	-0.75535
DE6ZD1	13	0.52695E-01	0.17096	1.1113
DE9ZD1	13	0.43215E-01	0.13748	1.1334
DE12D1	12	0.47030E-01	0.22881	0.71202
DE15D1	12	0.11309	0.39135	1.0011
DE18D1	12	0.81241E-01	0.32306	0.87113
DE21D1	12	0.52504E-01	0.23038	0.78949
DE24D1	12	0.81073E-01	0.28975	0.96926
DE27D1	12	0.52838E-01	0.31210	0.58648
DE30D1	12	0.81775E-01	0.24694	1.1472
DEB6D2	12	1.2719	1.3628	3.2331
DE3ZD2	12	0.53513E-01	0.85861E-01	2.1590
DE6ZD2	12	0.52601E-01	0.15172	1.2010
DE9ZD2	12	0.72923E-01	0.29249	0.86367
DE12D2	12	0.15002	0.47185	1.1014
DE15D2	12	0.91641E-01	0.35309	0.89908
DE18D2	12	0.79985E-01	0.61401	0.45125
DE21D2	12	0.19059	0.63861	1.0338
DE24D2	11	0.31440	1.1265	0.92567
DE27D2	11	0.44304	1.5525	0.94647
DE30D2	11	0.41158	1.3774	0.99104

Table B.7.a. Statistics for a six month rank period using November and May

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	55	0.49009	0.19366	18.768***
DE3Z	55	0.46367E-01	0.11608	2.9624***
DE6Z	54	0.52383E-01	0.13400	2.8726***
DE9Z	54	0.10075	0.19700	3.7582***
DE12	53	0.85467E-01	0.22777	2.7318***
DE15	53	0.85931E-01	0.28778	2.1738**
DE18	52	0.68742E-01	0.31466	1.5754
DE21	52	0.42015E-01	0.32435	0.93409
DE24	51	0.68028E-02	0.34126	0.14236
DE27	51	0.19336E-01	0.37255	0.37065
DE30	50	0.60066E-01	0.48067	0.88362
DAB6	55	0.24500	0.87062E-01	20.870***
DA3Z	55	0.31590E-01	0.69095E-01	3.3907***
DA6Z	54	0.41187E-01	0.76562E-01	3.9532***
DA9Z	54	0.81780E-01	0.12626	4.7596***
DA12	53	0.75562E-01	0.16181	3.3997***
DA15	53	0.75805E-01	0.20427	2.7017***
DA18	52	0.69444E-01	0.23705	2.1125**
DA21	52	0.66876E-01	0.27750	1.7378*
DA24	51	0.27551E-01	0.36577	0.53790
DA27	51	0.57052E-01	0.31043	1.3125
DA30	50	0.66484E-01	0.27682	1.6983*

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.7.b. Statistics for a six month rank period using November and May

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	28	0.49047	0.16385	15.840***
DE3ZJ	28	0.58128E-01	0.13309	2.3110**
DE6ZJ	27	0.55531E-01	0.13536	2.1316**
DE9ZJ	27	0.10236	0.18016	2.9524***
DE12J	27	0.73969E-01	0.20710	1.8559*
DE15J	27	0.39662E-01	0.25615	0.80457
DE18J	26	0.42098E-02	0.30431	0.70540E-01
DE21J	26	-0.38183E-01	0.33632	-0.57889
DE24J	26	-0.68558E-01	0.37699	-0.92729
DE27J	26	-0.63196E-01	0.39830	-0.80903
DE30J	25	-0.62128E-01	0.42305	-0.73429
DEB6D	27	0.48969	0.22364	11.378***
DE3ZD	27	0.34171E-01	0.96362E-01	1.8426*
DE6ZD	27	0.49235E-01	0.13513	1.8932*
DE9ZD	27	0.99147E-01	0.21599	2.3852**
DE12D	26	0.97408E-01	0.25102	1.9787*
DE15D	26	0.13398	0.31514	2.1678**
DE18D	26	0.13327	0.31736	2.1413**
DE21D	26	0.12221	0.29685	2.0992**
DE24D	25	0.85178E-01	0.28639	1.4871
DE27D	25	0.10517	0.32992	1.5939
DE30D	25	0.18226	0.51150	1.7816*

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.7.b. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	14	0.52951	0.18248	10.858***
DE3ZJ1	14	0.59012E-02	0.10101	0.21859
DE6ZJ1	14	0.77156E-02	0.13754	0.20989
DE9ZJ1	14	0.37719E-01	0.20613	0.68468
DE12J1	14	-0.19822E-01	0.20123	-0.36857
DE15J1	14	-0.54069E-01	0.23398	-0.86463
DE18J1	13	-0.10753	0.30868	-1.2560
DE21J1	13	-0.18299	0.32621	-2.0226**
DE24J1	13	-0.25033	0.35652	-2.5316**
DE27J1	13	-0.25195	0.32155	-2.8252***
DE30J1	13	-0.25488	0.27117	-3.3889***
DEB6J2	14	0.45143	0.13849	12.196***
DE3ZJ2	14	0.11035	0.14392	2.8691***
DE6ZJ2	13	0.10703	0.11691	3.3008***
DE9ZJ2	13	0.17198	0.11903	5.2094***
DE12J2	13	0.17498	0.16656	3.7878***
DE15J2	13	0.14060	0.24812	2.0432**
DE18J2	13	0.11595	0.26569	1.5735
DE21J2	13	0.10663	0.28949	1.3280
DE24J2	13	0.11321	0.31208	1.3080
DE27J2	13	0.12556	0.38720	1.1692
DE30J2	12	0.14668	0.46775	1.0863
DEB6D1	14	0.50380	0.23738	7.9410***
DE3ZD1	14	0.43012E-01	0.11016	1.4610
DE6ZD1	14	0.56109E-01	0.12279	1.7097*
DE9ZD1	14	0.12496	0.24147	1.9363*
DE12D1	13	0.11483	0.19217	2.1545**
DE15D1	13	0.15404	0.28014	1.9825*
DE18D1	13	0.17805	0.32387	1.9823*
DE21D1	13	0.13509	0.29154	1.6707
DE24D1	13	0.99448E-01	0.25652	1.3978
DE27D1	13	0.10823	0.26980	1.4463
DE30D1	13	0.13228	0.29131	1.6372
DEB6D2	13	0.47450	0.21643	7.9049***
DE3ZD2	13	0.24650E-01	0.82364E-01	1.0791
DE6ZD2	13	0.41832E-01	0.15204	0.99205
DE9ZD2	13	0.71350E-01	0.19053	1.3502
DE12D2	13	0.79986E-01	0.30608	0.94223
DE15D2	13	0.11392	0.35714	1.1501
DE18D2	13	0.88495E-01	0.31716	1.0060
DE21D2	13	0.10934	0.31342	1.2578
DE24D2	12	0.69719E-01	0.32660	0.73948
DE27D2	12	0.10186	0.39756	0.88753
DE30D2	12	0.23641	0.68711	1.1919

Table B.8.a. Statistics for a twenty-four month rank period with May and November

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	52	1.2209	0.79698	11.047***
DE3Z	52	0.26414E-01	0.12067	1.5785
DE6Z	51	0.17324E-01	0.17819	0.69429
DE9Z	51	0.29743E-01	0.20719	1.0252
DE12	50	-0.14488E-02	0.22930	-0.44677E-01
DE15	50	0.14822E-01	0.31292	0.33493
DE18	49	0.23543E-01	0.40986	0.40209
DE21	49	0.96063E-02	0.39313	0.17105
DE24	48	0.31363E-01	0.57512	0.37781
DE27	48	0.46014E-01	0.49028	0.65022
DE30	47	0.73080E-01	0.60763	0.82453
DAB6	52	0.58134	0.30119	13.919***
DA3Z	52	0.11929E-01	0.10790	0.79723
DA6Z	51	-0.37422E-02	0.11348	-0.23551
DA9Z	51	0.14648E-01	0.14060	0.74398
DA12	50	0.17071E-02	0.17318	0.69702E-01
DA15	50	-0.36667E-02	0.20190	-0.12842
DA18	49	0.60066E-03	0.22744	0.18487E-01
DA21	49	0.15187E-01	0.23782	0.44703
DA24	48	0.54095E-02	0.23277	0.16101
DA27	48	0.29774E-01	0.32031	0.64400
DA30	47	0.56882E-01	0.41112	0.94854

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.8.b. Statistics for a twenty-four month rank period with May and November

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	26	1.1657	0.56944	10.439***
DE3ZJ	26	0.35089E-01	0.10568	1.6931*
DE6ZJ	26	0.49659E-01	0.17380	1.4569
DE9ZJ	26	0.44005E-01	0.21633	1.0372
DE12J	25	-0.14866E-02	0.24716	-0.30075E-01
DE15J	25	0.28155E-01	0.31027	0.45373
DE18J	25	0.57924E-01	0.47178	0.61389
DE21J	25	0.90367E-02	0.36554	0.12361
DE24J	24	-0.11291E-02	0.39841	-0.13883E-01
DE27J	24	0.54892E-01	0.50703	0.53037
DE30J	24	0.10548	0.73529	0.70280
DEB6D	26	1.2760	0.98243	6.6228***
DE3ZD	26	0.17740E-01	0.13557	0.66721
DE6ZD	25	-0.16305E-01	0.17993	-0.45310
DE9ZD	25	0.14910E-01	0.20059	0.37164
DE12D	25	-0.14109E-02	0.21508	-0.32799E-01
DE15D	25	0.14877E-02	0.32137	0.23146E-01
DE18D	24	-0.12271E-01	0.34015	-0.17673
DE21D	24	0.10200E-01	0.42793	0.11677
DE24D	24	0.63855E-01	0.71762	0.43592
DE27D	24	0.37135E-01	0.48370	0.37611
DE30D	23	0.39268E-01	0.45215	0.41650

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.8.b. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	13	1.1694	0.61697	6.8339***
DE3ZJ1	13	0.60294E-01	0.88684E-01	2.4513**
DE6ZJ1	13	0.87545E-01	0.20249	1.5589
DE9ZJ1	13	0.48388E-01	0.17892	0.97514
DE12J1	13	0.50055E-01	0.29579	0.61015
DE15J1	13	0.79667E-01	0.29926	0.95983
DE18J1	13	0.65525E-01	0.32340	0.73053
DE21J1	13	0.44341E-01	0.32005	0.49953
DE24J1	12	-0.18961E-01	0.36711	-0.17892
DE27J1	12	0.54379E-01	0.52948	0.35577
DE30J1	12	0.16286	0.92856	0.60759
DEB6J2	13	1.1621	0.54300	7.7162***
DE3ZJ2	13	0.98833E-02	0.11842	0.30091
DE6ZJ2	13	0.11772E-01	0.13718	0.30941
DE9ZJ2	13	0.39622E-01	0.25581	0.55845
DE12J2	12	-0.57324E-01	0.17691	-1.1225
DE15J2	12	-0.27649E-01	0.32527	-0.29445
DE18J2	12	0.49690E-01	0.60941	0.28246
DE21J2	12	-0.29209E-01	0.42038	-0.24070
DE24J2	12	0.16703E-01	0.44320	0.13055
DE27J2	12	0.55406E-01	0.50712	0.37847
DE30J2	12	0.48102E-01	0.51092	0.32614
DEB6D1	13	1.4299	1.2544	4.1101***
DE3ZD1	13	-0.85633E-02	0.14727	-0.20965
DE6ZD1	13	-0.28208E-01	0.23394	-0.43475
DE9ZD1	13	-0.69054E-02	0.24565	-0.10136
DE12D1	13	-0.33272E-01	0.27105	-0.44258
DE15D1	13	0.13025E-02	0.41095	0.11427E-01
DE18D1	12	-0.75165E-01	0.33904	-0.76798
DE21D1	12	-0.54943E-01	0.53171	-0.35795
DE24D1	12	0.51787E-01	0.97688	0.18364
DE27D1	12	-0.18194E-01	0.56685	-0.11118
DE30D1	12	0.18170E-01	0.46029	0.13675
DEB6D2	13	1.1221	0.62122	6.5126***
DE3ZD2	13	0.44042E-01	0.12289	1.2921
DE6ZD2	12	-0.34093E-02	0.10286	-0.11482
DE9ZD2	12	0.38543E-01	0.14419	0.92596
DE12D2	12	0.33105E-01	0.13520	0.84822
DE15D2	12	0.16884E-02	0.20273	0.28850E-01
DE18D2	12	0.50623E-01	0.34400	0.50977
DE21D2	12	0.75342E-01	0.30152	0.86559
DE24D2	12	0.75922E-01	0.34950	0.75251
DE27D2	12	0.92464E-01	0.40150	0.79777
DE30D2	11	0.62284E-01	0.46432	0.44489

Table B.9.a. Statistics for a six month rank period with no sugar contracts

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	56	0.45906	0.20553	16.714***
DE3Z	56	0.26039E-01	0.10416	1.8706*
DE6Z	55	0.74186E-01	0.17027	3.2312***
DE9Z	55	0.98155E-01	0.18123	4.0167***
DE12	54	0.11557	0.27667	3.0697***
DE15	54	0.87251E-01	0.23496	2.7288***
DE18	53	0.74100E-01	0.26071	2.0692*
DE21	53	0.65935E-01	0.28944	1.6584
DE24	52	0.19409E-01	0.31798	0.44017
DE27	52	-0.67154E-02	0.31403	-0.15420
DE30	51	-0.35106E-01	0.36431	-0.68818
DAB6	56	0.25104	0.14085	13.338***
DA3Z	56	0.32406E-01	0.11517	2.1056**
DA6Z	55	0.64075E-01	0.14785	3.2140***
DA9Z	55	0.80586E-01	0.13373	4.4691***
DA12	54	0.94881E-01	0.18390	3.7914***
DA15	54	0.76159E-01	0.17802	3.1437***
DA18	53	0.75133E-01	0.21547	2.5385**
DA21	53	0.77056E-01	0.22131	2.5348**
DA24	52	0.57333E-01	0.22386	1.8468*
DA27	52	0.28935E-01	0.19790	1.0543
DA30	51	0.30698E-01	0.22771	0.96275

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.9.b. Statistics for a six month rank period with no sugar contracts

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	28	0.42977	0.22584	10.070***
DE3ZJ	28	0.22109E-01	0.97005E-01	1.2060
DE6ZJ	28	0.47599E-01	0.17278	1.4577
DE9ZJ	28	0.70130E-01	0.18178	2.0414*
DE12J	27	0.78227E-01	0.25841	1.5730
DE15J	27	0.54156E-01	0.22739	1.2375
DE18J	27	0.19592E-01	0.20137	0.50555
DE21J	27	0.18218E-03	0.24241	0.39050E-02
DE24J	26	-0.59633E-01	0.28984	-1.0491
DE27J	26	-0.59865E-01	0.33758	-0.90424
DE30J	26	-0.65364E-01	0.36321	-0.91763
DEB6D	28	0.48835	0.18239	14.168***
DE3ZD	28	0.29968E-01	0.11252	1.4093
DE6ZD	27	0.10176	0.16632	3.1791***
DE9ZD	27	0.12722	0.17937	3.6854***
DE12D	27	0.15292	0.29388	2.7039***
DE15D	27	0.12034	0.24198	2.5842**
DE18D	26	0.13070	0.30440	2.1895**
DE21D	26	0.13422	0.32190	2.1261**
DE24D	26	0.98452E-01	0.33055	1.5187
DE27D	26	0.46435E-01	0.28520	0.83018
DE30D	25	-0.36375E-02	0.37021	-0.49128E-01

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.9.b. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	14	0.39692	0.12973	11.448***
DE3ZJ1	14	0.54158E-01	0.91672E-01	2.2105**
DE6ZJ1	14	0.70679E-01	0.18469	1.4319
DE9ZJ1	14	0.10278	0.22737	1.6914*
DE12J1	14	0.87479E-01	0.27442	1.1927
DE15J1	14	0.38002E-01	0.19725	0.72086
DE18J1	14	0.18437E-01	0.18757	0.36778
DE21J1	14	-0.14854E-01	0.23795	-0.23358
DE24J1	13	-0.10934	0.28288	-1.3937
DE27J1	13	-0.13172	0.37328	-1.2723
DE30J1	13	-0.14262	0.38794	-1.3255
DEB6J2	14	0.46262	0.29458	5.8762***
DE3ZJ2	14	-0.99397E-02	0.94487E-01	-0.39361
DE6ZJ2	14	0.24518E-01	0.16354	0.56096
DE9ZJ2	14	0.37478E-01	0.12100	1.1589
DE12J2	13	0.68263E-01	0.25078	0.98142
DE15J2	13	0.71553E-01	0.26315	0.98038
DE18J2	13	0.20836E-01	0.22303	0.33684
DE21J2	13	0.16375E-01	0.25580	0.23082
DE24J2	13	-0.99266E-02	0.29940	-0.11954
DE27J2	13	0.11986E-01	0.29478	0.14661
DE30J2	13	0.11891E-01	0.33378	0.12845
DEB6D1	14	0.46592	0.17022	10.242***
DE3ZD1	14	0.54478E-01	0.10629	1.9178*
DE6ZD1	14	0.14271	0.18897	2.8256***
DE9ZD1	14	0.12935	0.20016	2.4180**
DE12D1	14	0.17868	0.35482	1.8842*
DE15D1	14	0.13066	0.24593	1.9879*
DE18D1	13	0.14641	0.31597	1.6708
DE21D1	13	0.15077	0.30472	1.7840*
DE24D1	13	0.70531E-01	0.25057	1.0149
DE27D1	13	0.45474E-01	0.24918	0.65799
DE30D1	13	0.63773E-01	0.36105	0.63685
DEB6D2	14	0.51079	0.19757	9.6734***
DE3ZD2	14	0.54580E-02	0.11706	0.17446
DE6ZD2	13	0.57656E-01	0.13109	1.5858
DE9ZD2	13	0.12493	0.16216	2.7776***
DE12D2	13	0.12518	0.22163	2.0365**
DE15D2	13	0.10924	0.24717	1.5936
DE18D2	13	0.11499	0.30441	1.3620
DE21D2	13	0.11766	0.34988	1.2125
DE24D2	13	0.12637	0.40392	1.1280
DE27D2	13	0.47396E-01	0.32767	0.52152
DE30D2	12	-0.76665E-01	0.38161	-0.69594

Table B.10.a. Statistics for a six month rank period with no spread portfolio

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6	56	0.55270	0.26854	15.402***
DE3Z	56	0.28614E-01	0.13072	1.6381
DE6Z	55	0.81708E-01	0.17842	3.3963***
DE9Z	55	0.11200	0.21313	3.8972***
DE12	54	0.12890	0.29884	3.1696***
DE15	54	0.10757	0.30912	2.5572**
DE18	53	0.82187E-01	0.37085	1.6134
DE21	53	0.92538E-01	0.48097	1.4007
DE24	52	0.28712E-01	0.59054	0.35061
DE27	52	-0.37443E-01	0.76583	-0.35256
DE30	51	-0.41858E-01	0.74890	-0.39915
DAB6	56	0.29346	0.16596	13.232***
DA3Z	56	0.34500E-01	0.86848E-01	2.9727***
DA6Z	55	0.62837E-01	0.13709	3.3994***
DA9Z	55	0.80335E-01	0.15127	3.9386***
DA12	54	0.94330E-01	0.22131	3.1322***
DA15	54	0.74966E-01	0.23246	2.3699**
DA18	53	0.70685E-01	0.26774	1.9220*
DA21	53	0.77333E-01	0.30735	1.8318*
DA24	52	0.47730E-01	0.34792	0.98926
DA27	52	-0.22976E-02	0.38546	-0.42983E-01
DA30	51	0.77738E-02	0.41310	0.13439

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.10.b. Statistics for a six month rank period with no spread portfolio

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J	28	0.51823	0.28421	9.6486***
DE3ZJ	28	0.38966E-01	0.14029	1.4697
DE6ZJ	28	0.63984E-01	0.19707	1.7180*
DE9ZJ	28	0.67791E-01	0.20090	1.7856*
DE12J	27	0.75729E-01	0.30001	1.3116
DE15J	27	0.51378E-01	0.33039	0.80803
DE18J	27	-0.11225E-01	0.36153	-0.16133
DE21J	27	-0.44684E-01	0.44381	-0.52316
DE24J	26	-0.14865	0.64592	-1.1734
DE27J	26	-0.20384	0.98466	-1.0556
DE30J	26	-0.18144	0.94585	-0.97810
DEB6D	28	0.58717	0.25232	12.314***
DE3ZD	28	0.18262E-01	0.12208	0.79160
DE6ZD	27	0.10009	0.15842	3.2829***
DE9ZD	27	0.15785	0.21942	3.7381***
DE12D	27	0.18207	0.29354	3.2229***
DE15D	27	0.16376	0.28118	3.0263***
DE18D	26	0.17919	0.36182	2.5253**
DE21D	26	0.23504	0.48464	2.4729**
DE24D	26	0.20607	0.47831	2.1968**
DE27D	26	0.12896	0.41147	1.5981
DE30D	25	0.10330	0.43984	1.1743

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.10.b. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
DEB6J1	14	0.49946	0.18844	9.9171***
DE3ZJ1	14	0.81952E-01	0.14808	2.0708*
DE6ZJ1	14	0.10223	0.18202	2.1014**
DE9ZJ1	14	0.96505E-01	0.24491	1.4744
DE12J1	14	0.79511E-01	0.27876	1.0672
DE15J1	14	0.22033E-01	0.29967	0.27510
DE18J1	14	-0.33706E-01	0.41163	-0.30638
DE21J1	14	-0.79461E-01	0.55045	-0.54013
DE24J1	13	-0.26319	0.84070	-1.1287
DE27J1	13	-0.40741	1.3508	-1.0874
DE30J1	13	-0.35051	1.2857	-0.98295
DEB6J2	14	0.53699	0.36262	5.5410***
DE3ZJ2	14	-0.40191E-02	0.12235	-0.12291
DE6ZJ2	14	0.25741E-01	0.21066	0.45721
DE9ZJ2	14	0.39077E-01	0.14855	0.98426
DE12J2	13	0.71656E-01	0.33286	0.77619
DE15J2	13	0.82981E-01	0.37033	0.80792
DE18J2	13	0.12986E-01	0.31370	0.14925
DE21J2	13	-0.72313E-02	0.30916	-0.84334E-01
DE24J2	13	-0.34105E-01	0.36604	-0.33595
DE27J2	13	-0.28186E-03	0.32472	-0.31296E-02
DE30J2	13	-0.12359E-01	0.38581	-0.11550
DEB6D1	14	0.54729	0.17093	11.980***
DE3ZD1	14	0.17781E-01	0.13132	0.50662
DE6ZD1	14	0.10290	0.15117	2.5471**
DE9ZD1	14	0.97231E-01	0.21523	1.6903*
DE12D1	14	0.15601	0.33259	1.7551*
DE15D1	14	0.17399	0.32321	2.0142**
DE18D1	13	0.20546	0.43475	1.7039*
DE21D1	13	0.33380	0.62580	1.9232*
DE24D1	13	0.29049	0.56679	1.8479*
DE27D1	13	0.20590	0.33342	2.2265**
DE30D1	13	0.25634	0.33348	2.7715**
DEB6D2	14	0.62705	0.31557	7.4349***
DE3ZD2	14	0.18743E-01	0.11707	0.59907
DE6ZD2	13	0.97059E-01	0.17205	2.0340**
DE9ZD2	13	0.22314	0.21267	3.7830***
DE12D2	13	0.21013	0.25536	2.9669***
DE15D2	13	0.15275	0.24058	2.2892**
DE18D2	13	0.15293	0.28677	1.9228*
DE21D2	13	0.13628	0.27670	1.7757*
DE24D2	13	0.12165	0.37407	1.1725
DE27D2	13	0.52021E-01	0.47827	0.39218
DE30D2	12	-0.62483E-01	0.49306	-0.43899

Table B.11. Statistics for a fifteen month rank period with no spread portfolios

Series	Mean	Pld Stnd dvn[a]	T-stat[b]
DE3Z	0.0088	0.0972	0.4685
DE6Z	0.0431	0.1930	1.144
DE9Z	0.0536	0.2067	1.329
DE12	0.0275	0.3162	0.441
DE15	-0.0312	0.3016	-0.525
DE18	-0.0717	0.4163	-0.866
DE21	-0.0907	0.4141	-1.100
DE24	-0.0999	0.4683	-1.061

[a]Pooled standard deviation.

[b]T-statistic tests whether mean is zero.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.12. Comparing interest rates and inflation

Year	Inflation rate	Interest rate
1964: 1	1.01309	1.04090
1965: 1	1.01722	1.04460
1966: 1	1.02857	1.05440
1967: 1	1.02881	1.05550
1968: 1	1.04200	1.06170
1969: 1	1.05374	1.08050
1970: 1	1.05920	1.09110
1971: 1	1.04299	1.05660
1972: 1	1.03298	1.04620
1973: 1	1.06225	1.07930
1974: 1	1.10969	1.11030
1975: 1	1.09140	1.07240
1976: 1	1.05769	1.05700
1977: 1	1.06452	1.05280
1978: 1	1.07603	1.07780
1979: 1	1.11470	1.10880
1980: 1	1.13459	1.11370
1981: 1	1.10243	1.17630
1982: 1	1.05986	1.14600
1983: 1	1.03222	1.09370
1984: 1	1.04431	1.11110
1985: 1	1.03568	1.08350
1986: 1	1.01924	1.07310
1987: 1	1.03568	1.06550
1988: 1	1.04137	NA
1989: 1	1.04793	NA
1990: 1	1.05396	NA

Table B.13. Count of winners and losers for a twelve month rank period

#	Futures code	Total extreme %	Total winner %	Extreme winner %	Extreme loser %	Standard deviation
44	HU	76.9%	69.2%	61.5%	15.4%	0.21671
15	WO	71.4%	33.3%	28.6%	42.9%	0.27151
13	WR	71.4%	14.3%	9.5%	61.9%	0.19191
35	SB	69.1%	43.6%	25.5%	43.6%	0.40323
32	KC	65.7%	57.1%	40.0%	25.7%	0.24881
23	PA	65.5%	44.8%	34.5%	31.0%	0.34233
24	PL	60.9%	41.3%	23.9%	37.0%	0.27214
18	LH	60.0%	60.0%	44.4%	15.6%	0.20770
34	JO	58.3%	56.3%	37.5%	20.8%	0.26013
31	CC	58.2%	38.2%	25.5%	32.7%	0.34520
10	WB	57.1%	33.3%	14.3%	42.9%	0.16713
53	NR	55.6%	66.7%	33.3%	22.2%	0.52783
14	WW	52.4%	38.1%	33.3%	19.0%	0.17666
11	WF	52.4%	19.0%	9.5%	42.9%	0.16404
5	SO	50.9%	49.1%	27.3%	23.6%	0.30493
21	HG	50.9%	56.4%	29.1%	21.8%	0.26324
19	PB	49.1%	49.1%	23.6%	25.5%	0.23860
33	LB	48.8%	48.8%	22.0%	26.8%	0.19527
22	GC	48.5%	42.4%	18.2%	30.3%	0.23986
36	SE	46.7%	53.3%	20.0%	26.7%	0.20936
2	CT	45.8%	54.2%	29.2%	16.7%	0.21546
25	SI	45.5%	38.2%	18.2%	27.3%	0.42567
47	SP	44.4%	77.8%	33.3%	11.1%	0.12004
49	YX	44.4%	72.2%	33.3%	11.1%	0.11957
62	CZLH	44.4%	33.3%	13.3%	31.1%	0.11298
42	CL	43.8%	62.5%	31.3%	12.5%	0.22558
51	GN	40.0%	55.0%	30.0%	10.0%	0.08767
30	SF	39.4%	39.4%	21.2%	18.2%	0.10249
43	HO	39.1%	60.9%	30.4%	8.7%	0.14841
3	OZ	36.4%	34.5%	7.3%	29.1%	0.17830
50	KV	33.3%	55.6%	22.2%	11.1%	0.14930
54	GCSI	33.3%	60.6%	21.2%	12.1%	0.10401
41	US	33.3%	48.1%	25.9%	7.4%	0.09091
16	FC	32.4%	59.5%	24.3%	8.1%	0.13327
4	SM	30.9%	50.9%	16.4%	14.5%	0.32242
7	WZ	30.9%	40.0%	12.7%	18.2%	0.20078
12	RS	28.6%	23.8%	9.5%	19.0%	0.18229
29	JY	28.6%	46.4%	17.9%	10.7%	0.10961

Table B.13. continued

#	Futures code	Total extreme %	Total winner %	Extreme winner %	Extreme loser %	Standard deviation
20	BL	27.8%	50.0%	11.1%	16.7%	0.21857
1	CZ	27.3%	41.8%	10.9%	16.4%	0.17974
28	DM	27.3%	45.5%	15.2%	12.1%	0.09247
52	PW	25.9%	44.4%	11.1%	14.8%	0.21230
27	BP	25.0%	56.3%	15.6%	9.4%	0.10202
60	CZLC	24.5%	24.5%	5.7%	18.9%	0.08596
9	MW	23.8%	35.7%	9.5%	14.3%	0.19283
56	CZWZ	23.6%	45.5%	7.3%	16.4%	0.08315
8	KW	23.3%	40.0%	13.3%	10.0%	0.14813
39	TY	22.2%	61.1%	22.2%	0.0%	0.06703
6	SZ	21.8%	45.5%	12.7%	9.1%	0.23222
61	CZFC	21.6%	29.7%	13.5%	8.1%	0.11773
57	SZCT	20.8%	47.9%	6.3%	14.6%	0.11044
17	LC	20.8%	67.9%	17.0%	3.8%	0.12285
48	DX	18.2%	36.4%	0.0%	18.2%	0.07342
59	LCLH	17.8%	40.0%	6.7%	11.1%	0.06973
58	LHPB	15.6%	75.6%	15.6%	0.0%	0.07895
55	CZSZ	14.5%	50.9%	3.6%	10.9%	0.06547
64	SZSMSO	10.9%	36.4%	3.6%	7.3%	0.03674
66	TBUS	7.4%	48.1%	7.4%	0.0%	0.03652
37	ED	5.6%	83.3%	5.6%	0.0%	0.02159
63	FCCZLC	5.4%	35.1%	0.0%	5.4%	0.04607
26	CD	3.3%	46.7%	3.3%	0.0%	0.03481
38	TB	3.2%	61.3%	3.2%	0.0%	0.02194
40	FY	0.0%	83.3%	0.0%	0.0%	0.05000
46	MB	0.0%	75.0%	0.0%	0.0%	0.04632
45	CR	0.0%	44.4%	0.0%	0.0%	0.04632
65	TBED	0.0%	22.2%	0.0%	0.0%	0.00334

Table B.14. Count regressions for six month and twelve month rank period

Dependent variable	R-squared	Beta	Standard deviation
	Six month rank period		
Total extreme percent	0.555	1.425	0.159
Extreme winner percent	0.285	0.582	0.115
Extreme loser percent	0.520	0.843	0.101
Total winner percent	0.048	-0.274	0.152
	Twelve month rank period		
Total extreme percent	0.536	1.395	0.162
Extreme winner percent	0.293	0.642	0.125
Extreme loser percent	0.382	0.753	0.120
Total winner percent	0.006	-0.111	0.176

Table B.15. Count of winners and losers for a six month rank period

#	Futures code	Total extreme %	Total winner %	Extreme winner %	Extreme loser %	Standard deviation
35	SB	80.4%	41.1%	32.1%	48.2%	0.40323
13	WR	72.7%	22.7%	18.2%	54.5%	0.19191
44	HU	71.4%	71.4%	50.0%	21.4%	0.21671
15	WO	68.2%	36.4%	27.3%	40.9%	0.27151
23	PA	66.7%	50.0%	26.7%	40.0%	0.34233
42	CL	64.7%	47.1%	41.2%	23.5%	0.22558
32	KC	63.9%	52.8%	33.3%	30.6%	0.24881
34	JO	59.2%	55.1%	32.7%	26.5%	0.26013
5	SO	58.9%	46.4%	32.1%	26.8%	0.30493
19	PB	58.9%	50.0%	28.6%	30.4%	0.23860
43	HO	58.3%	58.3%	37.5%	20.8%	0.14841
22	GC	55.9%	38.2%	23.5%	32.4%	0.23986
14	WW	54.5%	45.5%	36.4%	18.2%	0.17666
24	PL	53.2%	42.6%	19.1%	34.0%	0.27214
31	CC	51.8%	42.9%	26.8%	25.0%	0.34520
53	NR	50.0%	50.0%	20.0%	30.0%	0.52783
2	CT	49.0%	46.9%	26.5%	22.4%	0.21546
18	LH	47.8%	58.7%	34.8%	13.0%	0.20770
50	KV	47.4%	68.4%	31.6%	15.8%	0.14930
25	SI	46.4%	37.5%	16.1%	30.4%	0.42567
11	WF	45.5%	22.7%	13.6%	31.8%	0.16404
52	PW	42.9%	50.0%	21.4%	21.4%	0.21230
47	SP	42.1%	73.7%	36.8%	5.3%	0.12004
20	BL	42.1%	47.4%	21.1%	21.1%	0.21857
3	OZ	41.1%	46.4%	12.5%	28.6%	0.17830
33	LB	40.5%	54.8%	19.0%	21.4%	0.19527
21	HG	39.3%	57.1%	23.2%	16.1%	0.26324
4	SM	37.5%	53.6%	21.4%	16.1%	0.32242
62	CZLH	37.0%	37.0%	13.0%	23.9%	0.11298
49	YX	36.8%	73.7%	31.6%	5.3%	0.11957
28	DM	35.3%	50.0%	20.6%	14.7%	0.09247
29	JY	34.5%	48.3%	20.7%	13.8%	0.10961
48	DX	33.3%	33.3%	8.3%	25.0%	0.07342
54	GCSI	32.4%	58.8%	14.7%	17.6%	0.10401
36	SE	32.3%	51.6%	9.7%	22.6%	0.20936
10	WB	31.8%	22.7%	9.1%	22.7%	0.16713
30	SF	29.4%	50.0%	17.6%	11.8%	0.10249
12	RS	27.3%	22.7%	9.1%	18.2%	0.18229

Table B.15. continued

#	Futures code	Total extreme %	Total winner %	Extreme winner %	Extreme loser %	Standard deviation
27	BP	27.3%	54.5%	9.1%	18.2%	0.10202
7	WZ	26.8%	44.6%	8.9%	17.9%	0.20078
56	CZWZ	25.0%	50.0%	10.7%	14.3%	0.08315
41	US	25.0%	53.6%	17.9%	7.1%	0.09091
17	LC	24.1%	59.3%	20.4%	3.7%	0.12285
58	LHPB	23.9%	73.9%	23.9%	0.0%	0.07895
51	GN	23.8%	57.1%	19.0%	4.8%	0.08767
9	MW	23.3%	39.5%	11.6%	11.6%	0.19283
6	SZ	23.2%	42.9%	12.5%	10.7%	0.23222
8	KW	22.6%	51.6%	12.9%	9.7%	0.14813
1	CZ	21.4%	44.6%	12.5%	8.9%	0.17974
61	CZFC	21.1%	44.7%	15.8%	5.3%	0.11773
57	SZCT	20.4%	51.0%	6.1%	14.3%	0.11044
60	CZLC	18.5%	35.2%	5.6%	13.0%	0.08596
55	CZSZ	17.9%	46.4%	3.6%	14.3%	0.06547
59	LCLH	17.4%	45.7%	6.5%	10.9%	0.06943
16	FC	15.8%	60.5%	10.5%	5.3%	0.13327
39	TY	15.8%	68.4%	15.8%	0.0%	0.06703
46	MB	15.4%	76.9%	7.7%	7.7%	0.06296
66	TBUS	10.7%	50.0%	10.7%	0.0%	0.03652
64	SZSMSO	8.9%	39.3%	3.6%	5.4%	0.03674
26	CD	6.5%	51.6%	3.2%	3.2%	0.03481
63	FCCZLC	5.3%	44.7%	2.6%	2.6%	0.04607
45	CR	0.0%	60.0%	0.0%	0.0%	0.04632
37	ED	0.0%	73.7%	0.0%	0.0%	0.02159
38	TB	0.0%	68.8%	0.0%	0.0%	0.02194
40	FY	0.0%	71.4%	0.0%	0.0%	0.04000
65	TBED	0.0%	21.1%	0.0%	0.0%	0.00334

Table B.16. Rank period statistics

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
		Six month rank period		
EXWB6	56	1.2961	0.22626	9.7941***
EXLB6	56	0.80480	0.59067E-01	-24.730***
ALWB6	56	1.1508	0.11433	9.8709***
ALLB6	56	0.89065	0.45730E-01	-17.894***
		Twelve month rank period		
EXWB6	55	1.4973	0.40945	9.0078***
EXLB6	55	0.72807	0.85076E-01	-23.705***
ALWB6	55	1.2395	0.16619	10.689***
ALLB6	55	0.85474	0.40138E-01	-26.839***
		Fifteen month rank period		
EXWB6	54	1.6098	0.53217	8.4205***
EXLB6	54	0.70116	0.92243E-01	-23.807***
ALWB6	54	1.2895	0.20728	10.263***
ALLB6	54	0.83523	0.41256E-01	-29.349***
		Eighteen month rank period		
EXWB6	54	1.7126	0.66577	7.8659***
EXLB6	54	0.67257	0.97397E-01	-24.704***
ALWB6	54	1.3312	0.24454	9.9521***
ALLB6	54	0.82233	0.42724E-01	-30.558***

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is one.

***Significant at the .01 level.

Table B.16. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
		Twenty-four month rank period		
EXWB6	53	1.8856	0.88371	7.2960***
EXLB6	53	0.64643	0.10112	-25.454***
ALWB6	53	1.4125	0.31913	9.4106***
ALLB6	53	0.80280	0.43399E-01	-33.080***
		Thirty-six month rank period		
EXWB6	51	2.1855	1.1266	7.5143***
EXLB6	51	0.91957	0.42476E-01	-13.522***
ALWB6	51	1.5512	0.40837	9.6399***
ALLB6	51	0.77536	0.46710E-01	-34.345***
		Six month rank, no sugar		
EXWB6	56	1.2797	0.21499	9.7370***
EXLB6	56	0.82068	0.59883E-01	-22.409***
ALWB6	56	1.1474	0.11282	9.7757***
ALLB6	56	0.89633	0.47561E-01	-16.311***
		Six month rank, no spreads		
EXWB6	56	1.3415	0.27610	9.2554***
EXLB6	56	0.78879	0.71424E-01	-22.129***
ALWB6	56	1.1673	0.11196	11.184***
ALLB6	56	0.87387	0.77157E-01	-12.233***

Table B.17. Statistics for returns to buy-and-hold portfolios

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
		Six month rank period		
GRNB6	56	1.0222	0.87646E-01	1.8990*
GRN3	56	1.0057	0.35761E-01	1.2002
GRN6	55	1.0238	0.89146E-01	1.9802*
GRN9	55	1.0287	0.93262E-01	2.2815**
GRN12	54	1.0540	0.16267	2.4411**
GRN15	54	1.0608	0.16421	2.7201***
GRN18	53	1.0929	0.24240	2.7896***
GRN21	53	1.0967	0.24435	2.8808***
GRN24	52	1.1282	0.30608	3.0202***
GRN27	52	1.1301	0.30622	3.0646***
GRN30	51	1.1597	0.34786	3.2784***
		Twelve month rank period		
GRNB6	55	1.0517	0.15960	2.4038**
GRN3	55	1.0047	0.36154E-01	0.97166
GRN6	54	1.0234	0.90583E-01	1.8993*
GRN9	54	1.0287	0.95667E-01	2.2051**
GRN12	53	1.0547	0.16565	2.4054**
GRN15	53	1.0615	0.16695	2.6829***
GRN18	52	1.0925	0.24501	2.7224***
GRN21	52	1.0954	0.24625	2.7926***
GRN24	51	1.1254	0.30838	2.9048***
GRN27	51	1.1273	0.30912	2.9418***
GRN30	50	1.1566	0.35012	3.1634***

[a]Number of observations.

[b]Standard deviation.

[c]T-statistic tests whether mean is one.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table B.17. continued

Series	# Obs[a]	Mean	Stnd dvn[b]	T-stat[c]
		Six month rank, no sugar		
GRNB6	56	1.0244	0.87690E-01	2.0801**
GRN3	56	1.0065	0.35141E-01	1.3936
GRN6	55	1.0254	0.88008E-01	2.1375**
GRN9	55	1.0291	0.90089E-01	2.3978**
GRN12	54	1.0544	0.15773	2.5322**
GRN15	54	1.0592	0.15442	2.8190***
GRN18	53	1.0893	0.23050	2.8211***
GRN21	53	1.0908	0.21816	3.0308***
GRN24	52	1.1172	0.28022	3.0151***
GRN27	52	1.1162	0.26224	3.1963***
GRN30	51	1.1439	0.30962	3.3190***
		Six month rank, no spreads		
GRNB6	56	1.0317	0.11899	1.9942*
GRN3	56	1.0088	0.49944E-01	1.3135
GRN6	55	1.0336	0.12168	2.0463**
GRN9	55	1.0420	0.12685	2.4538**
GRN12	54	1.0762	0.22124	2.5313**
GRN15	54	1.0875	0.22398	2.8709***
GRN18	53	1.1311	0.33003	2.8922***
GRN21	53	1.1387	0.33256	3.0371***
GRN24	52	1.1822	0.41846	3.1396***
GRN27	52	1.1878	0.41991	3.2244***
GRN30	51	1.2291	0.47921	3.4141***

APPENDIX C:

GRAPHS OF RESULTS

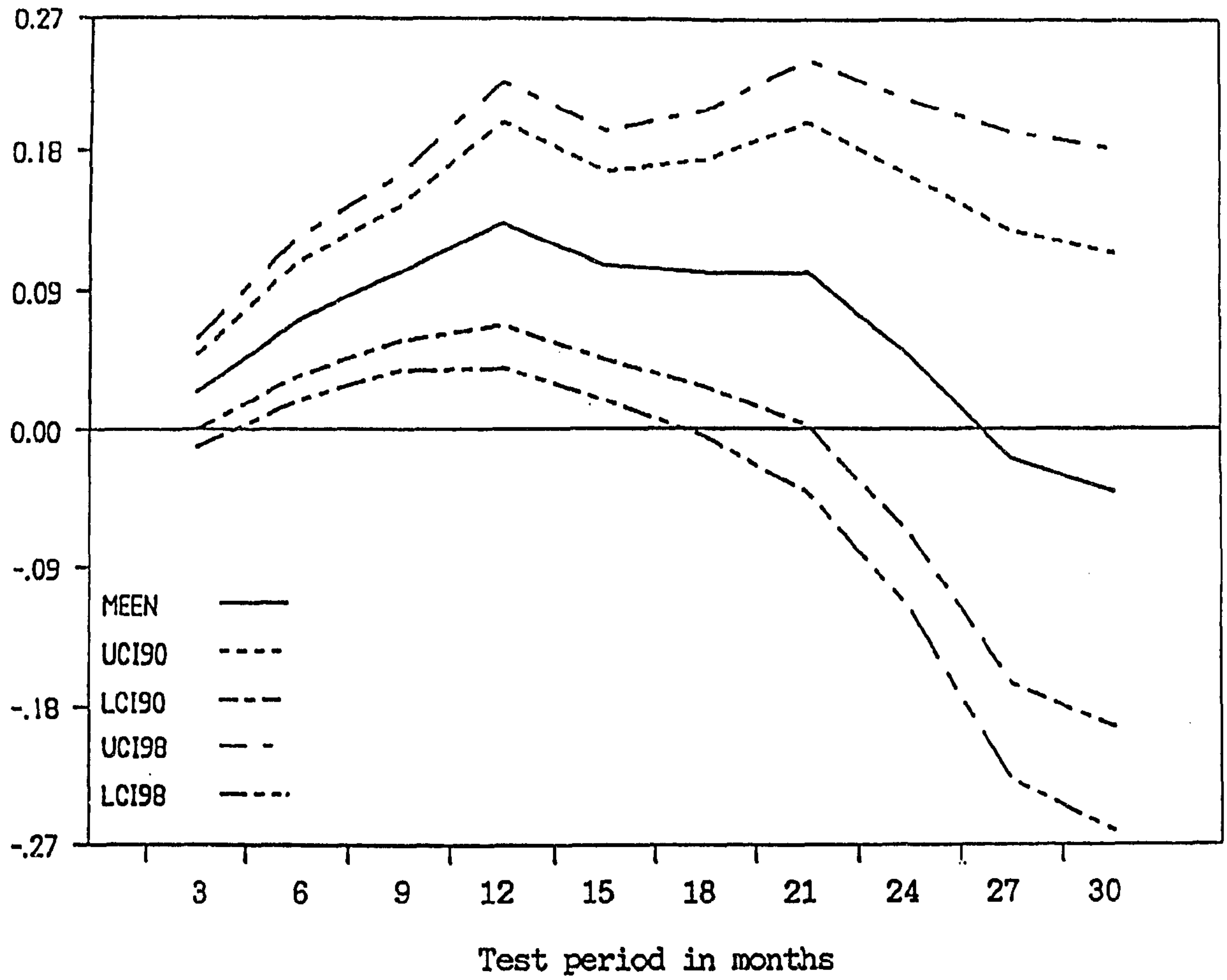

Figure C.1. A 90% and 98% confidence interval for differences of extreme portfolio means for a six month rank period

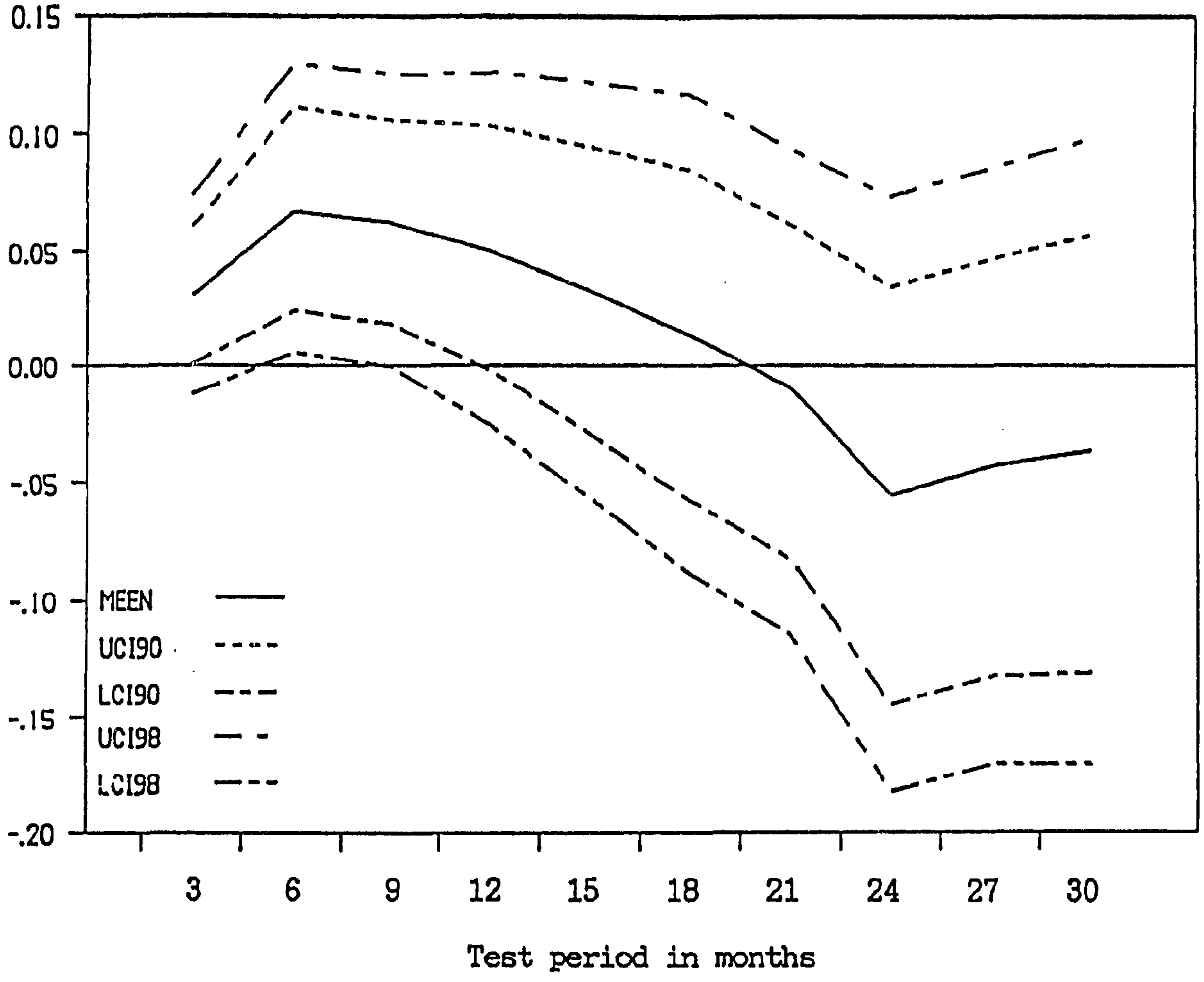

Figure C.2. A 90% and 98% confidence interval for differences of extreme portfolio means for a twelve moth rank period

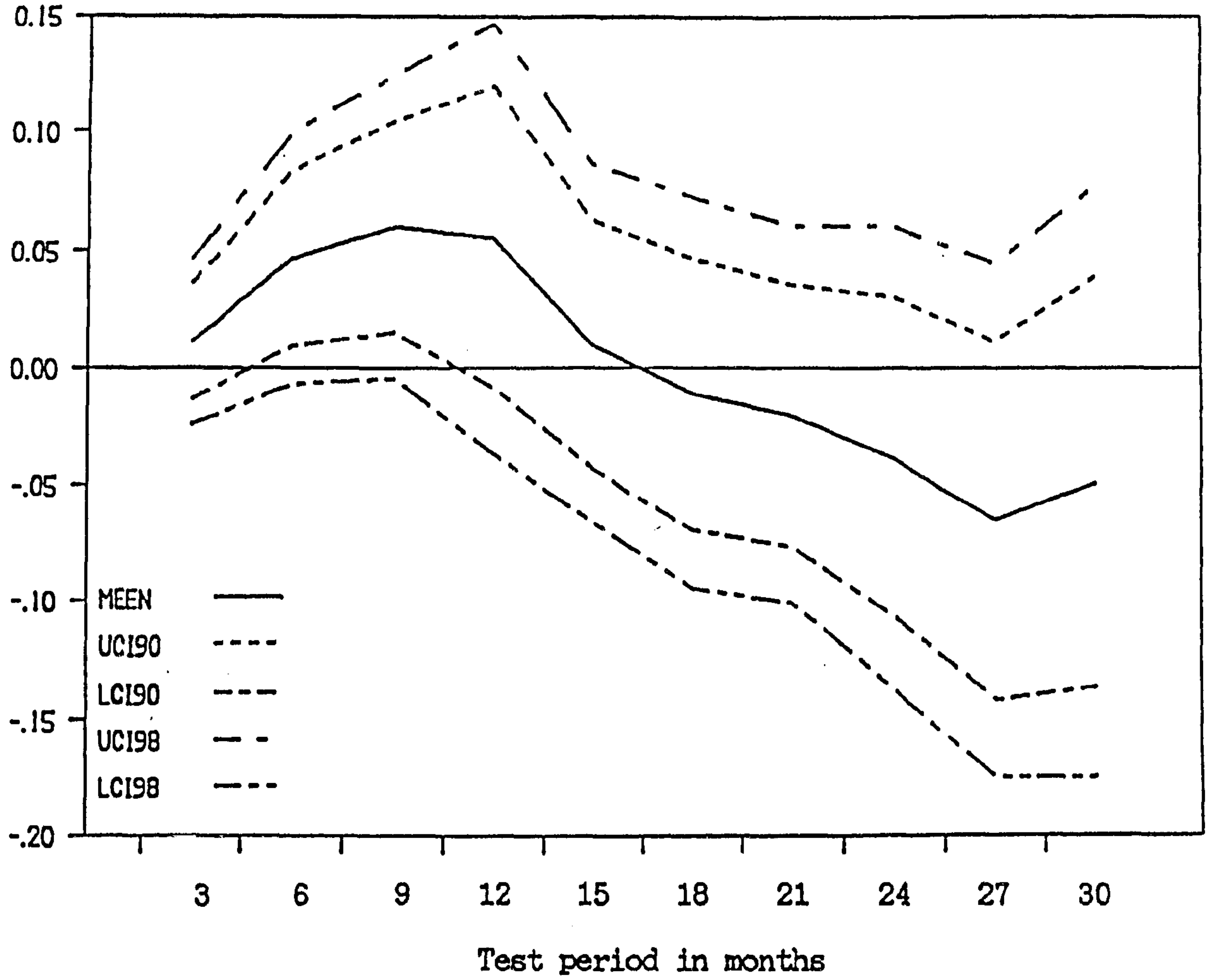

Figure C.3. A 90% and 98% confidence interval for differences of extreme portfolio means for a fifteen moth rank period

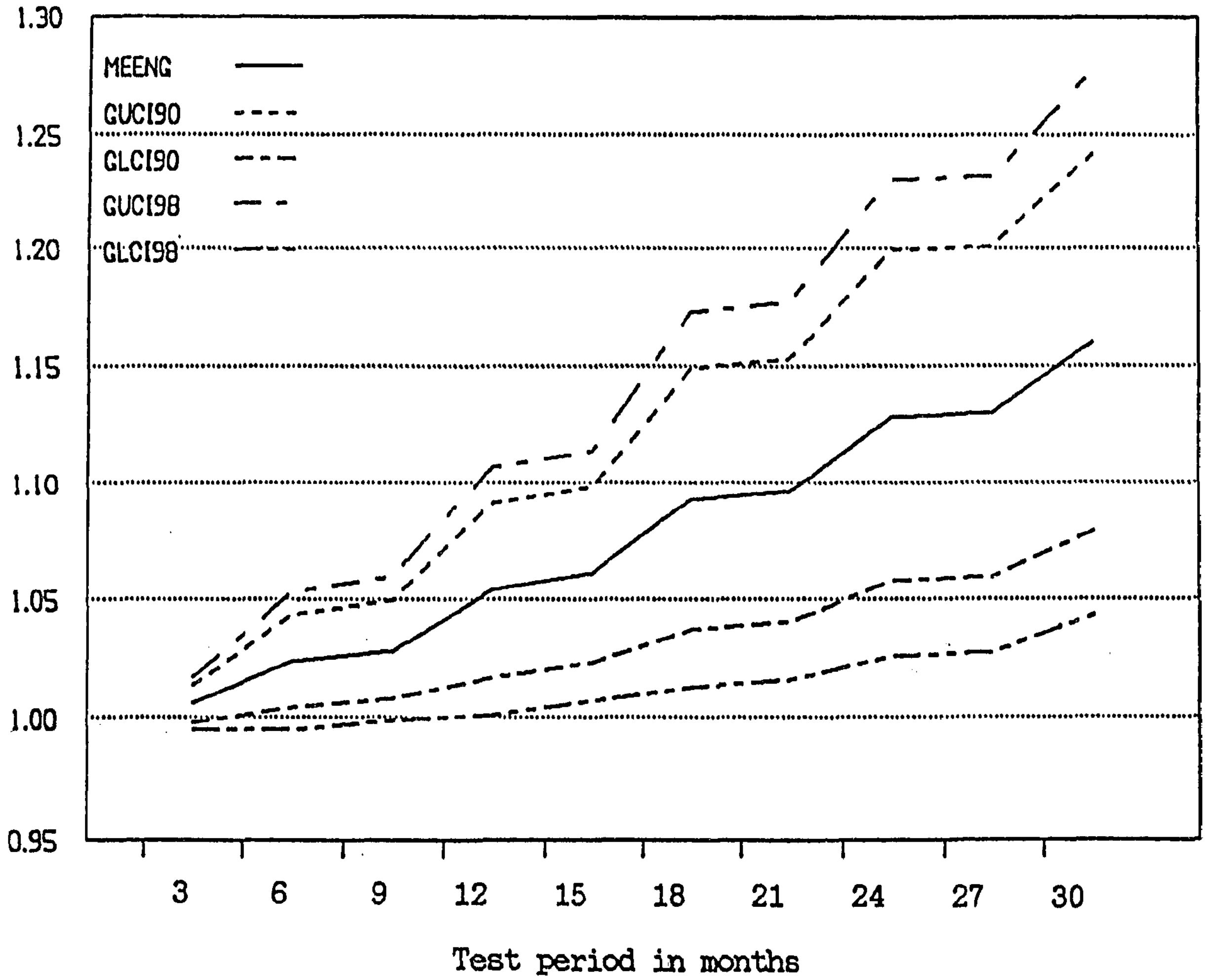

Figure C.4. A 90% and 98% confidence interval for mean returns to a buy-and-hold portfolio for a six month rank period

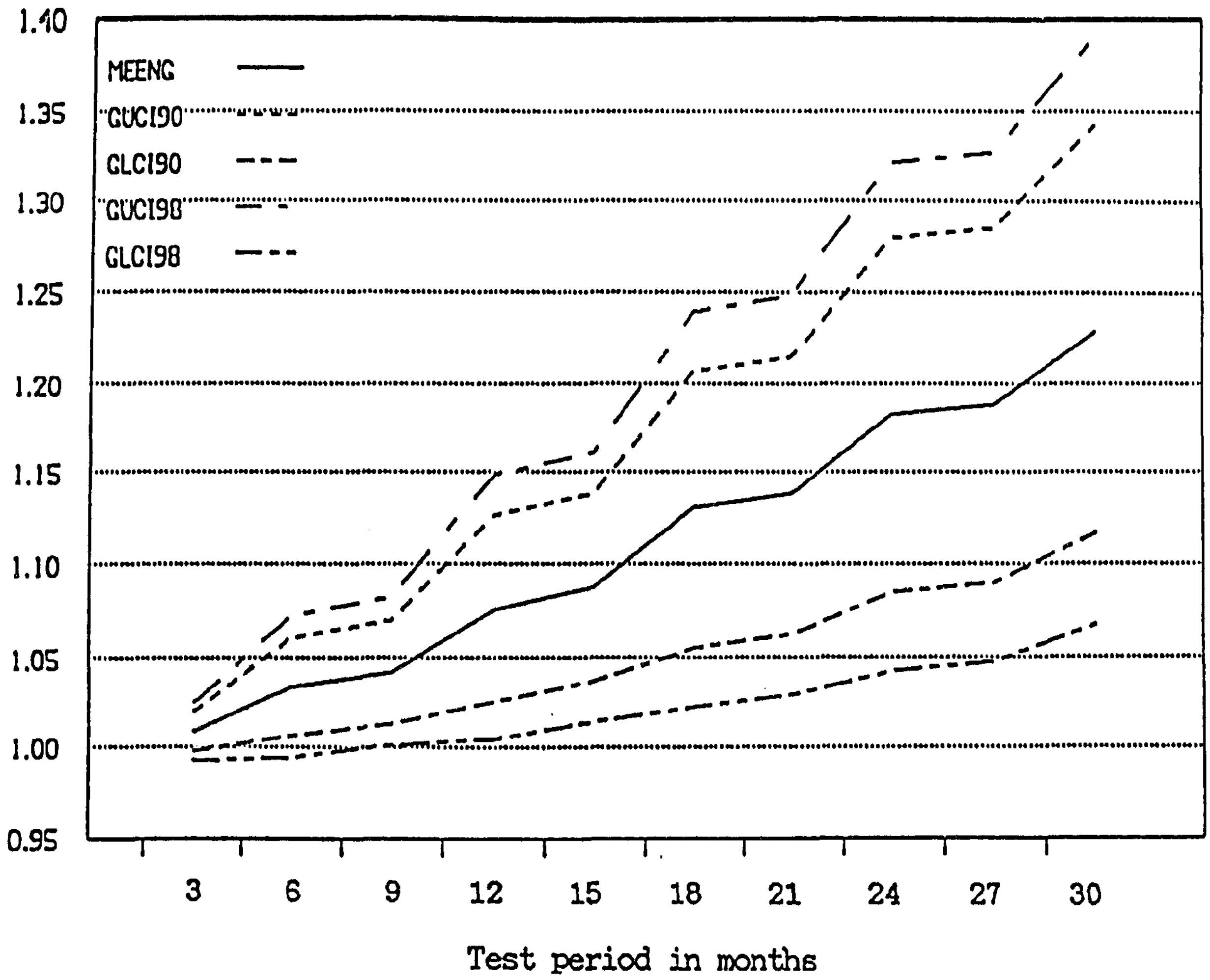

Figure C.5. A 90% and 98% confidence interval for mean returns to a buy-and-hold portfolio for a six month rank period with no spread positions in the sample