Alternative Commodity Trading Vehicles: A Performance Analysis

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INTRODUCTION

Previous research shows that commodity futures are not perfectly correlated with returns to equity or fixed income issues and may result in superior risk/return tradeoffs when added to a portfolio composed solely of stocks and/or bonds.[1] Given the cost and skills necessary to invest successfully in the futures markets, many investors opt to invest through various professionally managed commodity trading products, including publicly traded commodity funds, private commodity pools, and individually managed commodity trading accounts. Estimates of the funds invested in professionally managed commodity investment products indicate an increase from $1.0 billion in 1981 to over $9.0 billion in 1990.

Three primary methods of investment in professionally managed commodity trading products are publicly traded commodity funds (Funds), private commodity pools (Pools), and individually managed commodity trading accounts (CTA). Publicly traded commodity funds and private commodity pools are organized as vehicles for pooling investments, like mutual funds, and involve the allocation of investment funds to at least one and, often, two to five commodity trading advisors (CTAs). In addition, commodity trading advisors (professional traders who trade in one or a variety of commodity markets following technical, fundamental, or hybrid trading strategies) take individually managed accounts from investors. While initial minimum investments in public funds and commodity pools are often as small as $5000, initial investment minimums for individually managed accounts are frequently $1,000,000 or more.

While the existence of these various commodity products as investment vehicles implies their value to the investing public, considerable debate exists as to their use-

[1]See Bodie and Rosansky (1980), Brorsen et al. (1990), Levy (1987), and the New York Stock Exchange Report (1990).

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The Journal of Futures Markets, Vol. 11, No. 4, 475–490 (1991)
 CCC 0270-7314/91/040475-16$04.00

fulness in overall asset management. Elton et al. (1987, 1988) question the use of individual publicly traded commodity funds as stand-alone investments as well as additions to existing stock and bond portfolios. Brorsen and Irwin (1985), Irwin and Brorsen (1985), and Irwin and Landa (1987) argue that publicly traded commodity funds, when grouped into portfolios, offer an enlarged efficient frontier. However, results of the Irwin and Landa (1987) and the Elton et al. (1987) analyses are not strictly comparable, since Elton et al. assume a risk-free rate in determining the efficient frontier, while Irwin and Landa consider only a shift in the efficient frontier resulting from the inclusion of publicly traded commodity funds. In addition, while Elton and Gruber compare the value of individual publicly traded commodity funds to an existing stock and bond fund, Irwin and Landa (1987) test for the importance of publicly traded commodity funds when compared simultaneously with stocks and bonds in optimal portfolio management. Edwards and Ma (1988) question whether historical CTA performance is an adequate prediction of future private commodity pool or publicly traded commodity fund performance; but there is no direct research on the use of portfolios of CTAs or Pools in optimal portfolio management.

The purpose of this article is to analyze the risk/return performance of commonly used CTA, Pool, and Fund indices (e.g., indices compiled by Managed Account Reports (MAR)) as stand-alone investments, as additions to existing stock and bond indices, and as part of simultaneously determined optimal commodity trading products, stock, and bond portfolios (i.e., MAR commodity indices and Ibbotson and Sinquefield stock and bond indices). This study attempts to resolve some of the conflicting results of previous tests[2] by providing results which test for the inclusion of publicly traded commodity funds as additions to existing stock and bond portfolios as well as in optimal portfolios. This article also provides evidence on the performance of commodity vehicles such as CTAs and Pools. It is important to point out that in contrast to previous research on publicly traded commodity funds, results on CTA and Pool performance may be more relevant to the actual costs and returns available to large individual or institutional investors.[3]

DATA AND METHODOLOGY

Monthly commodity returns on the MAR indices of CTA–Equal Weighted, CTA–Dollar Weighted, Pool, Fund, Ibbotson and Sinquefield stock (S&P 500), small firm stock index, long-term government index, and corporate bond index are obtained (see Appendix A for description).[4] Similarly to previous studies on the performance

[2]See Elton et al. (1987), Elton et al. (1988), and Irwin and Brorsen (1985).

[3]Since this article tests the return performance of various commodity indices, the results are not strictly comparable with earlier studies which test the performance of individual publicly traded commodity funds. However, since most large investors would hold portfolios of commodity vehicles (and since the performance of CTAs and Pools may be more relevant to the actual cost and return available to institutional investors), results indicate that portfolios of these commodity products can be formed which offer suitable return/risk tradeoffs and can be of importance to the investment community.

[4]Since many commodity vehicles (e.g., Pools, Funds) are not traded on a central exchange, this article assumes that passively determined portfolios reflecting the commodity indices can be created, and that the past performance of the CTA, Pool, Fund, and stock and bond indices is indicative of future performance vehicles. As for the creation of portfolios reflecting the commodity indices, multiple manager commodity funds now exist which reflect the indices' performance. Moreover, recent work by Angrist (1990) and Schneeweis et al. (1990) shows the ease of creating multiple CTA commodity portfolios and the high degree of correlation between these funds and the commodity indices used.

of commodity vehicles, returns are calculated as follows:[5]

$$R_{it} = (V_{t+1}/V_t - 1) \times 100 \tag{1}$$

where V_{t+1} = index value at time$_{t+1}$ and V_t = index value at time$_t$.

While various decision rules for adding assets to an existing portfolio have been suggested, this article adopts the decision rules used in previous studies of commodity fund performance (Elton et al. (1987, 1988), Lintner (1983), Irwin and Landa (1987)).

Elton et al. show that a commodity portfolio should be added to an existing portfolio, P, if its return exceeds the break-even return required to shift the efficient frontier. The break-even returns for the various commodity indices are calculated as follows:

$$\text{Break-even } R_c = \left[\frac{R_P - R_f}{\sigma_P}(p_{cP})(\sigma_c)\right] + R_f \tag{2}$$

where R_c = the expected return of the commodity portfolio, R_f = the riskless rate, σ_c = the standard deviation of the commodity portfolio, R_P = the expected return of the asset portfolio, σ_P = the standard deviation of the asset portfolio, and p_{cP} = the correlation between the commodity portfolio and the comparison asset portfolio.

Break-even returns estimated from eq. (2) are, therefore, dependent on the risk-free rate, the correlation coefficient, returns and standard deviations of returns on the commodity portfolio, and the comparison asset. Lintner (1983) and Irwin and Landa (1987) also show that break-even returns can be estimated under the assumption of a no risk-free rate.

$$\text{Break-even } R_c = \frac{R_P}{\sigma_P}(p_{cP})(\sigma_c) \tag{3}$$

From eq. (3), a commodity portfolio should be added to an existing portfolio, p, if its return exceeds the break-even return necessary to enlarge the efficient frontier. It is important to note that the break-even return could be less under the assumption of a no risk-free rate (eq. (3)) than the required break-even rate under the assumption of a risk-free rate (eq. (2)).[6]

Finally, to test for the inclusion of the various commodity indices when commodity indices and the stock and bond indices are considered simultaneously, the Markowitz quadratic optimization framework under the assumption of no short sales is used (see Appendix D). Mean returns, standard deviations, and covariances for the period studied are used as parameter inputs to the model.

Several caveats are necessary when working with composite commodity data. First, monthly returns do not indicate the effects of possible intramonth draw-

[5]Returns are calculated as monthly arithmetic averages as done in Edwards and Ma (1988) and Elton et al. (1987, 1988). As pointed out by Elton et al. (1988), the average monthly return can overestimate the return the investor can expect to receive from investing in commodity vehicles and holding them for a year. The use of average monthly returns, although inaccurate as a projection of longer-run returns, is appropriate for comparing relative performance (see footnote 6 in Elton et al. (1988)). Results are also determined using natural logarithm of price relatives. These are similar to those reported in this article. For an example of a study of commodity trading advisors' performance using natural logarithms, see Schneeweiss et al. (1990). For a full discussion of problems in return measurement for commodity funds, see Szala (1987a,b).

[6]Equations (2) and (3) test for the inclusion of the commodity vehicle to an existing portfolio. A more rigorous test would compare the commodity vehicle against points along a predetermined, efficient frontier.

downs. As a result, intramonth returns may differ dramatically from reported monthly returns. Second, the CTA indices include only CTA customer funds. Thus, the performance of the personal account of the CTA may differ from the performance of the CTA indices if the funds managed by the CTA in their personal account is traded differently from customer funds. Lastly, the use of the Commodity Futures Trading Commission approved Net Asset Value approach to return measurement may bias results to the degree that intramonth cash flows produce incremental returns over that held at the start of the month.

The above caveats on return measurement for CTAs should have little effect on the results of this study. First, it is assumed that the investor is continually invested for the period of analysis. Second, the CTA indices correctly reflect only customer accounts and do not include funds held in CTA's personal accounts. Lastly, most of the CTAs analyzed generally hold incoming funds until month-end before integrating them into their trading. It is also important to note that the risk/return performance analysis, in this study, assumes equal weighting among CTAs, and does not indicate the benefits of running mean return/variance-based optimization programs on individual CTAs.

COMMODITY TRADING VEHICLES AS STAND-ALONE INVESTMENTS

This section analyzes the risk/return performance of the set of commodity indices in contrast to commonly used stock and bond indices.[7] Monthly returns and standard deviations for individual years are given in Appendix B. Table I summarizes the tests of the relative performance of various commodity trading products and stock and bond indices under alternative performance criteria (mean return, standard deviation, maximum/minimum ratio, and skewness). Table II provides evidence on the consistency of these performance relationships over the period of analysis.

In Table I, the average monthly returns, standard deviation, minimum/maximum returns, and skewness for the various commodity and stock and bond indices over the 1980–1988 period are presented. *T*-Tests and *F*-tests are given in Appendix C. Results in Table I and Appendix C show that the average monthly returns of three of the commodity indices (CTA–Equal Weighted (2.14%), CTA–Dollar Weighted (1.87%), and Pools (1.57%)) are greater than the average monthly return of the S&P 500 (1.37%), small firm (1.45%), government bond (1.03%), and corporate bond (1.07%); and that the average return of the Fund index (.80) is less than the average monthly return of any of the comparison stock and bond indices. In no comparison case, however, is the return difference between the assets significant. In contrast, results in Table I and Appendix C show that the standard deviation of each of the four commodity indices (CTA–Equal Weighted (7.99%), CTA–Dollar Weighted (7.36%), and Funds (6.48%)) is significantly greater than the standard deviation of each of the comparison indices: S&P 500 (4.85%), small firm (5.75%), government bonds (4.25%), and corporate bonds (3.90%). However, given the relatively similar standard deviations and return levels between the comparison assets (*t* statistics in Appendix C range between ±1.3, and *F* statistics range between 2.5 and 3.5), many investors may wish to consider other performance criteria such as maximum/minimum return ratios and/or skewness. The maximum/minimum return ratio of each of the four commodity indices; CTA–Dollar Weighted

[7]It is important to note that the relative performance of the various indices is net of any fees for management. It is possible that passively determined portfolios reflecting the commodity indices may require slightly greater management fees than passively determined stock and bond indices.

Table I
RISK AND RETURN DATA FOR ALTERNATIVE ASSET CLASSES (1980–1988)

	Mean	SD	Min. Return	Max. Return	Skewness
S&P 500	1.370	4.854	−21.520	13.430	−7.850
Small firm	1.453	5.751	−29.190	13.230	−1.583
Gov. bonds	1.037	4.252	−7.420	15.240	.618
Corp. bonds	1.074	3.908	−7.990	14.190	.517
CTA–Equal Weighted	2.144	7.997	−11.770	32.900	1.134
CTA–Dollar Weighted	1.876	7.362	−11.150	34.350	1.264
Pools	1.571	6.696	−11.180	21.200	.777
Funds	.808	6.480	−12.100	19.710	.700

Note. *T*-Tests and *F*-Tests of differences in means and variances are given in Appendix C.

(34.35/−11.15), CTA–Equal Weighted (32.90/−11.77), Pools (21.20/−11.18), and Funds (19.71/−12.10) is greater than the maximum/minimum ratio of the S&P return (13.4/−21.5) and small firm (13.23/−29.10). In addition, the CTA–Dollar Weighted and CTA–Equal Weighted have greater maximum to minimum return ratios (34.35/−11.15 and 37.90/−11.77) than the two bond indices: government bonds (15.24/−7.4) and corporate bonds (14.19/−7.99). Similarly, all the commodity trading vehicle indices have positive skewness: CTA–Equal Weighted (1.13%), CTA–Dollar Weighted (1.26%), Pools (.77%), Funds (.70%), while the S&P 500 (−7.85%) and small firm index (−1.58%) exhibit negative skewness. In addition, while the two bond indices have positive skewness (government bonds .61%, and corporate bonds .51%), the positive skewness levels are below that of any of the comparison commodity indices.

The results in Table I indicate that, when compared strictly on a return/variance basis, CTA–Equal Weighted, CTA–Dollar Weighted, Pools, and Funds do not necessarily provide attractive investment vehicles as stand-alone investments relative to the comparison stock and bond indices. However, when other performance criteria (e.g., skewness) are considered, CTA and Pool investments as well as Funds may be regarded as rational investments on a stand-alone basis.

Of equal importance is whether the commodity vehicle performance is consistent and predictable over longer time periods; that is, does the asset class that has a high-performance measure in one period tend to have high-performance values in subsequent periods? Table II compares the performance rankings of the various investment groups on a yearly basis over the period 1980–1988 (actual returns and risk measures are reported in Appendix B). Results in Table II show that the stock and bond indices rank in the upper half in terms of the total risk/return tradeoff (i.e., the Sharpe ratio) in at least five of the nine years. Similarly, in terms of total risk/return tradeoff (i.e., the Sharpe ratio), the CTA–Equal Weighted ranks in the upper half in five of the nine years, and the CTA–Dollar Weighted and Pools rank in the upper half in at least four of the nine years. In contrast, in terms of the Sharpe ratio, the Funds rank in the upper half in only one of the nine years, and Pools rank in the upper half in only three of the nine years. While these results support the dominance of the stock and bond indices as a stand-alone investment over the period, the results also indicate that the CTA investment performs well in many of the yearly comparisons.

Table II
PERFORMANCE RANKING FOR ALTERNATIVE ASSET CLASSES

	1980	1981	1982	1983	1984	1985	1986	1987	1988	Years in Top Half	1980 –88
Ranking by returns:											
CTA–Equal Weighted	2	1	3	3	1	5	5	2	4	7	1
CTA–Dollar Weighted	1	4	7	6	2	6	7	1	3	5	2
Pools	3	2	5	5	7	8	4	3	8	4	3
Funds	6	5	8	8	5	7	8	4	7	1	8
S&P 500	5	8	6	2	6	1	3	5	2	4	5
Small firm	4	3	4	1	8	4	6	8	1	5	4
Corp. bonds	7	7	1	4	3	3	2	6	5	4	6
Gov. bonds	8	6	2	7	4	2	1	7	6	4	7
Ranking by standard deviation:											
CTA–Equal Weighted	1	1	1	2	1	1	1	3	1	9	1
CTA–Dollar Weighted	2	2	2	3	2	4	3	5	4	8	2
Pools	4	3	3	1	3	3	5	6	3	7	3
Funds	5	4	4	4	4	2	2	4	2	8	4
S&P 500	8	8	5	8	6	9	4	2	7	2	6
Small firm	3	7	6	5	5	6	7	1	5	2	5
Corp. bonds	7	6	7	7	7	8	8	8	8	0	8
Gov. bonds	6	5	8	6	8	6	6	7	6	0	7
Ranking by Sharpe ratio:											
CTA–Equal Weighted	4	2	6	4	4	6	6	3	6	5	3
CTA–Dollar Weighted	2	4	7	6	3	5	7	1	5	4	4
Pools	1	3	5	5	7	7	4	2	8	3	7
Funds	6	5	8	8	5	8	8	4	7	1	8
S&P 500	3	8	4	2	6	2	3	5	2	6	1
Small firm	5	1	3	1	8	4	5	7	1	5	5
Corp. bonds	7	7	2	3	2	1	1	6	3	6	2
Gov. bonds	8	6	1	7	1	3	2	8	4	5	6
Ranking by absolute value of max/min ratio:											
CTA–Equal Weighted	3	1	6	3	1	7	3	2	2	7	2
CTA–Dollar Weighted	1	2	7	5	2	8	5	3	4	5	1
Pools	2	5	5	2	3	5	2	1	6	5	4
Funds	4	6	8	6	4	6	6	4	3	4	6
S&P 500	7	8	4	1	5	2	8	7	8	3	7
Small firm	8	7	1	4	7	3	7	8	7	3	8
Corp. bonds	5	4	2	7	6	1	1	6	5	4	5
Gov. bonds	6	3	3	8	8	4	4	5	1	5	3

(*continued*)

Table II (continued)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	Years in Top Half	1980–88
Ranking by skewness:											
CTA–Equal Weighted	3	1	8	1	1	8	3	3	1	7	2
CTA–Dollar Weighted	1	2	7	3	3	7	4	5	4	6	1
Pools	6	5	6	2	4	4	1	1	3	6	3
Funds	5	6	4	4	5	5	5	2	2	4	4
S&P 500	7	7	2	5	2	3	8	7	8	3	7
Small firm	8	8	1	8	6	1	7	8	7	2	8
Corp. bonds	4	4	3	7	7	2	2	6	6	5	6
Gov. bonds	2	3	5	6	8	6	6	4	5	3	5

While the S&P 500, small firm, and bond indices generally outperform the commodity indices, analyzed here in terms of Sharpe ratio rankings, the CTA–Equal Weighted, CTA–Dollar Weighted, and Pools generally rank higher in terms of skewness. The CTA–Equal Weighted, CTA–Dollar Weighted, and Pools rank in the upper half in at least six of the nine years. Likewise, in terms of the maximum/minimum ratio, the CTA–Equal Weighted, CTA–Dollar Weighted, and Pools rank in the upper half in at least five of the nine years. In contrast, the Funds rank in the lower half of the sample in terms of positive skewness and maximum/minimum ratios in at least five of the nine years.

In summary, the results in Tables I and II show that while the CTA–Equal Weighted, CTA–Dollar Weighted, and Pool exhibit higher standard deviations, they also have higher returns than any of the comparison indices. While none of the commodity indices have a higher Sharpe ratio than the S&P 500 or the corporate and government bond indices, the commodity-based indices all have higher positive skewness over the period, and the CTA–Equal Weighted and CTA–Dollar Weighted indices have higher maximum/minimum return ratios than any of the comparison indices. Thus, the results from Tables I and II indicate that various commodity vehicles, such as CTA–Equal Weighted, CTA–Dollar Weighted, and Pools, provide benefits over those of traditional investment media, especially if alternative performance measures (e.g., maximum/minimum return ratio and skewness) are considered. Other commodity vehicles, such as Funds, fail to outperform any of the traditional stock and bond investment vehicles on a Sharpe ratio basis. However, when compared to either of the stock investments on some investment criteria (e.g., skewness), Funds provide superior performance over several of the years examined.

COMMODITY TRADING VEHICLES IN OPTIMAL PORTFOLIO MANAGEMENT

Fixed Stock and Bond Positions

Modern portfolio theory questions the use of individual security performance comparisons as a means of determining investment worth. An asset which is not per-

fectly correlated with a comparison security or portfolio may offer a contribution to that security's or portfolio's overall risk/return profile. An examination is conducted here to determine whether the commodity vehicles examined should be added to a portfolio of existing stocks and bonds.[8] To simplify the presentation, a report is made on the required break-even return and the difference between the asset's actual return and break-even return of the asset derived from eqs. (2) and (3). Whether the commodity vehicle is added to an existing stock or bond portfolio depends on the relative means and standard deviations of the commodity vehicle and that of the existing portfolio, as well as on the correlation between the commodity vehicle and the portfolio.

The means and the standard deviations of returns for various investment categories (i.e., S&P 500, small firm, and government/corporate bond) are given in Table I, and the yearly correlations between each of the comparison groups are given in Table III.

The correlation between the S&P 500 and small firm indices and the various commodity indices range between 0.09 and −.02. The correlation coefficients between the government and corporate bond indices and the various commodity indices range between .04 and −.07. Thus, the correlations over the entire period between the commodity vehicles indices and stock and bond indices are similar and close to zero. In contrast, the correlation coefficients between the various commodity indices are positively and highly correlated. In no case does the correlation between the returns of the various commodity indices fall below .80.

Results of the break-even analysis from eqs. (2) and (3) are presented in Table IV. Table IV includes the differentials between the actual returns of the various commodity-trading vehicles and their required break-even returns determined from eq. (2). The greater the differential return the greater attraction the investment offers as an addition to the comparison asset class. Using eq. (2) as the basis for obtaining the break-even returns for the entire period from 1980–1988, the results indicate that the publicly traded commodity fund portfolio (Funds) must earn a return of about .8% per month (9.6% per year) to represent an attractive addition to

Table III
CORRELATION COEFFICIENTS FOR ASSET ALTERNATIVES (1980–1988)

	S&P 500	Small Firm	Corp. Bonds	Gov. Bonds	Funds	CTA–Equal Weighted	CTA–Dollar Weighted	Pools
S&P 500	1.0000	.8538	.2915	.3173	.0948	.0253	.0157	.0300
Small firm	.8538	1.0000	.1564	.1826	.0868	.0180	−.0059	−.0200
Corp. bonds	.2915	.1564	1.000	.9475	.0479	.0090	−.0156	−.0514
Gov. bonds	.3173	.1826	.9475	1.0000	.0493	−.0083	−.0322	−.0742
Funds	.0948	.0868	.0479	.0493	1.0000	.9018	.8730	.8186
CTA–Equal Weighted	.0253	.0180	.0090	−.0083	.9018	1.0000	.9831	.8549
CTA–Dollar Weighted	.0157	−.0059	−.0156	−.0322	.8730	.9831	1.0000	.8515
Pools	.0300	−.0200	−.0154	−.0742	.8186	.8549	.8515	1.0000

[8]The indices studied represent a sample of those funds which have existed for the period. In this regard, the use of commodity indices is similar to the use of the S&P 500 index, etc.

Table IV
BREAK-EVEN PERFORMANCE (R_c) AND DIFFERENTIAL BREAK-EVEN PERFORMANCE ($\mu - R_c$) FOR ALTERNATE ASSET CLASSES (1980–88) (IN PERCENT)

	With Rf Asset		Without Rf Asset	
	R_c	$\mu - R_c$	R_c^*	$\mu - R_c^*$
CTA–Equal Weighted vs. S&P 500	.74	.140	.0571	2.0869
CTA–Dollar Weighted vs. S&P 500	.73	.114	.0326	1.8434
Pools vs. S&P 500	.74	.083	.0567	1.5143
Funds vs. S&P 500	.80	.001	.1736	.6344
CTA–Equal Weighted vs. small firm	.74	.141	.0364	2.1076
CTA–Dollar Weighted vs. small firm	.71	.116	−.0110	1.8870
Pools vs. small firm	.70	.087	−.0338	1.6048
Funds vs. small firm	.79	.002	.1423	.6657
CTA–Equal Weighted vs. gov. bonds	.71	.143	−.0162	2.1602
CTA–Dollar Weighted vs. gov. bonds	.70	.118	−.0578	1.9338
Pools vs. gov. bonds	.68	.089	−.1212	1.6922
Funds vs. gov. bonds	.74	.007	.0780	.7300
CTA–Equal Weighted vs. corp. bonds	.72	.143	.0198	2.1242
CTA–Dollar Weighted vs. corp. bonds	.71	.118	−.0316	1.9076
Pools vs. corp. bonds	.69	.089	−.0946	1.6656
Funds vs. corp. bonds	.74	.007	.0854	.7226
CTA–Equal Weighted vs. SBP[a]	.72	.142	.0117	2.1323
CTA–Dollar Weighted vs. SBP	.74	.114	−.0069	1.8829
Pools vs. SBP	.71	.086	−.0189	1.5899
Funds vs. SBP	.74	.007	.0549	.7531

[a]SBP: Equal Weighted stocks and bonds portfolio.

the comparison S&P 500, small firm, government bond, and corporate bond portfolios. For the Funds, the difference between the actual return and the required break-even rate is close to zero; for the S&P 500 the ratio is .001%, and for the small firm index the ratio is .002%. In contrast, for the Funds, the differential return between the actual return and the required break-even return is slightly greater than zero; for both the corporate and government bond indices, the return is .007% monthly.

While the differential return between the Funds and the break-even return for the comparison assets shows little marginal benefit for the addition of the Funds to existing stock or bond portfolios, results also show that the other forms of commodity vehicle investment may offer attractive additions to the various investment alternatives. The other commodity vehicles (CTA–Dollar Weighted, CTA–Equal Weighted, and Pools) require a return of about .73% monthly (8.88% per year) to represent an attractive addition to the S&P 500, and must earn a return of about .70% monthly to represent an attractive addition to the government and corporate bond indices. The difference between the actual and the required break-even returns for the other forms of commodity vehicles range between .14% monthly for the CTA–Equal Weighted compared with the alternative stock and bond indices, and about .085% monthly for the Pools compared with the alternative stock and

bond indices. Thus, the positive differential returns for the CTA and Pool investment indicate that in the period examined, portfolios of CTA and Pool investment are worthwhile additions to existing stock and bond portfolios.

In addition to the individual comparisons of the commodity indices and the alternative asset indices, Table IV also includes the break-even and differential returns of the various commodity indices with an equally weighted portfolio (SBP) of the four alternative asset indices (i.e., S&P 500, small firm, and government and corporate bond).[9] The return of the equal-weighted stock and bond portfolio (SBP) for the period 1980–1988 is 1.23% with a variance of 13.079 (i.e., standard deviation of 3.713). The relative correlations of the SBP with the commodity indices are CTA–Equal Weighted (.016), CTA–Dollar Weighted (−.01), Pools (−.03), and Funds (.09), respectively. Table IV shows that the break-even return for the various commodity indices relative to the SBP is about .7% per month (8.4% yearly). In addition, the differential monthly return also ranges from .14% (CTA–Equal Weighted) to .007% (Funds) per month. Thus, the various commodity indices (with the exception of the Funds) offer diversification benefits both as an addition to a single asset comparison and as an addition to an equally weighted portfolio.

The possible benefits of various commodity-trading vehicles as additions to stock and bond portfolios are shown to be even greater if one removes the assumption of the existence of a risk-free rate. Table IV shows the break-even returns and differentials between actual and break-even returns obtained from eq. (3). In all cases, the break-even returns are considerably below the actual realized returns of the various commodity vehicles. Thus, results in Table IV also show that, in the absence of the assumption of a risk-free rate, the various commodity vehicles (CTAs, Pools, and Funds), due to their low correlation with the representative stock and bond vehicles, offer diversification advantages.

Variable Stock and Bond Positions

Results in Table IV indicate the diversification benefits of all the commodity-trading indices with the stock and bond indices only for pairwise comparisons. In an investment world with many alternative investments, other investments, such as bonds, may offer similar diversification advantages as commodity trading vehicles when added to an existing portfolio of stocks and/or bonds. Thus, while the commodity trading vehicles may provide pairwise diversification benefits, or even benefits relative to an existing equally weighted portfolio of stocks and bonds, the commodity-trading vehicles may not provide return/risk improvement in a world of multiple investment media. An alternative test of the benefits of commodity vehicles in overall portfolio investment would be the inclusion of the various commodity indices in an efficient portfolio of the S&P 500, small firm, and corporate and government bond indices. Table V reports on the inclusion of the various commodity indices (as a whole and individually) in mean/variance efficient portfolios of the stocks and bonds (Ibbotson and Sinquefield indices). However, to permit a direct comparison, a test is conducted for inclusion of the various commodity vehicles at a common return level of 1.2% (average of the highest and lowest return

[9]The addition of commodity funds to existing portfolios can also be determined from decision rules as discussed in Howard and D'Antonio (1984), and Yau et al. (forthcoming). The decision rule in Elton et al. (1988) as well as Howard and D'Antonio (1984), does not permit short positions. Research on the effect of short positions in commodity funds in optimizing risk/return opportunities is presently being conducted.

Table V
ALTERNATIVE MEAN/VARIANCE EFFICIENT PORTFOLIOS FOR DIFFERENT ASSET COMBINATIONS

	Efficient Portfolios					
Asset Weights	**I**	**II**	**III**	**IV**	**V**	**VI**
CTA–Equal Weighted		.08				.07
CTA–Dollar Weighted			.10			.03
Pools				.16		.10
Funds					.04	.08
S&P 500	.29	.18	.17	.17	.30	.12
Small firms	.24	.12	.12	.12	.24	.08
Corp. bonds	.32	.36	.35	.32	.29	.30
Gov. bonds	.15	.26	.26	.23	.13	.22
R_p	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
σ^2	9.4%	7.8%	7.5%	7.15%	9.4%	6.2%

of the stock and bond investments) for all portfolios. Since no risk-free rate is assumed, results can best be compared directly with the break-even return (R_c*) and differential return ($\mu - R_c$*) (see Table IV).

As shown in Table V, the inclusion of either the CTA–Equal Weighted, CTA–Dollar Weighted, or Pools results in significantly lower variance of the combined portfolio at the same return level as that of the portfolio consisting solely of stocks and bonds. However, results also confirm that the inclusion of Funds do not significantly reduce the variance of the stock and bond portfolio at a similar level of return. Thus, on an individual basis at the return level cited, the Funds do not offer the portfolio benefits available in CTA or Pools investment. Table V also gives evidence of the benefits of investing in all of the commodity vehicles as an addition to a portfolio of stocks and bonds. At a common return level of 1.2%, the variance of the portfolio of all commodity vehicles and alternative asset classes (efficient portfolio VI) is 6.2%—in contrast to the variance of 9.4% of the stock and bond portfolio without commodity vehicles included (efficient portfolio I). Moreover, the variance of the full commodity and stock and bond portfolio (6.2%) is at least 10% less than the variance of any of the portfolios of any single commodity vehicle and stocks and bonds (e.g., 7.15%, portfolio III with Pool investment). Lastly, it is important to point out that while Funds do not offer an improved return/risk tradeoff when considered separately, Funds are included in the optimal portfolio when all commodity vehicles and stocks and bonds are considered (portfolio VI). Thus, when considered as part of a simultaneously determined optimal portfolio, even Funds must not be rejected out of hand as a possible investment vehicle in overall asset management.

CONCLUSIONS

This study tests the benefits of CTAs, Pools, or Funds as stand-alone investments, as additions to an existing stock and bond portfolio, or as inclusion in optimal portfolio management. The results of this analysis indicate that, in contrast to previous

analyses of individual publicly traded commodity funds, when alternative performance measures (e.g., skewness) are considered, CTA, Pool, and Fund portfolios may offer a superior risk/return tradeoff to stock and bond indices on a stand-alone basis. In addition, the results indicate that the performance of CTA, Pools, and Funds relative to the comparison indices is relatively stable over time. Moreover, while portfolios of publicly traded commodity funds (Funds) do not offer a profitable addition to a portfolio of stocks or bonds when the existence of a risk-free investment is assumed, results show that CTA and Pool portfolios, with or without the assumption of a risk-free rate, improve overall performance. Finally, the results indicate that when no risk-free asset is assumed, all commodity vehicles tested (CTAs, Pools, and Funds) are found to be a worthwhile addition to an existing portfolio of stocks and bonds as well as an overall optimal portfolio including stocks and bonds. Future research is required to determine the basis for the differential results for publicly traded commodity funds and other commodity products.

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Appendix A

DESCRIPTION OF CTA INDICES AND OTHER POPULAR INDICES

Index Name	Percent of Universe	Number of Entities In Index	Value Weighted or Equal Weighted	Price or Total Ret. Index	Indexing Method	Description
Dow Jones Industrial	25% of NYSEs	30	Equal	Price	Arithmetic	Top industrials
S&P 500 index	75% of NYSEs 58% U.S. Stock $	500	Value	Both	Ratio of $	500 Top mkt. value
NYSE index	All NYSEs 77% U.S. Stock $	2000 active	Value	Tot. Ret.	Ratio of $	All common stocks
CRB index	90% of all Non-fin	27	Equal	Price and (buy and hold)	Geometric	Active commodities
Salomon bond indices	All above $25 million	Varies	Value	Tot. Ret. return avg.	Value Weighted	Index by type
MAR CTA indices	79% of $ under management	25	Value and Equal	Tot. ret. commis. and all fees	Value Weighted Equal Weighted Monthly ret.	All CTAs in top 25% of CTAs based on $ under management
MAR pools	All domestic	Active	Equal	Tot. Ret. commis. and all fees	Equal Weighted monthly ret.	All domestic private pools
MAR fund	All domestic	Active	Equal	Tot. Ret. commis. and all fees	Equal Weighted monthly ret.	All domestic public pools

Appendix B

RISK AND RETURN DATA FOR ALTERNATIVE ASSET CLASSES

	1980 ($\mu\sigma$)	1981 ($\mu\sigma$)	1982 ($\mu\sigma$)	1983 ($\mu\sigma$)	1984 ($\mu\sigma$)	1985 ($\mu\sigma$)	1986 ($\mu\sigma$)	1987 ($\mu\sigma$)	1988 ($\mu\sigma$)
CTA–Equal	5.218	1.681	2.342	.777	1.972	1.777	.725	3.779	1.021
Weighted	11.551	8.471	7.879	8.075	9.086	5.855	7.000	6.421	7.952
CTA–Dollar	5.423	1.116	1.096	.293	1.931	1.652	.118	4.123	1.094
Weighted	11.464	7.473	7.624	7.584	8.616	4.609	6.014	5.176	6.190
Pools	4.331	1.263	2.012	.407	.575	1.244	.785	3.198	.321
	7.833	7.323	6.551	8.976	7.281	5.246	5.062	5.067	7.021
Funds	1.874	.745	.224	−.733	1.090	1.286	−.783	3.006	.565
	6.363	6.483	6.288	7.393	7.216	5.762	6.651	6.210	7.209
S&P 500	2.497	−.355	1.763	1.743	.580	2.406	1.546	.810	1.342
	5.286	3.720	5.524	2.863	4.046	3.512	5.178	8.805	2.907
Small firm	3.147	1.220	2.187	2.918	−.486	1.933	.633	−.272	1.797
	8.036	5.358	4.968	4.569	4.413	4.213	4.152	9.968	3.802
Corp. bonds	−.061	.079	3.130	.431	1.335	2.312	1.545	.013	.877
	6.005	5.985	3.599	3.222	3.724	3.106	2.364	2.783	2.383
Gov. bonds	−.170	.334	2.907	.106	1.252	2.330	1.950	−.188	.810
	6.157	6.399	3.036	3.273	3.332	3.528	4.995	2.968	2.908

Appendix C

STATISTICAL TESTS FOR MEAN RETURNS AND VARIANCES OF ALTERNATIVE ASSET CLASSES

	t-Statistic for Equality of Means	*F*-Statistic for Equality of Variances
CTA–Equal Weighted vs.		
CTA–Dollar Weighted	.256	1.180
Pools	.571	1.426
Funds	1.348	1.519
S&P 500	.860	2.714
Small firm	.729	1.934
Corp. bonds	1.249	4.187
Gov. bonds	1.270	3.537
CTA–Dollar Weighted vs.		
CTA–Equal Weighted	−.256	.847
Pools	.319	1.209
Funds	1.131	1.288
S&P 500	.596	2.300
Small firm	.471	1.639
Corp. bonds	1.000	3.549
Gov. bonds	1.026	2.998

Appendix C

STATISTICAL TESTS FOR MEAN RETURNS AND VARIANCES OF ALTERNATIVE ASSET CLASSES continued

Pools vs.		
CTA–Equal Weighted	−.571	.701
CTA–Dollar Weighted	−.319	.827
Pools	.850	1.065
S&P 500	.253	1.903
Small firm	.139	1.356
Corp. bonds	.666	2.936
Gov. bonds	.700	2.480
Funds vs.		
CTA–Equal Weighted	−1.348	.658
CTA–Dollar Weighted	−1.131	.777
Pools	−.850	.939
S&P 500	−.721	1.787
Small firm	−.773	1.273
Corp. bonds	−.365	2.756
Gov. bonds	−.307	2.328

Appendix D

PORTFOLIO OPTIMIZATION METHODS

The Markowitz Method:

Find the set of weights (Xi) which minimizes the objective function:

$$\sigma_p^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} x_i x_j \sigma_{ij}$$

subject to constraints:

$$(1)\ R_p = \sum_{i=1}^{N} x_i R_i = K$$

$$(2) \sum_{i=1}^{N} x_i = 1$$

$$(3)\ x_i \geq 0,\ i = 1 \text{ to } N$$

where:

x_i = proportion of funds in the portfolio place in asset i;
σ_p^2 = variance of returns for the portfolio;
σ_{ij} = covariance of return asset i and j;
R_p = expected return to the portfolio;
R_i = expected return to asset i; and
K = a constant, the target return of the portfolio.