TECHNICAL TRADING SYSTEM PROFITS: FACT OR FICTION?

by

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TECHNICAL TRADING SYSTEM PROFITS: FACT OR FICTION?

Academic researchers question whether technical trading is profitable in practice.[1] The skepticism is usually based on the efficient market hypothesis, which implies speculative prices fully reflect all information, including past prices (Fama, 1970). Thus, a trading rule based only on price history will not have any predictive power beyond random chance. Criticism of the efficient market model's restrictive assumptions, however, casts doubt on its empirical validity (Danthine, 1977). An alternative model of short-run price behavior is provided by disequilibrium pricing theory (Beja and Goldman, 1980). The basic premise of disequilibrium theory is that prices do not adjust instantaneously to supply and demand imbalances. Therefore, short-run periods of disequilibrium are a natural characteristic of markets. During disequilibrium periods it is profitable for traders to act not only on supply and demand information, but also on price trends signalled by technical systems.

Neither of the previous two theories can be conclusively rejected or accepted based on the evidence of past trading system studies (Stevenson and Bear, 1970; Peterson and Leuthold, 1983; Irwin and Uhrig, 1984) due to various testing deficiencies. Thus, a rigorous test of the profitability of system trading in U.S. futures markets is needed. The purpose of this paper is to report the results of testing the Donchian trading system over the 1963 through 1984 period. The study improves upon past research by (1) simulating trading over twenty-two years and fourteen commodities, (2) using

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1 Technical trading systems are "rules" which forecast short-term futures price movements using only past prices.

adaptive, optimal parameters, (3) analyzing only out-of-sample returns, (4) testing the statistical significance of the simulated returns and (5) analyzing the effects of adding technical futures trading to a portfolio of financial assets.

Following sections of the paper discuss theoretical background, the technical trading simulation, procedure, results and the summary.

Theoretical Background

An efficient market fully reflects all available information (Fama, 1970). A weak form efficient market fully reflects the information in past prices. Furthermore, weak form efficiency implies current prices follow the random walk model and price changes are uncorrelated.[2] The implications of the random walk model for technical trading system returns are more subtle than many have been led to believe (Tomek and Querin, 1984). Even in a random walk, futures prices will have "trends" over finite periods and trading systems applied to the same data may be profitable. But, over a sufficiently long period of time the "trending" periods will be offset by "non-trending" periods and average trading system profits will be zero. Tomek and Querin asserted this explained why previous trading system simulations, which searched in-sample for profits, would eventually be successful if enough systems and periods were tried.

Panton (1980) proposed an alternative efficient market definition; a market is efficient if a trader cannot earn a profit above a return to risk. A modified weak form efficiency test would be whether a trader could earn

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[2] More specifically, weak form efficiency implies futures prices will follow a martingale model. For all practical purposes, though, the martingale and random walk models are indistinguishable (Fama and Blume, 1965).

"above normal" profits employing a technical trading system. The difficulty with such tests is defining the "normal" return to risk (Brorsen and Irwin, 1985).

Beja and Goldman (1980) proposed a disequilibrium pricing model which explicitly allows for profitable technical trading. According to Beja and Goldman (p. 235), "... it is intuitively inconceivable that a man-made institution (such as a market) could be so mechanically perfect that all [price] discrepancies would be totally annihilated before they can be observed." Therefore, market prices will not instantaneously adjust to changes in supply and demand due to "friction" caused by transaction costs, taxes, costs of acquiring and evaluating information and noisy information systems. Without instantaneous adjustment, a market is characterized by short-run disequilibrium prices and trading. Speculation on price adjustments towards equilibrium must be primarily based on a trader's assessment of the trend in prices, rather than fundamental supply and demand conditions. Thus, technical trading systems, which forecast price trends, play an essential role in short-run speculation.

Beja and Goldman also suggested the parameters of a technical system should change according to market conditions. More specifically, trading systems should be adaptive in response to changing information and dependence levels. Martell and Phillipatos (1974) found adaptive systems outperformed non-adaptive systems over a sample of corn and wheat futures prices. Nawrocki (1984) reached a similar conclusion with respect to common stocks and trading systems.

The previous discussion indicates there are two competing hypotheses concerning the absolute level of technical trading system profits. The first hypothesis, based on equilibrium theory (weak form efficiency), is that profits on average will equal zero. The second hypothesis, based on disequilibrium theory, is that profits on average will be positive.

Modern portfolio theory asserts investors are interested in an asset's contribution to the expected return and risk of a portfolio, not simply the absolute return of an asset held in isolation. The role of futures trading in financial asset portfolios has been analyzed by several researchers. Bodie (1983) found that buying-and-holding a diversified bundle of futures contracts improved the real reward-risk tradeoff of treasury bills, treasury bonds, and common stock portfolios. Lintner (1983) and Irwin and Brorsen (1985) found that the inclusion of public futures funds in financial asset portfolios substantially improved the reward-risk tradeoff. In all of the previous studies, futures trading was found to be negatively correlated with commonly held financial assets.

The role of technical futures trading in financial asset portfolios has been analyzed indirectly through the study of public futures funds. Conclusions based on this evidence are uncertain because not all trading advisers depend on technical systems. Furthermore, the results were based on relatively short sample periods.

The Technical Trading Simulation

The number of technical trading systems in existence is large (Patel (1980) lists over 100 systems). The Donchian system was selected for three reasons. First, it was publicly introduced in 1960 (Donchian, 1960), and was available to traders over the entire simulation period. Second, it has been widely used by futures fund and managed account advisors (Dunn, 1985). Third, it was a simple system to program and thus minimized computer costs. The Donchian system may not be representative of trading systems in general.

Whether the Donchian system produces returns similar to other trend-following systems such as moving averages and oscillators is beyond the scope of this study.

The Donchian trading rules are:

a. Buy long when today's high or open is above the highest high in the price channel.

b. Sell short when today's low or open is below the lowest low in the price channel.

c. If, due to limit move conditions, trading is not possible, move to the next day and repeat process.

d. The system is reversing, which means that it will always maintain a long or short position in the futures market.

e. Entry or exit of a position is determined in one of two ways. First, if the open is above (below) the channel high (low) on a given day a position is entered or exited at the open price. Second, if the open signal is not generated then the daily high (low) is checked against the channel high (low). If a buy (sell) signal is given, then the exit or entry price is assumed to be just above (below) the channel high (low). For example, a stop would be placed one-quarter cent above the channel high in corn.

Trading signal generation was guided by two objectives, (1) optimal trading system parameters should be adaptive and (2) the resulting returns should be out-of-sample. In order to satisfy the objectives, trading was simulated over three years for Donchian system parameters of one to twelve weeks for each commodity. The parameter yielding the largest profit over the three year period was defined to be the optimal parameter for the next year. At the end of the "next" year, the process was repeated. To illustrate, the optimal parameter for 1963 corn trading was the highest profit parameter tested over 1960-1962 data; the optimal parameter for 1964 corn trading was the highest profit parameter tested over 1961-1963 data; etc. The process of annually re-optimizing made the Donchian system adaptive and any resulting returns out-of-sample.

Previous studies have reported final results in absolute dollar terms, typically assuming one contract traded per commodity. Results reported in such a form are not comparable across commodities (due to different contract sizes) and investments (due to not being in percent terms). The first step in putting absolute dollar returns into a more useful form is to determine the relevant investment for futures speculation.

According to Black (1976), margins on futures contracts are collateral only, thus the initial investment in a futures contract is zero. Such a definition ignores the reality of futures speculation. An investor in a futures fund, managed account or regular brokerage account must invest an amount in excess of the funds to be used for margins. Excess funds act as a reserve in case of adverse price movements. Therefore, the relevant investment for futures speculation is the total amount necessary to continue trading over an extended period of time. For example, if $1,000,000 was available for trading, $300,000 might be "actively" committed to margins and the remaining $700,000 held as a reserve. When calculating returns, $1,000,000 would be used as the base.

The previous definition of initial investment was only the starting point in calculating a percent return series. The following assumptions, mirroring the operation of a futures fund, were used in addition.[3] First, thirty percent of available funds were "actively" committed to margins at any point in time. Second, equal dollar amounts were committed to margins for each commodity. Third, margins were assumed to be ten percent of the

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[3] Management, incentive, and administrative costs were not accounted for due to their variation across futures funds. Irwin and Brorsen (1985) reported these categories of costs averaged eight and one-half percent of average annual equity for a sample of twenty public futures funds.

cash value of a contract. Fourth, a commission of sixty-five dollars was subtracted for each trade. Fifth, investment of margin money and excess funds in treasury bills was not allowed. It is important to note that the assumptions generated a specific return series. If any of the five assumptions were changed a different set of returns would have been generated.

Once the percent return series were generated the question of the proper average arose. When working with a percent change series the geometric average is normally correct. However, due to the reinvestment assumptions of the trading simulation the arithmetic average was correct. More specifically, trading profits earned during the year were assumed to be withdrawn and any loss of initial capital replenished. Thus, a constant dollar amount was available for trading over the entire simulation period.

The futures price data were from the Dunn and Hargitt Commodity Data Bank. Trading was allowed only in the dominant contract, i.e., the one with the highest open interest. Fourteen highly traded commodities were selected to represent the most commonly traded categories of futures contracts: agricultural commodities, metals, and financial instruments. The specific contract, observation period and exchange are listed in Table 1.

Procedure

The first step of the analysis was a statistical test of mean Donchian annual returns (both on an aggregate and individual commodity basis). Based on equilibrium and disequilibrium pricing theory, the appropriate hypotheses are

$$H_0\text{: Mean Annual Returns} = \text{zero}$$
$$H_1\text{: Mean Annual Returns} > \text{zero}$$

The hypothesis specification implies a one-tailed rather than two-tailed test since only positive returns are of interest. The measure used to test the zero returns hypothesis was the t-statistic:

Table 1. Futures Price Data

Contract	Trading Period	Exchange[a]
Corn	1963 - 1984	CBOT
Soybeans	1963 - 1984	CBOT
Wheat (Chicago)	1963 - 1984	CBOT
Sugar	1963 - 1984	CEX
Copper	1963 - 1984	CMX
Cocoa	1963 - 1984	CEX
Silver (N.Y.)	1967 - 1984	CMX
Live Cattle	1969 - 1984	CME
Live Hogs	1973 - 1984	CME
Gold (N.Y.)	1978 - 1984	CMX
U.S. Treasury Bills	1979 - 1984	IMM
British Pound	1980 - 1984	IMM
Deutsche Mark	1980 - 1984	IMM
U.S. Treasury Bonds	1981 - 1984	CBT

[a] CBT: Chicago Board of Trade

CEX: Coffee, Sugar, Cocoa Exchange, Incorporated

CME: Chicago Mercantile Exchange

IMM: International Monetary Market of Chicago Mercantile Exchange

$$(1)\quad t = \frac{MAR}{\sqrt{\frac{S^2}{n}}}$$

where MAR is the mean annual percent return, S^2 is the variance of annual returns and n is the number of years trading was simulated.

The second step of the analysis was to calculate the risks of surviving trading for a period of years. Survival was defined to be a year where losses did not exceed initial trading funds. The probabilities were derived from the following relationship:

$$(2)\quad P_k = Pr(|X-\mu| \leq K\sigma) = Pr\ (|t_{n-1}| \leq k)$$

In words, the result states the probability that random variable X (which is drawn from a t-distribution) will deviate from its mean by k standard deviations equals the probability the absolute value of a t-statistic with n-1 degrees of freedom will be less than or equal to k. Based on (2), the probability of surviving trading M years was derived by first calculating the t-statistic:

$$(3)\quad t^* = \frac{-100.0 - MAR}{s}$$

where MAR is the mean annual percent return and s is the standard deviation of annual returns. The final calculation proceeded as follows:

$$(4)\quad Pr(\text{surviving M years}) = [1 - Pr(t^*)]^M$$

where $Pr(t^*)$ is the probability a t-statistic with n-1 degrees of freedom will be less than or equal to t^*. Note, the calculated survival probabilities depend on the particular money managaement strategy assumed for the simulation. For example, if the amount devoted to margins changed as losses accumulated, a different set of survival probabilities would result.

The third step of the analysis was based on mean-variance portfolio theory (Markowitz, 1952). The basic premise of mean-variance theory is that given the choice between two assets with the same reward (mean), a risk-averse investor will choose the one with less risk (variance or standard deviation). The decision process of portfolio construction has four phases. First, portfolio candidates must be selected. Second, predictions of the means, standard deviations and correlations of the assets considered for inclusion must be obtained. Third, portfolios with the minimum risk for a given level of reward must be calculated. The efficient frontier or efficient reward-risk set contain all such portfolios. Fourth, investors choose the point on the efficient reward-risk curve that matches their personal preference for reward in relation to risk.

Assets considered for inclusion in the efficient portfolios were treasury bills, treasury bonds, common stocks and Donchian futures trading. Historical returns were used to estimate the standard deviations and correlations required. All returns were first adjusted for changes in the general price level by the Consumer Price Index. The means (geometric) for treasury bills, treasury bonds and common stocks (0%, 3%, 7%) were estimated to equal the long-term levels estimated by Ibbotson Associates (1985) over 1926 through 1984. Three different Donchian means (aggregate) were used in order to test the sensitivity of efficient portfolios to the level of technical trading returns.

Results

A. Donchian Trading Results

The optimal number of weeks used for each commodity in the technical system simulation varied over 1963 through 1984 (Table 2).[4] Six or more of the twelve possible parameters were utilized for corn, soybeans, wheat, sugar, copper, cocoa, and silver. Several of the commodities showed definite tendencies. First, eighty percent of the financial commodity parameters (treasury bills, British pound, Deutsche mark and treasury bonds) were four weeks or less. Second, over two-thirds of the cocoa optimal parameters were from one to four weeks. Third, only one silver or live cattle parameter was greater than eight weeks.

Donchian system returns, aggregated over all fourteen commodities, were positive twenty-one of the twenty-two years trading was simulated (Figure 1). The mean annual return was 54.5 percent and the standard deviation was 47.3 percent.[5] The calculated t-statistic of 5.28 was significant at the .002 percent level. Therefore, the null hypothesis of a zero aggregate mean annual return was rejected and the alternative hypothesis of a positive aggregate mean annual return was accepted. The results indicate disequilibrium best described short-term aggregate futures price movements over 1963 through 1984. Practical implications of the results must be tempered by the

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[4] Trading was also simulated using non-adaptive, in-sample parameters. In other words, a single parameter was optimized for the entire 1963 to 1984 period. Aggregate returns were slightly <u>lower</u> for this strategy compared to the adaptive, out-of-sample simulation.

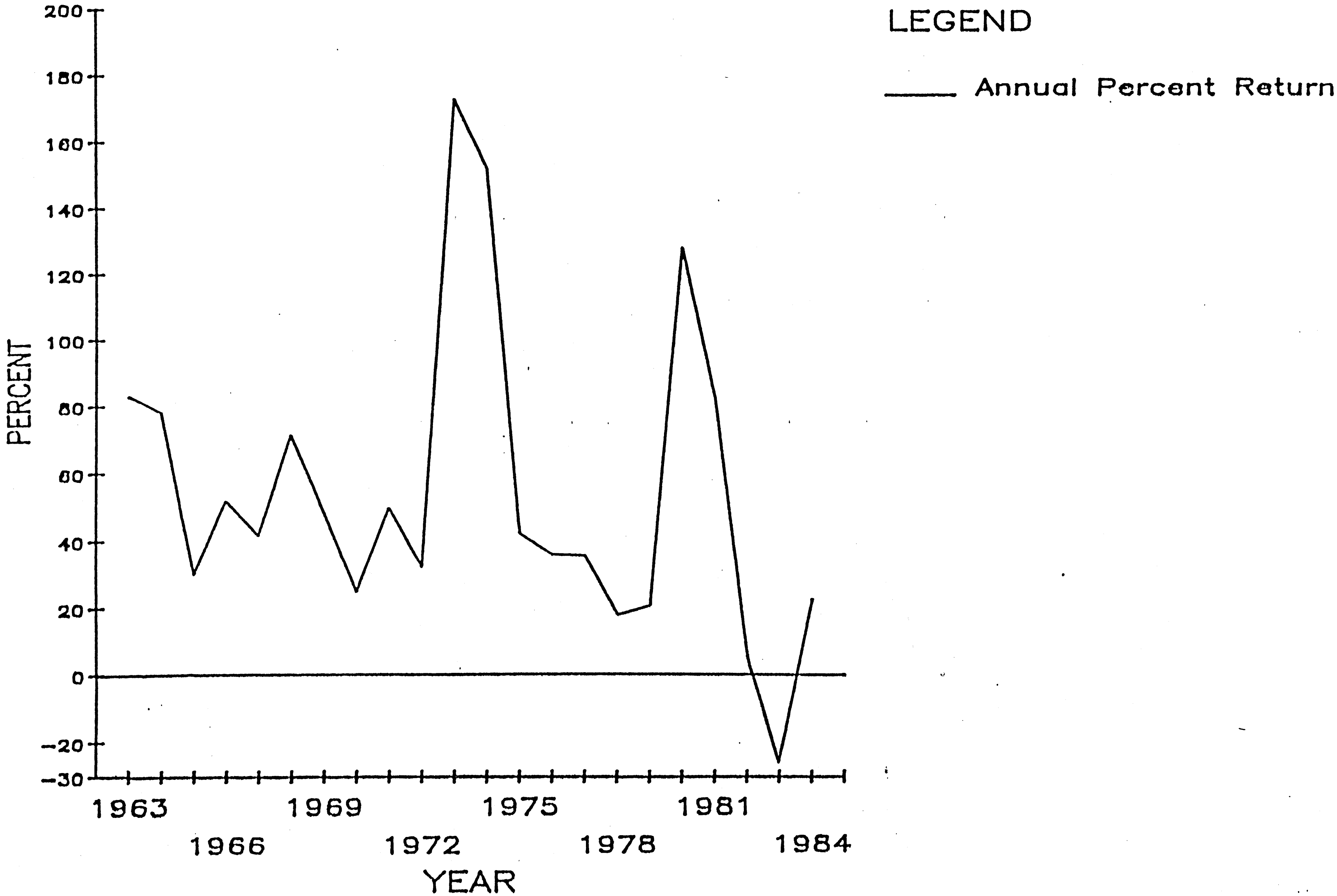
[5] Trading was also simulated assuming all positions were entered or exited at the opening price of the day after a buy or sell signal was generated. The returns presented in Figure 1 were simulated assuming positions were entered or exited at the maximum or minimum of the open or calculated stop price the same day a signal was generated. Comparison of the two simulations did not reveal any significant differences in returns.

Table 2. Optimal Weekly Parameters for the Donchian System, 1963-1984.[a]

Year	Corn	Soybeans	Wheat	Sugar	Copper	Cocoa	Silver	Live Cattle	Live Hogs	Gold	Treasury Bills	British Pound	Deutsche Mark	Treasury Bonds
								(Weeks)						
1963	7	3	7	8	3	3								
1964	9	3	7	2	10	3								
1965	9	7	7	2	12	11								
1966	7	12	7	2	3	3								
1967	2	9	6	3	2	9	1							
1968	11	9	9	3	2	1	2							
1969	11	9	4	3	2	1	5	7						
1970	8	1	4	3	2	1	5	7						
1971	7	4	4	9	11	3	8	5						
1972	3	4	1	9	6	3	6	7						
1973	3	10	3	7	6	3	12	3	2					
1974	10	9	12	7	12	3	2	5	2					
1975	10	8	3	11	11	12	1	2	2					
1976	10	8	3	5	11	3	1	2	2					
1977	6	3	3	8	7	12	1	2	1					
1978	11	2	6	5	7	6	1	4	11	10				
1979	2	4	5	10	10	6	1	4	7	4	3			
1980	2	4	2	6	1	1	5	4	10	6	2	2	4	
1981	6	5	2	4	9	1	5	7	2	2	2	2	4	
1982	10	8	2	10	6	2	5	7	2	2	2	2	4	3
1983	11	12	10	10	10	6	5	7	11	2	2	2	3	3
1984	10	3	12	11	12	3	2	4	12	9	3	7	11	2

[a] The parameter listed for a given year was optimal in the sense that it was the highest profit parameter over the previous three years.

FIGURE 1. TOTAL DONCHIAN SYSTEM RETURNS, 1963 – 1984.



downward trend in profits over the simulation period. Aggregate returns averaged 69.7 percent from 1963 through 1974, compared to 36.1 percent from 1975 through 1984. Furthermore, returns averaged 0.4 percent over 1982 through 1984, the lowest of any three year period.

Underlying the aggregate results are the individual commodity returns (Table 3). Every commodity had a positive mean annual return, ranging from a high of 192.6 percent for treasury bills to a low of 9.8 percent for treasury bonds. The range of standard deviations was even larger. Treasury bonds had the lowest, 16.2 percent, while treasury bills had the highest, 329.0 percent. Half of the commodities had annual standard deviations larger than 100.0 percent. Due to the relatively large standard deviations, six of the fourteen commodities (silver, live hogs, gold, treasury bills, the British pound, treasury bonds) had mean annual returns that were not significant at an acceptable level (defined to be ten percent). Thus, the null hypothesis was rejected and the alternative accepted for the remaining eight commodities. Although weaker than at the aggregate level, the results suggest disequilibrium was a good description of short-run futures price movements at the individual commodity level.

Survival probabilities and correlation coefficients illustrate the benefits of trading a diversified bundle of commodities (Table 4). Over a twenty year period, aggregate trading would have a 96 percent probability of not losing all trading funds in any single year. In contrast, over five and twenty years half of the commodities would individually have no greater than a 75 and 15 percent probability of surviving trading, respectively. While four of the commodities (corn, live cattle, British pound, Deutsche mark, treasury bond) had relatively high survival probabilities, overall, the probabilities give an important insight to the risks inherent in individual

Table 3. Donchian Return Statistics for Individual Commodities.

Period	Corn	Soybeans	Wheat	Sugar	Copper	Cocoa	Silver	Live Cattle	Live Hogs	Gold	Treasury Bill	British Pound	Deutsche Mark	Treasury Bond
Initial Trading Year	1963	1963	1963	1963	1963	1963	1967	1969	1973	1978	1979	1980	1980	1981
Mean Annual Return(%)	16.5	41.6	31.0	128.3	51.1	61.6	38.3	24.8	22.8	69.5	192.6	15.8	68.4	9.8
Standard Deviation(%)	45.1	106.1	72.0	180.3	98.0	154.1	140.3	51.7	111.8	181.1	329.0	32.5	55.2	16.2
t-statistic	1.68	1.80	1.97	3.26	2.39	1.83	1.12	1.86	0.68	0.94	1.31	0.97	2.48	1.05
Significance Level(%)	5.4	4.3	3.1	0.2	1.3	4.1	13.9	4.1	26.1	19.2	12.4	19.3	3.4	18.5

Table 4. Survival Probabilities and Correlation Coefficients for Donchian Trading.

	Aggregate	Corn	Soybeans	Wheat	Sugar	Copper	Cocoa	Silver	Live Cattle	Live Hogs	Gold	Treasury Bill	British Pound	Deutsche Mark	Treasury Bond
Probability of Surviving Five Years	.99	.96	.60	.81	.56	.93	.44	.40	.93	.45	.34	.31	.94	.91	.98
Probability of Surviving Ten Years	.98	.92	.90	.65	.31	.49	.19	.16	.86	.20	.12	.10	.89	.82	.97
Probability of Surviving Twenty Years	.96	.84	.13	.43	.10	.24	.04	.02	.75	.04	.01	.01	.79	.68	.94
Correlation Coefficients:															
Soybeans		.41													
Wheat		.04	.70												
Sugar		-.19	-.10	-.17											
Copper		-.04	.31	.26	.36										
Cocoa		.23	.11	.32	-.26	.14									
Silver		-.38	.12	.18	-.04	-.20	.04								
Live Cattle		.13	.15	.37	-.03	-.01	.33	-.39							
Live Hogs		.29	.59	.45	.51	.55	.18	.24	-.01						
Gold		.86	-.28	-.10	-.42	.54	.80	-.37	.49	-.39					
Treasury Bills		-.71	.98	.60	.26	-.17	.01	.84	-.50	.95	-.47				
British Pound		.11	.58	.45	.28	.68	.46	.50	.10	.47	.39	.49			
Deutsche Mark		.19	.51	.25	.32	.82	.55	.45	.32	.60	.41	.51	.92		
Treasury Bond		-.60	.04	.74	-.75	-.83	.05	.32	-.32	-.43	-.11	-.26	-.32	-.58	

commodity trading. Mean annual returns for a commodity may be positive and statistically significant, yet the probability of experiencing a year where all trading funds are lost may be quite substantial.

Aggregate trading was less risky, in the sense of high survival probabilities, because of the correlation of trading returns across commodities. Thirty of the ninety-one coefficients were negative and forty-one were less than one-half. Low returns in one commodity tended to be offset by high returns in other commodities.

B. Portfolio Results

Four efficient reward-risk curves were estimated (Figure 2).[6,7,8] Curve I is comprised of treasury bills, treasury bonds, and common stock portfoliios. The remaining three curves include aggregate Donchian trading in the set of efficient portfolios. Each assumed a different level of Donchian returns. Curve II assumed Donchian trading yielded a real return of 0.0 percent, equal to returns in the most recent three-year period. Surprisingly, Donchian trading was as much as 12 percent of the efficient portfolio and improved the risk-return tradeoff an average of 14 percent. Curve III assumed Donchian trading yielded a real return of 26.2 percent, equal to the average return over 1975 through 1984. Such a level of returns allowed portfolio returns not possible with only treasury bills, treasury

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[6] The annual real rates of return and summary statistics which were used as guidelines for estimating the risk-return curves are shown in Appendix A.

[7] Standard deviations rather than variances are presented for simplicity. Risk-return relationships are identical whether stated in mean-variance or mean-standard deviation mean-standard deviation space.

[8] Numerical listings of the risk-return curves and portfolio proportions are shown in Appendices B, C, D, and E.

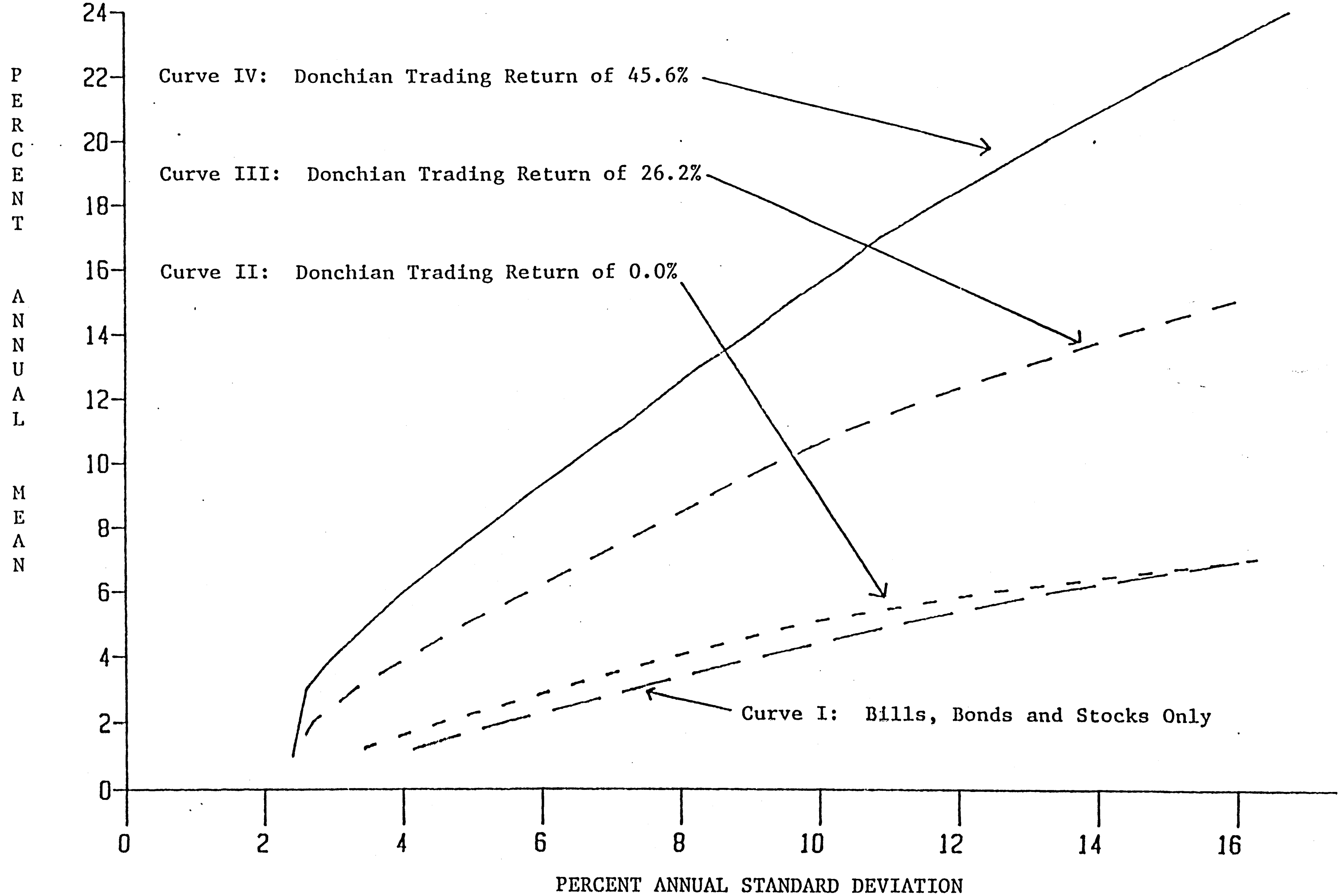

Figure 2: Efficient Risk-Return Curves

bonds and common stocks. Thus, only the portion of Curve III comparable to Curve I was presented. Donchian trading ranged from 3 to 17 percent over the portion of Curve III presented. However, the relatively small amount of Donchian trading improved the portfolio reward-risk tradeoff an average of 53 percent. Curve IV assumed Donchian trading yielded a return of 45.6 percent, equal to the real rate of return over 1963 through 1984. Donchian proportions ranged from 3 to 16 percent and improved the reward-risk tradeoff an average of 62 percent.

The previous results indicate Donchian trading may substantially improve the reward-risk tradeoff of financial asset portfolios. Even at an expected return of zero, Donchian trading improved the risk-return tradeoff an average of 14 percent. The source of the risk reductions was the negative correlation of real Donchian returns with the real return of treasury bills, treasury bonds and common stocks.[9] Furthermore, real Donchian returns were positively correlated with the reate of inflation while the other investments were negatively correlated with the rate of inflation. The results are consistent with the research of Linter (1983) and Irwin and Brorsen (1985) on public futures funds.

Summary

Donchian system trading was simulated over 1963 through 1984 on fourteen commodities. All returns were net of transaction costs and the result of out-of-sample trading. Aggregate returns averaged 47.3 percent over the twenty-two years trading was simulated. However, returns trended downward over the period, averaging 69.7 percent from 1963 through 1974 and 36.1

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[9] See Appendix A.

percent from 1975 through 1984. Furthermore, 1982 through 1984 returns were the lowest of any three year period simulated.

Individual commodity mean returns were all positive, ranging from a low of 9.8 percent for treasury bonds to a high of 192.6 percent for treasury bills. Due to relatively large standard deviations, only eight of the fourteen commodities had means significantly greater than zero. Overall, disequilibrium pricing theory appears to have been a better description of short-run futures price behavior than equilibrium theory (weak form efficiency).

Survival probabilities and correlation coefficients illustrated the benefits of trading a diversified bundle of commodities. Mean annual returns for an individual commodity may be positive and statistically significant, yet the probability of experiencing a year where all trading funds are lost may be quite substantial. Aggregate trading was less risky because of the negative or low positive correlation of trading returns across commodities. Low returns in one commodity tended to be offset by high returns in other commodities.

Mean-variance analysis indicated Donchian trading could improve the real reward-risk tradeoff of a portfolio of treasury bills, treasury bonds and common stocks. At expected returns of 0.0 and 45.3 percent, Donchian trading improved the risk-return tradeoff an average of 14 and 62 percent, respectively. The source of the risk reductions was the negative correlation of real Donchian returns with the real returns of treasury bills, treasury bonds, and common stocks.

In conclusion, Donchian trading profits were positive and statistically significant over 1963 through 1984. Thus, technical trading profits were a fact rather than fiction. However, the results do not imply all technical trading systems were or will be profitable. It is possible that only a small subset of technical trading systems have been and will continue to be profitable. Whether the Donchian system generates profits similar to other systems awaits further research.

References

Beja, A. and M.B. Goldman. "On the Dynamic Behavior of Prices in Disequilibrium," Journal of Finance, 34(1980):235-247.

Black, F. "Implications of the Random Walk Hypothesis for Portfolio Management," Financial Analysis Journal, 27(1971):16-22.

Black, F. "The Pricing of Commodity Contracts," Journal of Financial Economics, 3(1976):167-179.

Bodie, Z. "Commodity Futures as a Hedge Against Inflation," The Journal of Portfolio Management, 9(1983):12-17.

Brorsen, B.W. and S.H. Irwin. "Evaluation of Commodity Funds," Review of Research in Futures Markets, 4(1985):84-94.

Danthine, J.P. "Martingale Market Efficiency and Commodity Prices," European Economic Review, 10(1977):1-17.

DeGroot, M.H. Probability and Statistics, Addison-Wesley, Reading, MA, 1975.

Donchian, R.D. "High Finance in Copper," Financial Analysts Journal, 16(1960):133-142.

Dunn, D. Dunn & Hargitt, Inc., West Lafayette, Indiana. "Personal Conversations," August-December 1984.

Dunn & Hargitt, Inc. "The Dunn & Hargitt Commodity Data Bank," West Lafayette, Indiana.

Fama, E.F. "Efficient Capital Markets: A Review of Theory and Empirical Work," Journal of Finance 25(1970):383-417.

Fama, E.F. and M.E. Blume. "Filter Rules and Stock Market Trading Profits," Journal of Business 39(1, Part II)(1966):226-241.

Ibbotson Associates. Stocks, Bonds, Bills, and Inflation: 1985 Yearbook, Capital Market Research Center, Chicago, 1985.

Irwin, S.H. and B.W. Brorsen. "Public Futures Funds," Journal of Futures Markets, 1985 (forthcoming).

Irwin, S.H. and J.W. Uhrig. "Do Technical Analysts Have Holes in Their Shoes?" Review of Research in Futures Markets, 3(1984):264-277.

Linter, J. The Potential Role of Managed Commodity-Financial Futures Accounts (and/or Funds) in Portfolios of Stocks and Bonds, paper presented at the annual conference of the Financial Analysts Federation, Toronto, Canada, May 16, 1983.

Markowitz, H.M. "Portfolio Selection," Journal of Finance, 7(1952):77-91.

Martell, T.F. and G.C. Phillipatos. "Adaption, Information, and Dependence in Commodity Markets," Journal of Finance, 29(1974):493-498.

Nawrocki, D. "Adaptive Trading Rules and Dynamic Market Disequilibrium," Applied Economics, 16(19894):1-14.

Panton, D. "A Semi-Strong Form Evaluation of the Efficiency of the Hog Futures Market: Comment," American Journal of Agricultural Economics, 62(1980):584.

Patel, C. Technical Trading Systems for Commodities and Stocks, Trading Systems Research, 1980.

Peterson, P.E. and R.M. Leuthold. "Using Mechanical Trading Systems to Evaluate the Weak Form Efficiency of Futures Markets," Southern Journal of Agricultural Economics 14(1982):147-152.

Stevenson, R.A. and R.M. Bear. "Commodity Futures: Trends or Random Walks?" Journal of Finance, 25(1970):65-81.

Tomek, W.G. and S.F. Querin. "Random Processes in Prices and Technical Analysis," Journal of Futures Markets, 4(1984):15-24.

Appendix A: Annual Real Rates of Return for Alternative Investments, 1963-1984.

Year	U.S. Treasury Bills[a] (%)	Long-term U.S. Treasury Bonds[a] (%)	Common Stocks[a] (%)	Donchian Futures Trading (%)	Rate of Inflation[a] (%)
1963	1.5	-0.4	20.8	80.2	1.7
1964	2.3	2.3	15.1	75.9	1.2
1965	2.0	-1.2	10.3	27.3	1.9
1966	1.4	-0.3	-13.0	47.1	3.4
1967	1.3	-11.9	20.3	37.5	3.0
1968	0.5	-4.8	6.1	63.1	4.7
1969	0.4	-10.5	-13.8	40.3	6.1
1970	1.0	6.3	-1.4	18.0	5.5
1971	1.0	9.6	10.6	48.3	3.4
1972	0.4	2.2	15.1	27.7	3.4
1973	-1.7	-9.1	-21.6	150.6	8.8
1974	-3.7	-7.0	-34.5	124.7	12.2
1975	-1.1	2.0	28.2	32.6	7.0
1976	0.3	11.4	18.2	29.3	4.8
1977	-1.6	-6.9	-13.1	26.5	6.8
1978	-1.8	-7.3	-2.4	7.7	9.0
1979	-2.6	-12.8	4.5	6.2	13.3
1980	-1.8	-15.8	17.4	102.9	12.4
1981	4.4	-6.5	-12.7	67.0	8.9
1982	6.4	35.1	16.9	1.2	3.9
1983	4.8	-3.0	18.0	-28.7	3.8
1984	5.6	11.0	2.2	17.4	4.0
Mean	0.9	-0.8	4.1	45.6	5.9
Standard Deviation	2.7	11.1	16.3	42.0	3.5

Correlation Coefficients:

	Bonds	Stocks	Futures	Inflation
Bills	.6161	.3284	-.4317	-.6259
Bonds		.3193	-.3612	-.4955
Stocks			-.4261	-.4551
Futures				.3032

[a] Source: Ibbotson Associates, Stocks, Bonds, Bills and Inflation: 1985 Yearbook, Capital Market Research Center, Chicago, 1985.

Appendix B: Efficient Reward-Risk Tradeoff Curve for Bills, Bonds and Stocks Portfolios.

Point	Mean	Standard Deviation	Portfolio Proportions Bills	Bonds	Stocks
A	0.0	2.7	1.0	.00	.00
B	1.0	3.8	.85	.02	.13
C	2.0	5.5	.65	.11	.24
D	3.0	7.3	.45	.21	.34
E	4.0	9.2	.26	.30	.44
F	5.0	11.2	.06	.39	.55
G	6.0	13.4	.00	.25	.75
H	7.0	16.3	.00	.00	1.00

Appendix C: Efficient Reward-Risk Tradeoff Curve for Bills, Bonds, Stocks and Donchian Futures Trading (0.0% mean) Portfolios.

Point	Mean	Standard Deviation	Portfolio Proportions			
			Bills	Bonds	Stocks	Futures
A	0.0	2.3	.97	.00	.00	.03
B	1.0	3.1	.79	.03	.13	.04
C	2.0	4.6	.57	.13	.23	.07
D	3.0	6.2	.35	.23	.33	.09
E	4.0	7.9	.13	.33	.43	.11
F	5.0	9.8	.00	.29	.59	.12
G	6.0	12.5	.00	.07	.83	.10
H	7.0	16.3	.00	.00	1.00	.00

Appendix D: Efficient Reward-Risk Tradeoff Curve for Bills, Bonds, Stocks and Donchian Futures Trading (26.2% mean) Portfolios.

Point	Mean	Standard Deviation	Portfolio Proportions			
			Bills	Bonds	Stocks	Futures
A	0.8	2.3	.97	.00	.00	.03
B	1.0	2.4	.95	.00	.01	.04
C	2.0	2.7	.87	.00	.07	.06
D	3.0	3.3	.77	.03	.12	.08
E	4.0	4.1	.67	.07	.16	.10
F	5.0	4.9	.56	.12	.20	.12
G	6.0	5.8	.45	.16	.24	.15
H	7.0	6.7	.34	.21	.28	.17
I	10.0	9.0	.06	.30	.42	.22
J	15.0	16.0	.00	.00	.58	.42
K	20.0	26.6	.00	.00	.32	.68
L	26.2	42.0	.00	.00	.00	1.00