Investment Performance of Public Commodity Pools: 1979–1990

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INTRODUCTION

Several academic studies investigate the investment performance of public commodity pools.[1] The studies do not provide a consensus regarding their investment performance. One set of studies [Lintner (1983); Brorsen and Irwin (1985); Irwin and Brorsen (1985); Murphy (1986); Irwin and Landa (1987)] conclude that public commodity pools produce favorable or appropriate investment returns. In contrast, another set of studies [Elton, Gruber, and Rentzler (1987, 1990); Schneeweis, Savayana, and McCarthy (1991)] conclude that public commodity pools are inferior investment vehicles compared to other financial instruments.

The different findings of previous studies may be a function of the sample periods examined. Studies that find positive investment performance generally examine pool returns from the late 1970s and early 1980s. In contrast, studies that find inferior performance generally examine returns only from the 1980s. Another important difference is that some studies [Brorsen and Irwin (1985); Murphy (1986), Elton, Gruber, and Rentzler (1987, 1990)] assume investment in a single randomly-selected pool, while others (Lintner (1983); Irwin and Brorsen (1985); Irwin and Landa (1987); Schneeweis, Savayana, and McCarthy (1991)] assume investment in a portfolio of pools.

This study investigates the impact of sample period and investment strategy on the investment performance of public commodity pools. The sample period for the study is January, 1979 through December, 1990. Compared with previous studies, the sample

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[1]Commodity pools also are known as commodity funds and futures funds. The official term in all regulatory matters is commodity pool, and hence, this term is used throughout the article.

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period is relatively long, and permits testing of whether performance is sensitive to the inclusion of returns from the late 1970s. In contrast to previous studies, investment in both a single randomly selected pool and a portfolio of pools is considered. This permits testing of whether performance is sensitive to the strategy assumed for investing in public commodity pools.

Three aspects of investment performance are examined. First, the attractiveness of public commodity pools as a stand-alone investment is evaluated. Second, the role of public commodity pools in investment portfolios is investigated. Third, the impact of costs on the portfolio performance of public commodity pools is analyzed.

In addition, these results are used to examine the efficiency of futures markets. Unique tests of efficiency are possible because: (1) pool returns represent actual trading experience in futures markets and (2) pool trading represents a non-trivial proportion of speculative trading in futures markets. Only one previous study (Murphy) analyzes the implications of public commodity pool returns for the efficiency of futures markets.

DATA

Data is collected for all public commodity pools trading during the period January, 1979 through December, 1990. The pools include domestic U.S. pools which collect money predominantly from U.S. citizens, as well as off-shore commodity pools which trade in U.S. futures markets but are open only to foreign investors. The initial year of 1979 is chosen because this is the first year in which ten public commodity pools are active throughout the year.[2] By comparison, only three public commodity pools are active throughout 1978.

End of month net asset value per unit and distributions per unit are collected for each public commodity pool. The unit values are net of all costs for a given month. Costs include brokerage charges, management and incentive fees, and administrative charges.[3] Sources include: (1) the *Norwood Report* from January 1979 to April 1982, (2) the "Funds Review" section published monthly in *Futures* (formerly *Commodities*) magazine from May 1982 through December 1990,[4] (3) *Managed Accounts Reports* and 10-Q reports filed with the Securities and Exchange Commission, and (4) direct communication with commodity pool managers to obtain data otherwise unavailable.

Elton, Gruber, Rentzler's (1987) procedures are followed for pools entering the data set and for pools dissolving during a year.[5] A pool does not enter a calendar year's data set until its first January of trading. When a pool dissolves during a year, the dissolution value is reinvested in the market portfolio (average commodity pool) until the end of

[2]Twelve pools report monthly public data in January 1979 to the *Norwood Report*. However, the Talisman Fund and The Dunn Corporation Limited Partnership cease to report monthly data in April 1979 and January 1981, respectively, even though they continue to trade after these dates. The reason for the cessation of reporting is unknown. Hence, these two pools are not included in the data set.

[3]Public commodity pool returns do not reflect initial sales (load) charges sometimes paid by investors. The effect of including load charges is relatively small. Consider the case of an investor who places funds in a pool for 5 years and pays a typical load charge of 8.5% of initial investment. The cost of the load charge over the 5 years is 0.142% per month.

[4]Return data is provided to *Futures* by Managed Accounts Reports, Inc.

[5]Most commodity pools are created to trade for a specific length of time [e.g., Merrill Lynch, Pierce, Fenner, and Smith (1989)]. However, a pool will cease trading before this specified time if the total equity or unit value falls below the prescribed minimum in the prospectus or an amount needed to trade effectively. The pool may also stop trading if performance is less than acceptable. In the 12-year period from 1979 through 1990, 56 pools cease trading. Dissolution net asset values are obtained for 32 pools. The net asset value at the end of the last reported month of trading is used as the dissolution value for the remaining pools. For a detailed examination of commodity pool dissolution, see Elton, Gruber, and Rentzler (1990).

the calendar year of dissolution. This procedure allows the usually lower rate of return of a dissolving pool to be included in calculating average returns. Thus, a survivorship bias in average returns is avoided.

If a pool suspends trading, the unit value from the last month of trading is brought forward until trading resumes. This produces a zero percent monthly rate of return for as long as trading is suspended. Once trading begins again, the usual calculations are resumed.

Monthly returns of a broad range of financial investments are collected to provide comparisons with public commodity pools. They include buy-and-hold portfolios of common stocks, small stocks, U.S. Treasury bills, intermediate government bonds, long-term government bonds, and long-term corporate bonds. Data for these instruments are taken from Ibbotson Associates, Inc. (1991).

In addition, returns are calculated to a passive futures buy-and-hold strategy based on the Commodity Research Bureau (CRB) Composite Index of 27 commodity futures prices. Since futures margins may be deposited in the form of interest-bearing instruments, buy-and-hold futures returns are calculated as the sum of the change in the CRB Index and treasury bill returns [Edwards and Ma (1988)].

Finally, returns for all of the alternative investments are on a gross rather than net basis. Because transactions costs generally are small relative to the returns of the alternative investments, comparison to net public commodity pool returns is appropriate.

CALCULATION OF PUBLIC COMMODITY POOL RETURN AND RISK

Consistent with earlier studies, the monthly net return of a public commodity pool is defined as,

$$R_{c,t} = \frac{NAV_{c,t} - NAV_{c,t-1} + D_{c,t}}{NAV_{c,t-1}} \tag{1}$$

where $R_{c,t}$ is the net return for commodity pool c in month t, $NAV_{c,t}$ is the net asset value per unit for commodity pool c at the end of month t, $NAV_{c,t-1}$ is the net asset value per unit for commodity pool c at the end of month $t - 1$, and $D_{c,t}$ is the cash distribution made by commodity pool c in month t. The formula assumes cash distributions are reinvested in the pool at the end of the month of distribution.

Two different strategies for investing in public commodity pools are examined: (1) a single randomly selected pool and (2) a market portfolio of pools. The first strategy assumes that funds are invested in a *single* randomly selected pool, whereas the second strategy assumes an equally weighted investment is made in *all* pools.[6]

The two strategies may entail substantially different risks. If the "market" is defined as all public commodity pools, a randomly selected pool contains both the systematic (undiversifiable) market risk and the unsystematic (diversifiable) risk associated with holding only one pool. A market portfolio of pools contains only the systematic risk associated with holding all pools. If returns of individual commodity pools are less than perfectly correlated (positively), the risk of a randomly selected pool will exceed the risk of a market portfolio of pools.

Following Elton, Gruber, and Rentzler (1987), both monthly and annual holding period investment horizons are examined. The two holding periods are used to reflect different time horizons which investors may use when making investments. The rate of return

[6]Equity-weighted returns also are calculated. They are not significantly different than equal-weighted returns, so only the latter are used in this study. See Appendix D in Krukemyer (1990) for results and further discussion.

for a monthly horizon is calculated as the average arithmetic rate of return. The rate of return for an annual horizon is calculated as the average geometric rate of return.[7]

For a given year, average monthly returns and standard deviation of monthly returns for a randomly selected pool are generated by a two-step procedure. First, the arithmetic average, geometric average, and standard deviation of the monthly returns during the year are calculated for each pool. Second, the individual average returns (arithmetic or geometric) and standard deviations are averaged.[8] If a pool ends trading in any month other than December, it is not included in calculating that year's average standard deviation. The reason is that lack of trading during part of the year could bias the average standard deviation downward.

Average monthly returns and standard deviation of the market portfolio for a given year also are generated by a two-step procedure. First, portfolio returns for each month during the year are calculated. Portfolio returns are generated by averaging the returns of all pools trading during a month. Second, the average and standard deviation of the 12 monthly portfolio returns is calculated.

Average returns for a monthly holding period will be identical for a randomly selected pool and the market portfolio of pools. The reason is that the average of the individual pools' average monthly returns equals the average of the monthly portfolio returns. This equality holds only when equal weighting of returns is assumed for the market portfolio.

Average returns for an annual holding period are not expected to be equal for a randomly selected pool and the market portfolio. This is due to the use of a geometric average to calculate average returns for the annual holding period. The larger the standard deviation of returns, the smaller will be the geometric average of returns. Since the standard deviation of a randomly selected pool is likely to be higher than that of the market portfolio, the average return of a randomly selected pool for an annual holding period is expected to be smaller than the average return of the market portfolio of pools.

Finally, to provide a check on the data and application of the methodology, returns and risk are calculated for the sample period examined by Elton, Gruber, and Rentzler (1987). The returns generated by this study closely replicate those reported by Elton, Gruber, and Rentzler. Results of the comparison are presented in Appendix A.

STAND-ALONE PERFORMANCE

As shown in Table I, public commodity pool returns are highly variable across years. For example, monthly holding period returns for a randomly selected commodity pool range from a high of 4.221% per month in 1979 to a low of −0.876% in 1986. Furthermore, average returns are sensitive to the sample period selected, particularly to the inclusion of 1979. For a monthly holding period, randomly selected pool returns average 1.158% per month over 1979–1990, but decrease to 0.879% per month over 1980–1990, and 0.784% per month over 1986–1990.

[7]Over the same period, the average return for monthly holding periods will be equal to or larger than the average return for an annual holding period. This occurs because an arithmetic average will always be equal to or larger than a geometric average, assuming the variance of the series is greater than zero [Grossman (1987)].

[8]It is not possible to directly calculate the average annual holding period returns for a randomly selected pool in 1980. The reason is that one pool (McClean I) had a −100% return in December 1980. Hence, the 1980 annual holding period return (geometric average) for this pool is not defined (it equals negative infinity). As a consequence, the average annual holding period return for all pools in 1980 also is undefined. Returns to an equally weighted portfolio of all 15 pools are substituted. Initial weights are determined by December 1979 net asset values. No rebalancing of the portfolio weights is allowed in the calculations.

Table I

NET RETURN AND STANDARD DEVIATION FOR PUBLIC COMMODITY POOLS, 1979–1990

Year	Number of Pools	Randomly Selected Commodity Pool			Market Portfolio of Commodity Pools		
		Average Return		Standard Deviation	Average Return		Standard Deviation
		MHP[a]	AHP[b]		MHP[a]	AHP[b]	
		Percent per month			Percent per month		
1979	10	4.221	3.138	13.713	4.221	3.912	8.352
1980	15	2.520	1.728	15.015	2.520	2.284	7.320
1981	22	0.838	0.399	8.845	0.838	0.670	6.124
1982	43	0.518	0.053	9.436	0.518	0.327	6.450
1983	62	−0.577	−1.177	10.155	−0.577	−0.818	7.303
1984	78	1.098	0.585	9.741	1.098	0.863	7.381
1985	94	1.358	1.006	8.154	1.358	1.212	5.672
1986	98	−0.876	−1.350	9.299	−0.876	−1.066	6.498
1987	111	2.854	2.495	8.441	2.854	2.696	6.038
1988	128	0.715	0.202	9.482	0.715	0.481	7.415
1989	149	−0.297	−0.622	7.413	−0.297	−0.428	5.360
1990	186	1.522	1.340	5.611	1.522	1.479	3.059
Average:							
1979–1990		1.158	0.650	9.609	1.158	0.968	6.414
1980–1990		0.879	0.424	9.236	0.879	0.700	6.238
1986–1990		0.784	0.413	8.049	0.784	0.632	5.674

[a]Monthly holding period.
[b]Annual holding period.

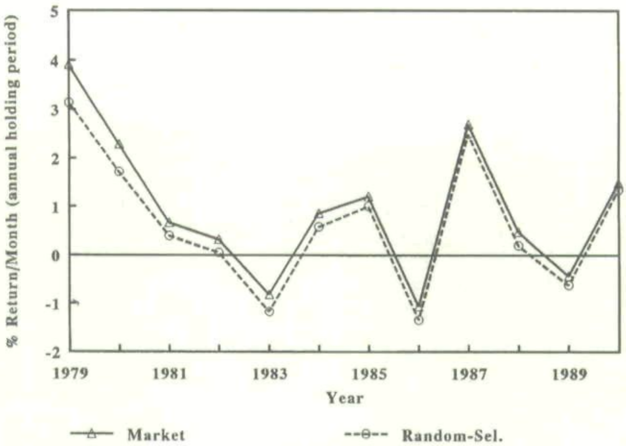

Figure 1
Average monthly return of public commodity pools, 1979–1990.

A time series plot of annual holding period returns is shown in Figure 1. The plot suggests that the 1979 return may be an outlier.[9] Over 1980–1990, returns appear to follow a stationary pattern. It has been suggested that public commodity pool returns may diminish as the size of their trading increases [Irwin and Brorsen (1987)], but commodity pool returns exhibit no such downward trend after 1979.[10]

A randomly selected commodity pool's monthly standard deviation ranges from 15.015% per month in 1980 to 5.611% per month in 1990 (Table I). Over the entire 1979–1990 period, average monthly standard deviation of a randomly selected commodity pool is 9.609%. As expected, standard deviation for the market portfolio of commodity pools is substantially smaller. It averages 6.414% per month over 1979–1990, a one-third reduction in risk compared to holding a single randomly selected commodity pool.

For comparative purposes, average returns and standard deviations of the alternative investments over 1979–1990 are reported in Table II. Several observations are noteworthy. First, the standard deviation of commodity pool returns is generally greater than the standard deviation of returns for alternative investments. This is especially true for a randomly selected pool, which has a standard deviation over one-and-a-half times that of common stocks. Second, over the entire 1979–1990 period, monthly and annual holding period returns for the market portfolio of pools, as well as the monthly holding period returns for a randomly selected pool, exceed returns for bills and bonds, but not for common and small stocks. In contrast, over both 1980–1990 and 1986–1990, returns for commodity pools are not favorable relative to both stock and bond investments. This difference in results reinforces the previously noted importance of the data for

[9]The abnormal returns in 1979 appear to be related to market conditions rather than the particular pools trading in that year. The ten pools trading in 1979 produce returns and risks representative of all pools over the remainder of the sample period, despite the fact that five of the ten pools dissolve between 1980 and 1985. (As before, when a pool dissolves, it is assumed that the dissolution value is reinvested in the remaining pools until the end of the year.) Over 1980–1990, the ten pools generate average returns for a monthly holding period of 1.013% per month and a standard deviation of 8.456% per month. By comparison, average return and standard deviation of all pools over 1980 to 1990 equals 0.879% per month and 9.236% per month, respectively.

[10]Linear time-trend regressions support this conclusion. Using annual observations over 1980–1990, public pool returns are regressed on time. Coefficients for time are insignificantly different from zero for the randomly selected pool regressions and the market portfolio regressions. The same result is found using monthly returns for the market portfolio of pools over 1980–1990.

1979. Third, over none of the sample periods does the annual holding period return of a randomly selected commodity pool exceed the return of treasury bills or of the passive buy-and-hold futures strategy. Fourth, the average return of the market portfolio of commodity pools exceeds the average return for the buy-and-hold futures strategy over both monthly and annual holding periods. This result suggests that the active trading strategies used by public pools as a group generate net returns which exceed the gross returns of a passive buy-and-hold strategy.

Given the well-known tradeoff between the return and risk of investments, a comprehensive measure of stand-alone investment performance is needed. A widely used method of ranking individual investment alternatives is the Sharpe ratio,

$$SR_i = \frac{R_i - r_f}{\sigma_i} \tag{2}$$

where SR_i is the Sharpe ratio of investment i, R_i is the expected return of investment i, r_f is the risk-free return, and σ_i is the standard deviation of investment i.

Sharpe ratios are calculated using treasury bill returns as a proxy for the risk-free return. The calculated ratios and corresponding investment rankings are presented in Table III. The rankings indicate that the stand-alone performance of public pools generally is poor. There are only two cases where a pool investment outranks a stock or bond investment: the market portfolio of pools is ranked higher than long-term government bonds for a monthly holding period over 1979–1990 and is ranked higher than small stocks for an annual holding period over 1986–1990. Among the alternative futures investments, the market portfolio of commodity pools always is the highest ranked investment.

PORTFOLIO PERFORMANCE

While the stand-alone performance of public commodity pools is poor, this does not necessarily imply that investment in pools is without merit. It is possible that public pools may be an attractive addition to investment portfolios. Elton, Gruber, and Rentzler (1987) show that a commodity pool should be added to an existing portfolio if,

$$\frac{R_c - r_f}{\sigma_c} > \frac{R_p - r_f}{\sigma_p} \cdot \rho_{c,p} \tag{3}$$

where R_c is the expected return of commodity pool c, r_f is the risk-free return, σ_c is the standard deviation of commodity pool c, R_p is the expected return of portfolio p, σ_p is the standard deviation of portfolio p, and $\rho_{c,p}$ is the correlation coefficient between the expected returns of commodity pool c and portfolio p.

Equation (3) is the condition commodity pools must meet to improve the return-risk tradeoff of an existing portfolio of investments. The intuition behind the condition may be more evident if interpreted in terms of Sharpe Ratios. For commodity pools to improve the return-risk tradeoff of an investment portfolio, the Sharpe Ratio of commodity pools must exceed the product of the Sharpe Ratio of the existing investment portfolio and the correlation coefficient between commodity pools and the investment portfolio. It is important to note that the breakeven condition is not based on an equilibrium asset pricing model. The condition is relevant only to a pre-specified portfolio, which may or may not be an efficient or optimal portfolio.

A key component of the breakeven condition is the correlation between commodity pool returns and portfolio returns. Correlation coefficients between a randomly selected pool and the alternative investments are shown in Table IV. Monthly returns of the market

Table II
RETURN AND STANDARD DEVIATION FOR ALTERNATIVE INVESTMENTS, 1979–1990

Investment[a]	1979–1990 Average Return MHP[b]	1979–1990 Average Return AHP[a]	1979–1990 Standard Deviation	1980–1990 Average Return MHP[b]	1980–1990 Average Return AHP[c]	1980–1990 Standard Deviation	1986–1990 Average Return MHP[b]	1986–1990 Average Return AHP[c]	1986–1990 Standard Deviation
					Percent per month				
RS comm. pool	1.158	0.650	9.609	0.879	0.424	9.236	0.784	0.413	8.049
MP comm. pools	1.158	0.968	6.414	0.879	0.700	6.238	0.784	0.632	5.674
B&H futures	0.753	0.702	3.209	0.579	0.530	3.165	0.542	0.504	2.787
Common stocks	1.337	1.225	4.711	1.323	1.208	4.793	1.185	1.034	5.418
Small stocks	1.280	1.108	5.748	1.099	0.933	5.623	0.235	0.048	5.849
T-bills	0.715	0.715	0.222	0.705	0.705	0.228	0.553	0.552	0.108
IT gov't bonds	0.901	0.877	2.181	0.950	0.927	2.195	0.757	0.746	1.445
LT gov't bonds	0.936	0.861	3.924	1.026	0.949	3.985	0.905	0.853	3.286
LT corp. bonds	0.933	0.870	3.592	1.046	0.982	3.622	0.856	0.830	2.284

RS comm. pool: Randomly selected commodity pool; MP comm. pools: Market portfolio of commodity pools; B&H futures: Buy-and-Hold futures; T-bills: Treasury bills; IT gov't bonds: intermediate-term government bonds; LT gov't bonds: Long-term government bonds; LT corp. bonds: Long-term corporate bonds.

[b]Monthly holding period.

[c]Annual holding period.

Table III
SHARPE RATIO AND RANK FOR ALTERNATIVE INVESTMENTS, 1979–1990

	1979–1990		1980–1990		1986–1990	
Investment[a]	MHP[b]	AHP[c]	MHP[b]	AHP[c]	MHP[b]	AHP[c]
			Sharpe ratio			
RS comm. pool	0.046	–0.007	0.019	–0.031	0.029	–0.017
MP comm. pools	0.069	0.038	0.028	–0.002	0.040	0.012
B&H futures	0.012	–0.004	–0.040	–0.055	–0.004	–0.017
Common stocks	0.132	0.108	0.129	0.105	0.117	0.089
Small stocks	0.098	0.068	0.070	0.041	0.054	–0.086
IT gov't bonds	0.085	0.074	0.112	0.101	0.141	0.134
LT gov't bonds	0.056	0.037	0.081	0.061	0.107	0.092
LT corp. bonds	0.061	0.043	0.094	0.076	0.133	0.122
			Sharpe ratio rank			
RS comm. pool	7	8	7	7	7	7
MP comm. pools	5	6	6	6	6	5
B&H futures	8	7	8	8	8	6
Common stocks	1	1	1	1	3	4
Small stocks	2	3	5	5	5	8
IT gov't bonds	3	2	2	2	1	1
LT gov't bonds	6	5	4	4	4	3
LT corp. bonds	4	4	3	3	2	2

[a]RS comm. pool: Randomly selected commodity pool; MP comm. pools: Market portfolio of commodity pools; B&H futures: Buy-and-hold futures; IT gov't bonds: Intermediate-term government bonds; LT gov't bonds: Long-term government bonds; LT corp. bonds: Long-term corporate bonds.

[b]Monthly holding period.

[c]Annual holding period.

Table IV
CORRELATION BETWEEN MONTHLY RETURNS OF A RANDOMLY SELECTED COMMODITY POOL AND OTHER FINANCIAL INVESTMENTS, 1979–1990

Year	Number of Pools	Common Stocks	Small Stocks	T-Bills	IT Gov't Bonds	LT Gov't Bonds	LT Corp. Bonds	B&H Futures	MP of Comm. Pools	Inflation
1979	10	0.086	0.139	−0.144	0.319	0.379	0.357	0.395	0.641	0.094
1980	13	0.098	0.137	−0.217	−0.105	−0.265	−0.229	0.121	0.389	−0.056
1981	22	−0.056	−0.066	0.161	0.092	0.154	0.204	−0.359	0.624	0.091
1982	43	−0.115	−0.228	−0.027	−0.261	−0.067	−0.130	−0.287	0.676	0.145
1983	60	−0.120	−0.093	0.334	−0.193	−0.363	−0.257	0.389	0.708	0.176
1984	77	−0.320	−0.324	−0.073	0.153	0.140	0.203	−0.425	0.672	−0.110
1985	88	0.299	0.404	0.127	−0.120	−0.033	0.008	−0.155	0.635	−0.255
1986	94	0.310	0.305	0.343	0.385	0.462	0.485	−0.195	0.655	−0.378
1987	106	0.143	0.134	−0.309	−0.221	−0.192	−0.174	0.496	0.705	0.008
1988	124	0.240	0.071	0.085	0.156	0.172	0.239	0.486	0.744	0.019
1989	144	0.383	0.368	0.111	0.162	0.205	0.240	−0.334	0.622	0.143
1990	174	−0.364	−0.313	0.132	−0.313	−0.345	−0.373	0.165	0.492	0.179
Average:										
1979–1990		0.049	0.045	0.044	0.005	0.021	0.048	0.025	0.630	0.005
1980–1990		0.045	0.036	0.061	−0.024	−0.012	0.020	−0.009	0.629	−0.003
1986–1990		0.142	0.113	0.072	0.034	0.060	0.083	0.124	0.644	−0.006

[a]IT gov't bonds: Intermediate-term government bonds; LT gov't bonds: Long-term government bonds; LT corp. bonds: Long-term corporate bonds; B&H futures: Buy-and-hold futures; MP of comm. pools: Market portfolio of commodity pools.

portfolio of pools exhibit nearly identical correlations with the alternative investments. Hence, only correlations for a randomly selected pool are presented.

While the correlations between commodity pool returns and stock and bond returns vary somewhat from year-to-year, the central tendency is towards zero correlation. Over the 1979–1990 sample period, the average correlation between monthly returns of a randomly selected commodity pool and stock and bond investments range from 0.005 for intermediate-term government bonds to 0.049 for common stocks. Monthly commodity pool returns also do not show any evidence of correlation with buy-and-hold futures or the rate of inflation. Finally, the correlation between returns to a randomly selected pool and returns to the market portfolio of commodity pools are relatively high, indicating that the degree of co-movement in individual commodity pool returns is substantial.

The correlation results suggest that it is reasonable to assume that public commodity pool returns are uncorrelated with the returns to any of the stock and bond investments. The assumption of zero correlation allows eq. (3) to be simplified as follows,

$$R_c - r_f > 0 \tag{4}$$

Hence, if public commodity pools are to enter a portfolio of the stock and bond investments, the difference between pool returns and the risk-free rate (excess returns) must be greater than zero. The hypothesis that excess returns are greater than zero can be tested with the use of a t-statistic. Note that the breakeven condition applies to any individual stock or bond investment as well as any portfolio of stock and bond investments. The reason is that the correlation between commodity pools and any portfolio of stock and bond investments (e.g., 60% common stocks and 40% corporate bonds) is zero if the correlation between pools and the individual stock and bond investments is zero.[11]

Excess net public pool returns are presented in Table V.[12] Again, treasury bill returns are used as a proxy for the risk-free rate of return. Consistent with the above described findings of this study, excess net returns are highest for the 1979–1990 period. Excess net returns for a randomly selected pool are positive over all three sample periods at the monthly holding period, but are negative over all three sample periods at the annual holding period. Excess net returns for the market portfolio of pools are positive for all holding periods and sample periods except for the annual holding period over the 1980 to 1990 sample period. However, based on t-statistics, none of the positive excess returns for a randomly selected pool or the market portfolio of pools are significantly different from zero.[13]

The results show that investment in public pools does not cause a statistically significant improvement in the performance of stock and bond portfolios. Therefore, the portfolio performance of pools is not superior. On the other hand, investment in public pools is not significantly detrimental to the performance of stock and bond portfolios. Hence, the portfolio performance of pools is not inferior. The most appropriate conclusion is that

[11]This follows from the fact that,

$$\mathrm{Cov}(X, bY + cZ) = b\,\mathrm{Cov}(X, Y) + c\,\mathrm{Cov}(X, Z)$$

If $\mathrm{Cov}(X, Y) = \mathrm{Cov}(X, Z) = 0$, then $\mathrm{Cov}(X, bY + cZ) = 0$.

[12]Excess returns and t-statistics are calculated using annual observations. Hence, the t-statistics for 1979–1990, 1980–1990, and 1986–1990 are based on 12, 11, and 5 observations.

[13]Note that a two-tailed test of significance is used. This is done for two reasons. First, a two-tailed test is more conservative. Second, a two-tailed test allows the hypothesis tests to be interpreted in the context of the Capital Asset Pricing Model. This latter issue will be considered in the section on market efficiency implications.

Table V
EXCESS NET RETURNS FOR PUBLIC COMMODITY POOLS, 1979–1990[a]

	Randomly Selected Commodity Pool		Market Portfolio of Commodity Pools	
Sample Period	**MHP[b]**	**AHP[a]**	**MHP[b]**	**AHP[c]**
		Percent per month		
1979–1990	0.443	−0.066	0.443	0.252
	(1.043)	(−0.165)	(1.042)	(0.601)
1980–1990	0.174	−0.282	0.174	−0.005
	(0.484)	(−0.772)	(0.484)	(−0.014)
1986–1990	0.231	−0.139	0.231	0.080
	(0.341)	(−0.199)	(0.341)	(0.116)

Note: The figure in parentheses is a t-statistic. One (two) star(s) indicates the average excess return of public commodity pools is significantly different from zero at the 10 (5)% level of significance. Two-tailed tests of significance are used.
[a]Excess net return = net return − treasury bill return.
[b]Monthly holding period.
[c]Annual holding period.

the portfolio performance of public pools is neutral, neither improving nor worsening the return-risk tradeoffs of stock and bond portfolios.

Finally, it is useful to note that portfolio performance is ordinally better when data from 1979 is included. This result is consistent with the different conclusions of earlier studies. Previous studies that include data from the high return years of the late 1970s tend to find positive portfolio results [e.g., Lintner (1983)], while studies that use samples solely from the 1980s tend to report negative portfolio results [e.g., Elton, Gruber, and Rentzler (1990)].

THE IMPACT OF COST ON PORTFOLIO PERFORMANCE

Performance problems of public commodity pools frequently have been attributed to high operating costs [e.g., Elton, Gruber, and, Rentzler (1987)]. Estimates of the total operating costs of public commodity pools range from 17 to 19% of annual equity [Irwin and Brorsen (1985); Murphy (1986); Basso (1989)]. In contrast, Ippolito (1989) reports that costs of stock mutual funds are about 1% of annual equity.

The performance impacts of lower costs can be analyzed by using evidence from institutional pension fund investments in commodity pools. Costs for institutional commodity pools are 10 to 12% of annual equity, approximately seven percentage points less than costs for public commodity pools (Table VI).[14] The biggest reduction is in commissions, which are decreased from 9 to 2% of annual equity. This reflects a much lower brokerage charge per trade.[15] In addition, the usual management fee paid by

[14]The term *institutional commodity pools* is used only in the descriptive sense. To date, there are no commodity pools created for and marketed to institutional investors. Instead, institutions directly employ commodity trading advisors and brokers who trade the institution's monies in a similar fashion to a public commodity pool.

[15]Irwin and Brorsen (1985) report that investors in their sample of public commodity pools often are charged full retail commission rates. The data in Table VI imply that institutional investors have negotiated for brokerage rates nearly 80% lower than that paid by public investors (assuming similar trading strategies across the two investments).

institutional investors is half the usual management fee paid by public investors, 2.5 versus 5.0% of annual equity.

The potential impact of these lower costs is analyzed by adjusting the monthly returns on the market portfolio of pools to reflect the lower costs paid by institutional investors.[16] The adjustment requires two steps. First, gross trading returns of public commodity pools are estimated. This entails subtracting treasury bill returns from net public pool returns and then adding back the public pool costs. Second, the net return to institutional commodity pools is estimated by subtracting the costs of institutional investors from the estimated gross trading returns and adding back treasury bill returns. Details of the procedure are reported in Appendix B.

The lower costs negotiated by institutional investors substantially impacts the performance of commodity pools (Table VII). Average returns increase one-and-a-half to two times after the cost adjustment. For example, average returns for an annual holding period over 1980–1990 are 1.339% per month after the cost adjustment, compared to 0.700% per month before the cost adjustment. Standard deviation of returns is changed only slightly by the adjustment, while the correlation with other investments, as represented by the correlation with common stocks, remains near zero. In fact, the correlation with stocks is even closer to zero after the cost adjustment.

The portfolio breakeven results stand in sharp contrast to the original breakeven results. Average excess net returns after the cost adjustment are substantially positive in all six cases. Moreover, excess net returns are significantly different from zero and positive for the monthly and annual holding periods over 1979–1990 and for the monthly holding period over 1980–1990. Hence, using the typical cost structure negotiated by institutions, this analysis suggests that commodity pool investment may improve the return-risk tradeoffs of stock and bond portfolios.

IMPLICATIONS FOR THE EFFICIENCY OF FUTURES MARKETS

The returns to public commodity pools provide a unique test of the efficiency of futures markets for two reasons. First, pool returns represent actual trading experience in futures markets. Most previous studies of market efficiency rely on simulated returns to trading strategies [e.g., Lukac, Brorsen, and Irwin (1988)] or statistical tests of the behavior of futures prices [e.g., Chowdhury (1991)]. Second, pool returns represent a non-trivial proportion of speculative trading in futures markets. While precise estimates are unavailable, public commodity pool positions may represent as much as 10% of the total open interest in some futures markets [Brorsen and Irwin (1987)]; Commodity Futures Trading Commission (1991)].

Market efficiency usually implies that prices reflect all available information [Fama (1970)]. If futures markets are fully efficient, then it is futile to expend resources in an effort to "beat the market." Since it is not possible to improve upon the information reflected in market prices, gross trading returns should equal zero, or equivalently, traders should experience losses equal to costs.

Applying Fama's definition of futures market efficiency to public commodity pools requires estimates of gross trading returns. Gross trading returns are estimated as a part of the cost analysis discussed in the previous section. The estimated average gross trading return (excluding interest earnings) for the market portfolio of public pools over 1979–1990, 1980–1990, and 1986–1990 is 1.696, 1.312, and 1.644% per month, respectively. The smallest *t*-statistic for the average gross trading returns is 2.28,

[16]Related analysis is reported in Murphy (1986), Cornew (1988), and Edwards and Ma (1988).

Table VI
COSTS OF COMMODITY POOL INVESTMENTS

Type of Commodity Pool	Cost Category			
	Commissions (Annual Percent of Equity)	Management (Annual Percent of Equity)	Incentive (Annual Percent of Gross Trading Profits)	Total (Annual Percent of Equity)
Public commodity pool	9.3	5.0	20.0	17–19
Institutional commodity pool	2.0	2.5	25.0	10–12

Sources: Irwin and Brorsen (1985); Murphy (1986); Basso (1989); Hecht (1989).

Table VII

NET RETURN STATISTICS FOR THE MARKET PORTFOLIO OF PUBLIC COMMODITY POOLS AFTER COST ADJUSTMENT FOR INSTITUTIONAL INVESTORS, 1979–1990

Sample Period	Average Net Return		Standard Deviation	Correlation with Common Stocks	Excess Net Return[a]	
	MHP[b]	AHP[c]			MHP[b]	AHP[c]
	Percent per month				Percent per month	
1979–1990	1.767	1.593	6.151	0.010	1.051**	0.878*
					(2.582)	(2.172)
1980–1990	1.503	1.339	5.929	0.010	0.800**	0.634
					(2.287)	(1.796)
1986–1990	1.418	1.281	5.510	0.029	0.865	0.728
					(1.313)	(1.091)

Note: The figure in parentheses is a t-statistic. One (two) star(s) indicates the average excess return of public commodity pools is significantly different from zero at the 10 (5)% level of significance. Two-tailed tests of significance are used.

[a]Excess net return = net return − treasury bill return.

[b]Monthly holding period.

[c]Annual holding period.

and all gross returns are significantly different from zero at the 5% level.[17] Hence, Fama's definition of futures market efficiency is strongly rejected with respect to public commodity pool returns.[18]

The rejection of Fama's definition of market efficiency may not be as serious as appearances suggest. The reason is that Fama's depiction of equilibrium is based on the assumption that information is costless to collect and use. However, a full information equilibrium is impossible if information is costly [Grossman and Stiglitz (1980)]. Market participants have an incentive to collect and use costly information only if returns cover the cost of information. If returns do not cover the cost of information, rational participants will not trade based on the information, and market prices will not reflect the information. Hence, the impossibility of fully efficient markets when information is costly.

Jensen (1978) suggests a definition of market efficiency that is not subject to the aforementioned "impossibility" problem, and hence, is more economically sensible. According to Jensen, an efficient market is one in which prices reflect information to the point where the marginal benefits of collecting and using information equal the marginal costs. In other words, the returns to any trading strategy adjusted for costs and risk should equal zero in an efficient market.

Applying Jensen's definition of market efficiency to public commodity pool returns requires two steps. First, the returns must be net of all costs. Second, the returns must be adjusted for risk, which requires the assumption of a particular equilibrium asset pricing model. While not universally accepted, the Capital Asset Pricing Model (CAPM) [Sharpe (1964); Lintner (1965)] is widely used to adjust returns for risk. If the "market return" is proxied by any linear combination of the stock and bond return series examined in this study, then the (near) zero correlations reported in Table IV imply that the CAPM market beta of public commodity pools is approximately equal to zero. Under the CAPM, any investment with a zero beta, and hence no market risk, should earn the risk-free rate of return.

The above discussion suggests a relatively simple test of (Jensen) market efficiency in the case of public commodity pools: net returns should not be significantly different from the risk-free rate of return. In other words, the excess net return of public pools should not be significantly different from zero. None of the excess net returns for public commodity pools reported in Table V are significantly different from zero. Returns of public pools, therefore, are consistent with market efficiency after adjusting for costs and risk. That is, pools earn a gross return just sufficient to offset the costs and risk involved

[17]The estimated gross trading returns of pools are of further interest in light of the trading strategies used by most public commodity pools. Previous researchers note that most pools base trading decisions on "trend-following" technical systems [Irwin and Brorsen (1985); Murphy (1986); Elton, Gruber, and Rentzler (1987)]. It is frequently argued that trend-following systems do not work [e.g., Elton, Gruber, and Rentzler (1987, p. 176)]. The gross trading returns of public commodity pools suggest that trend-following systems may have some value. Corroborating evidence is found in recent simulation studies of the profitability of technical trading systems [e.g., Lukac, Brorsen, and Irwin (1988); Lukac and Brorsen (1990)]. Lukac and Brorsen simulate trading of 23 technical systems on 30 futures markets over 1976–1985. Using leverage assumptions similar to that actually employed by public commodity pools, Lukac and Brorsen find that gross trading profits (before interest earnings) average 2.15% per month across all systems and markets. Gross trading returns are positive and significantly different from zero for all 23 systems.

[18]The general rejection of efficiency may reflect a mixture of inefficient and efficient futures markets. It is possible that all or most of the gross trading returns are earned in just a few futures markets. For example, anecdotal evidence suggests public commodity pools may have generated much of their profits during the 1980s in currency futures markets.

in collecting and using information. It is interesting to note that a similar result is found for stock mutual funds [Ippolito (1989)].

The same efficiency test can be applied to the estimated returns to an institutional commodity pool. In contrast to the results for public pools, estimated excess returns to institutional commodity pools are positive and significantly different from zero for a monthly holding period over 1979–1990 and 1980–1990, as well as for the annual holding period over 1979–1990 (Table VII). Market efficiency is thus rejected with respect to the estimated returns for institutional commodity pools over some of the sample scenarios.

Several interpretations can be given to the rejections of market efficiency with respect to institutional commodity pools. First, the significant excess returns may reflect a return to risk which the CAPM does not incorporate. The CAPM assumes a constant return to risk for all investments. The estimated returns for institutional commodity pools may reflect a time-varying return to risk. Second, the excess returns may represent a market inefficiency that is in the process of being eliminated. Institutional pension funds increasingly are investing in commodity pool programs [Angrist (1992)]. As this investment increases, the estimated excess returns may be eliminated. Third, the assumptions used to estimate institutional returns may not be representative of actual futures trading by institutions.

SUMMARY AND CONCLUSIONS

This study investigates the investment performance of public commodity pools over the sample period January, 1979 through December, 1990. The sample period is relatively long and permits testing of whether performance is sensitive to the inclusion of returns from the late 1970s. Investment in both a single randomly selected pool and a portfolio of pools is evaluated to determine if performance is sensitive to the investment strategy. Returns are calculated for both a monthly and an annual holding period.

Among the alternative futures investments, the market portfolio of commodity pools performs the best. The Sharpe ratio of the market portfolio of pools always exceeds the Sharpe ratio of a randomly selected pool and a passive buy-and-hold futures strategy. This result suggests: (1) that investment in public commodity pools should involve a portfolio of pools and (2) that the active trading strategies used by public pools as a group generate net returns which exceed the returns of a passive buy-and-hold strategy.

Compared with alternative stock and bond investments, the stand alone investment performance of public commodity pools is poor. In only two cases is the Sharpe Ratio of a public commodity pool higher than a stock or bond investment. The poor stand alone performance is not particularly sensitive to the sample period or to whether the investment strategy involves a single randomly selected pool or a market portfolio of pools.

Investment in public pools does not cause a statistically significant improvement in the performance of stock and bond portfolios, and hence, the portfolio performance of pools is not superior. On the other hand, investment in public pools is not significantly detrimental to the performance of stock and bond portfolios, and therefore, the portfolio performance of pools is not inferior. The most appropriate conclusion is that the portfolio performance of public pools is neutral, neither improving nor worsening the return-risk tradeoffs of stock and bond portfolios.

Portfolio performance is ordinally better when data from 1979 is included in the analysis. This result is consistent with the conclusions of earlier studies. Previous studies that include data from the high return years of the late 1970s tend to find positive portfolio results [e.g., Lintner (1983)], while studies that use samples solely form the 1980s tend to report negative portfolio results [e.g., Elton, Gruber, and Rentzler (1990)].

The cost of investing in public commodity pools is often mentioned as a reason for their unattractive performance. When costs are reduced to the level which large institutional pension funds have been able to obtain, average returns to the market portfolio of pools exceed stock and bond portfolio breakeven levels in all cases. Moreover, returns are significantly greater than breakeven returns over 1979–1990 and 1980–1990. Therefore, reducing costs to investors has the potential to make a portfolio of public commodity pools a desirable addition to stock and bond portfolios.

Finally, the results provide unique evidence regarding futures market efficiency. Unique tests of efficiency are possible because: (1) pool returns represent actual trading experience in futures markets and (2) pool trading represents a non-trivial proportion of speculative trading in futures markets. Returns of public commodity pools are consistent with market efficiency after adjusting for costs and risk. That is, public commodity pools earn a gross return just sufficient to offset the costs and risk of collecting and using information.

In contrast to the results for public pools, estimated returns to institutional commodity pools over some periods more than offset costs and risk. Market efficiency is therefore rejected for institutional commodity pools over some of the sample scenarios. Several interpretations can be given to the rejections of market efficiency. First, the estimated returns for institutional commodity pools may reflect a time-varying return to risk. Second, institutional returns may represent a market inefficiency that is in the process of being eliminated. Third, the assumptions used to estimate institutional returns may not be representative of actual futures trading by institutions.

Appendix A

Returns to public commodity pools also are calculated for the sample period July, 1979–June, 1985, which is the sample period examined by Elton, Gruber, and Rentzler (1987). Both sets of returns are based on the strategy of investing in a single randomly selected pool. Returns and standard deviations differ only slightly over the entire sample (bottom row, Table AI). Furthermore, except for the first 2 years, returns and standard deviations are similar for each year. The differences for the first 2 years are likely due to the different sources of data for this earlier period. For this study, data over July, 1979–April, 1982 are collected from the *Norwood Report.* The remainder of the data are collected from *Managed Accounts Reports* (as reported in *Futures*). All of Elton, Gruber, and Rentzler's data is collected from *Managed Accounts Reports.*

Appendix B

Two steps are required to adjust public commodity pool returns for the lower costs of institutional investors. First, gross public commodity pool trading returns for month t are calculated as follows,

$$GPCP_t = (NPCP_t - TB_t + CCPCP_t + MMPCP_t)$$
$$\text{if } (NPCP_t - TB_t + CCPCP_t + MMPCP_t) \leq 0 \quad \text{(5a)}$$

Table AI:
COMPARISON OF PUBLIC COMMODITY POOL RETURNS OVER JULY, 1979–JUNE, 1985

Sample Period	Irwin, Krukemyer, and Zulauf				Elton, Gruber, and Rentzler			
	No. of Pools	Average Return		Standard Deviation	No. of Pools	Average Return		Standard Deviation
		MHP[a]	AHP[b]			MHP[a]	AHP[b]	
		Percent per month				Percent per month		
July, 1979–June, 1980	12	2.20	0.73	15.71	12	1.82	0.27	15.77
July, 1980–June, 1981	16	2.05	1.31	10.56	16	2.19	0.90	12.11
July, 1981–June, 1982	34	1.54	1.19	8.00	34	1.49	1.12	8.24
July, 1982–June, 1983	49	−1.94	−2.70	11.67	49	−1.91	−2.67	11.67
July, 1983–June, 1984	72	−0.17	−0.48	7.64	70	−0.20	−0.54	7.93
July, 1984–June, 1985	88	1.05	0.58	9.26	85	0.97	0.48	9.43
Average		0.79	0.10	10.48		0.73	−0.07	10.86

Note: The returns reported under the heading of Irwin, Krukemyer, and Zulauf are based on original calculations. The returns reported under the heading of Elton, Gruber, and Rentzler are drawn from Table I (p. 178) of their 1987 article.

[a]Monthly holding period.

[b]Annual holding period.

$$GPCP_t = (NPCP_t - TB_t + CCPCP_t + MMPCP_t)/(1 - (IPCP_t/100))$$
$$\text{if } (NPCP_t - TB_t + CCPCP_t + MMPCP_t) > 0 \quad (5b)$$

where

$GPCP_t$ = gross trading return of the market portfolio of public pools (percent of equity per month),
$NPCP_t$ = net return of the market portfolio of public pools (percent of equity per month),
TB_t = treasury bill return (percent per month),
$CCPCP_t$ = public pool commission cost (percent of equity per month),
$MMPCP_t$ = public pool management cost (percent of equity per month),
$IPCP_t$ = public pool incentive cost (percent of gross trading returns).

Commission, management, and incentive costs are calculated based on the rates reported in the first row of Table VI. The rates are assumed to be fixed. Monthly commission (0.775% per month) and management (0.417% per month) costs are calculated by dividing the annual rates reported in Table VI by 12. The incentive cost (20% of gross trading return) is conditionally applied only when gross trading returns before incentive costs are greater than zero.

The second step is the calculation of net commodity pool returns based on the lower institutional costs. This return is calculated as follows,

$$NICP_t = GPCP_t - CCICP_t - MMICP_t + TB_t \quad \text{if } GPCP_t \leq 0 \qquad (6a)$$

$$NICP_t = GPCP_t(1 - (IICP_t/100)) - CCICP_t - MMICP_t + TB_t \quad \text{if } GPCP_t > 0 \qquad (6b)$$

where

$NICP_t$ = net return of the market portfolio of institutional pools (percent of equity per month),
$GPCP_t$ = gross trading return of the market portfolio of public pools (percent of equity per month),
TB_t = treasury bill return (percent per month),
$CCICP_t$ = institutional pool commission cost (percent of equity per month),
$MMICP_t$ = institutional pool management cost (percent of equity per month),
$IICP_t$ = institutional pool incentive cost (percent of gross trading returns).

Again, fixed values for commission, management, and incentive costs are assumed (second row, Table VI). Monthly commission (0.167% per month) and management (0.208% per month) rates are calculated by dividing the annual rates by 12. The incentive cost (25% of gross trading return) is conditionally applied only when gross trading returns exceed zero.

To illustrate the generation of the institutional commodity pool returns, assume a net public commodity pool return and treasury bill return of 1.0 and 0.5%, respectively, for month t. Then, the gross trading return to public pools is calculated as,

$$GPCP_t = (1.000 - 0.500 + 0.775 + 0.417)/(1 - (20/100)$$
$$= 2.115\%,$$

and the net institutional commodity pool return is,

$$NICP_t = 2.115(1 - (25/100)) - 0.167 - 0.208 + 0.5$$
$$= 1.711\%$$

Finally, note that the calculation of incentive costs is a simplification of the actual calculation used by public commodity pools. Incentive fees for a given month actually are paid only on net new profits. The following example illustrates this calculation. First, assume the following sequence of net asset values for a pool: 100 at the end of January, 75 at the end of February, and 125 at the end of March. In this case, the trading advisor will be paid an incentive fee in March based only on the $25 gain above the previous high net asset value of $100.

Pro forma returns also are calculated assuming incentive fees are paid only on net new profits. Average returns change only slightly and portfolio breakeven results are unaffected. Hence, the results of the simpler procedure are presented in the article. Results of the alternative simulation are available from the authors upon request.

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