Hedge Funds versus Managed Futures as Asset Classes

FRANKLIN R. EDWARDS AND JIMMY LIEW

FRANKLIN R. EDWARDS is the Arthur F. Burns professor of economics and finance at Columbia Business School in New York.

JIMMY LIEW is a quantitative strategies associate at Morgan Stanley Dean Witter in Hong Kong.

This study examines the performance of hedge funds and managed futures funds during the fifteen-year period 1982 through 1996 using data on the monthly returns of more than 3,500 distinct funds. Equally weighted and value-weighted portfolios of both hedge funds and managed futures funds are formed, and the returns on those portfolios are compared to the returns on traditional asset classes, such as common stocks and bonds.

In each time period examined, both hedge funds and some managed futures funds have provided attractive risk-adjusted returns, and rank highly as stand-alone investments. Hedge funds and managed futures also are found to be complementary asset classes, and including both in diversified stock and bond portfolios significantly raises the Sharpe ratios of those portfolios.

Finally, hedge funds and managed futures are compared to passive investments in equity and commodity indexes that may be viewed as substitutes for holding hedge funds and managed futures. While these index strategies do enhance portfolio performance, the authors find they are not substitutes for hedge funds and managed futures.

During the 1990s, high stock prices and low interest rates have driven investors in search of assets whose returns are uncorrelated with stock and bond returns but are still high. Hedge funds and managed futures funds fit this description. Despite some poor returns during the summer of 1998, when Long-Term Capital Management collapsed, these funds have consistently provided high risk-adjusted returns that have been relatively uncorrelated with stock and bond returns. As a consequence, more than $200 billion is now invested in hedge funds and managed futures funds, a more than tenfold increase since 1989.

This article provides a comparative analysis of hedge funds and managed futures funds as alternative asset classes. The analysis encompasses the monthly returns of over 3,500 hedge funds and managed futures funds over a sixteen-year period, and includes the returns of non-surviving as well as surviving funds.[1]

We evaluate the performance of hedge funds and managed futures as both stand-alone investments and portfolio assets, as well as the degree to which these are substitute or complementary investments. In addition, the returns of hedge funds and managed futures are compared to the returns on various passive equity and commodity index strategies that may be viewed as substitutes for investments in hedge funds and managed futures.

The terms "hedge funds" and "managed futures" describe a number of different investment vehicles that are available to investors. Hedge funds are basically unregulated limited liability partnerships established for the purpose of investing the money of their partners. They are exempt from regulation under the 1940 Investment Company Act (which governs mutual funds) if either there are fewer than 100 investors (or partners) or all the investors are "qualified purchasers" at the time of investment. "Qualified purchasers" are individuals with at least $5 million in investments and institutions with at least $25 million under management. Hedge funds are thus available only to high-net worth individuals and to institutional investors. Hedge funds also are exempt from regulation under the Securities Act of 1933 because they generally offer their securities privately.

We examine all types of hedge funds as a group as well as a separate category of funds called "funds of hedge funds," which are funds that invest only in (or take participations in) other hedge funds. Hedge fund managers are free to pursue whatever investment strategy they wish, to make extensive use of leverage, to take both short and long positions in any market or asset, to hold concentrated positions in an asset, and to charge whatever management fees the market will bear. For an investor, therefore, putting money in a hedge fund is tantamount to buying the skills of the fund manager.

About half of all existing hedge funds are foreign-based (or are non-U.S. funds), organized under the laws of a foreign jurisdiction. Foreign-based hedge funds provide tax advantages to non-U.S. residents.[2]

The term "managed futures" refers to the range of investment vehicles available to investors wishing to participate indirectly in "commodity" markets, or in the trading of futures and forward and option contracts on both physical commodities and financial instruments. There are three types of "managed futures" vehicles: commodity trading advisors (CTAs), commodity pools (CPOs), and public (commodity) funds. Institutional investors and wealthy individuals typically go directly to one or more CTAs to have their funds managed, avoiding the costs associated with using commodity pools or public funds. In this case, investors can have their funds managed on an individual basis, and can choose a fund manager with an investment strategy that suits their particular risk preferences.

Commodity pools are private investment partnerships organized and operated by a commodity pool operator (CPO). The CPO pools investors' funds into a common portfolio and selects professional traders or CTAs (commodity trading advisors) to manage the funds. Commodity pools usually have high minimum-investment requirements, and are therefore generally available only to high-net worth individuals and institutional investors.

Public (commodity) funds are similar to conventional stock or bond mutual funds, except that public fund managers buy and sell commodity futures and forward and option contracts rather than stocks and bonds. Like mutual funds, they accept money from individuals (public funds) and have low minimum-investment requirements, so that they are accessible even to small (retail) investors.[3]

The fees charged by hedge funds and managed futures funds can be substantial. Most impose both administrative (or fixed fees) and incentive fees. Administrative fees are assessed as a percent of assets under management, similar to mutual fund fees. Incentive fees are performance-based and are assessed as a percent of "net new annual profits."

The annual median administrative fee is about 2% to 3% of assets for managed futures and about 1.0% to 1.5% for hedge funds. Median incentive fees are typically about 20% of net annual profits above a designated "high-water mark," for both managed futures and hedge funds, and somewhat lower for funds of hedge funds. There may also be significant brokerage and trading expenses, as well as one-time front- or back-load fees. Thus, for investors in hedge funds and managed futures funds to receive attractive after-fee returns, the *gross* returns (or returns before fees and expenses) must be substantial, typically above 20% a year.

I. DATA

We analyze the returns of hedge funds and managed futures funds over the period from 1982 through 1996, virtually the entire history of both fund industries. These data are provided by Managed Account Reports (MAR), which receives monthly performance information from participating funds, and consist of 2,194 distinct managed futures funds and 1,456 distinct hedge funds, encompassing 178,100 month-return observations.[4] Most hedge fund observations are subsequent to 1989, as in the 1980s there were relatively few hedge funds in existence. All monthly returns are net of fees.[5]

We compare the returns of hedge funds and managed futures funds to the returns on a broad range of asset classes. These include buy-and-hold portfolios of both large- and small-capitalization stocks, U.S. Treasury bills, intermediate- and long-term government bonds, and long-term corporate bonds.[6]

II. DATA BIASES

There are two potential biases in our data: a self-selection bias, and a survivorship bias. A self-selection bias would occur if only successful traders self-select to report to MAR, which would hardly be surprising. In this event, there would be an upward bias in reported returns for the universe of all hedge funds and managed futures funds, because unsuccessful funds would be underrepresented in the data.

A self-selection bias could also occur if data vendors include in the performance histories of funds the returns that the funds earned prior to their reporting to the data vendor. Because only funds with successful track records typically choose to report their performance, the result will be an upward bias in reported returns. An analysis of our data indicates that the inclusion of prereporting performance histories does in fact impart a significant upward bias to CTA returns.

To eliminate this bias, we analyze the returns of CTAs as well as all other managed futures funds only after excluding from the data all reported returns prior to these funds first reporting to MAR. Specifically, we use MAR "first-reporting" dates to determine how much of a fund's earlier performance history to exclude from the data. For 70% to 90% of the CTAs, pools, and funds in the MAR data base, MAR reports the dates on which performance was first reported to it. Using these first-reporting dates, we determined that the median periods of prereporting performance data included in the MAR data base are twelve months for CTAs, five months for pools, and six months for funds.[7] Thus, we exclude the first twelve, five, and six months of returns for all CTAs, pools, and funds, respectively. No data are omitted for hedge funds because there is no evidence of a self-selection bias in these data.

Reported returns for hedge funds and managed futures typically also have an upward survivorship bias because they exclude non-surviving funds from the data. If non-surviving funds have lower returns than surviving funds (which is likely), the omission of non-surviving (or lower-return) funds will result in upwardly biased observed returns. In our data, however, the performance of non-surviving funds is well represented; the data include approximately the same number of fund-month observations for surviving and non-surviving CTAs, pools, public funds, and hedge funds (98,650 versus 79,450 as of December 1996).[8]

Even so, an analysis of attrition rates suggests that the data may not include all non-survivors, especially in earlier years. In particular, the annual attrition rates for managed futures are much lower in 1980 through 1988 than in 1989 through 1996: about 9% versus 15% for CTAs, 1% versus 15% for pools, and less than 1% versus 12% for public funds (see Exhibit 1).[9]

While the increase in attrition rates in the 1990s may be due to the particularly turbulent commodity markets in that period, or to greater competition, these explanations seem incapable of explaining the large differences in attrition rates. The more likely explanation is that the data do not include all non-survivors in earlier years, which, if true, would result in an upward survivorship bias in reported returns during those years.[10]

While the exact magnitude of the survivorship bias in the data is impossible to estimate, the observed differences in returns between survivors and non-survivors are suggestive. In particular, if the data were to include only surviving funds, annual return differentials would be substantially higher than they are in our data: 5.17 percentage points for CTAs, 6.74 percentage points for pools, 3.05 percentage points for public funds, 1.91 percentage points for hedge funds, and 0.35 percentage points for funds of hedge funds.[11] See Edwards and Liew [1999].

Because our data include a large number of non-surviving funds, however, the survivorship bias in our data should be much smaller than suggested by these figures.

III. PERFORMANCE MEASURES

Monthly returns are examined for three distinct

EXHIBIT 1
Attrition Rates of Managed Futures and Hedge Funds, 1980-1996 (%)

Period	CTAs	Private Pools	Public Funds	Hedge Funds	Funds of Hedge Funds
1980-1996	11.84	7.66	5.85		
1980-1988	8.67	1.10	0.16		
1989-1996	15.41	15.04	12.25	9.12	2.81
1989-1992	11.29	8.07	11.49	1.60	0.00
1993-1996	19.53	16.43	18.59	16.63	5.62

portfolios of hedge funds and managed futures funds: 1) one-fund portfolios, where a single fund is randomly selected each month; 2) an equal-weighted portfolio (EW) of all funds in existence in a particular month, which assumes that an identical amount is invested in each fund; and 3) a value-weighted portfolio (VW) of all funds in existence in a particular month, where each fund's monthly return receives a weight that reflects the amount of money that the fund has under management relative to the total amount of money managed by all funds in that month. Monthly returns are defined as the sum of the change in the value of a "unit" of a fund's portfolio over the month plus any cash distributions made per unit during the month divided by the unit value at the end of the preceding month, net of all expenses.

Thus, the monthly return on an EW is the simple arithmetic average of the monthly returns of all funds in the portfolio, while the monthly return on a VW is the value-weighted average of the monthly returns of all funds in the portfolio. To replicate the returns on either an EW or a VW, investors would have to hold every fund in existence and rebalance their portfolios at the end of every month to maintain the assumed portfolio weights: equal for the EW and dollar-weighted for the VW. This implicitly assumes a one-month investment horizon, and that funds can be bought and sold costlessly.[12]

For the randomly selected, single-fund fund portfolio, the *expected* monthly return is the same as the monthly return on an EW of all funds. The actual returns on any particular fund that an investor may select can differ substantially from this expected return, however.

Returns volatility and risk-adjusted returns are also examined. Returns volatility is measured by the standard deviation (SD) of monthly returns for a specific time period, and risk-adjusted returns are defined as excess returns per unit of returns volatility. For example, the annual returns volatility for an EW of hedge funds is the annualized standard deviation of the twelve monthly returns on that portfolio during the year.

The returns volatility for a randomly selected, single-fund portfolio is more complicated. It depends on both the time variation in returns and the cross-sectional variation in returns that occurs because the portfolio requires that a different fund be selected every month from the population of funds. Thus, the expected annual returns volatility for a one-fund portfolio is the standard deviation of all individual fund returns in all months of the year.

As a measure of risk-adjusted returns, we use Sharpe ratios (SR):

$$\frac{R_i - R_f}{\sigma_i} \qquad (1)$$

where

R_i = the average monthly rate of return on the i-th investment (or asset class) during a specified investment period;
R_f = the average monthly risk-free rate of return (or T-bill return) during the investment period; and
σ_i = the standard deviation of monthly rates of return on the i-th investment (or asset class) during the investment period.

IV. HEDGE FUNDS AND MANAGED FUTURES AS STAND-ALONE INVESTMENTS

Exhibit 2 provides performance measures for different time periods for hedge funds and managed futures compared to other asset classes. In the 1982-1996 period, an EW of CTAs has the highest Sharpe ratio, and a VW of pools has the fourth-highest Sharpe ratio (hedge funds are excluded from this analysis because of the paucity of observations prior to 1989). Both managed futures investments outperform an investment in the S&P 500 index, which had an annual return of 16.7% during this period.

In the 1989-1996 period, when hedge funds are included in the analysis, hedge funds and funds of hedge funds receive the highest four rankings among all investments. A VW of pools is ranked fifth, and an EW of CTAs is ranked seventh, after the S&P 500 index. Hedge funds and funds of hedge funds dominate during this period because they have both higher returns and lower returns volatility than managed futures. In the 1990s, returns on managed futures are generally much lower than in the 1980s, but so is their returns volatility, which enables an EW of CTAs and a VW of pools to keep their high rankings. Thus, given the exceptionally high stock returns since 1989, hedge funds and managed futures funds have provided very attractive risk-adjusted returns compared to other financial assets.

EXHIBIT 2

Average Annual Sharpe Ratios and Average Annual Returns, 1982-1996

	1982:1-1996:12		1982:1-1988:12		1989:1-1996:12	
	Sharpe Ratio	Average Annual Returns (%)	Sharpe Ratio	Average Annual Returns (%)	Sharpe Ratio	Average Annual Returns (%)
RS CTAs	0.420	23.2	0.407	34.3	0.275	13.3%
RS Private Pools	0.345	18.4	0.405	28.7	0.157	9.4%
RS Public Funds	0.108	9.8	0.154	14.0	0.037	6.2%
RS Hedge Funds					0.364	16.4%
RS Funds of Hedge Funds					0.609	11.2%
EW CTAs	0.976	23.2	1.196	34.3	0.799	13.3%
EW Private Pools	0.659	18.4	0.893	28.7	0.381	9.4%
EW Public Funds	0.205	9.8	0.301	14.0	0.093	6.2%
EW Hedge Funds					1.791	16.4%
EW Funds of Hedge Funds					1.500	11.2%
VW CTAs	0.419	13.8	0.465	18.0	0.401	10.1%
VW Private Pools	0.752	16.7	0.694	19.8	0.969	13.9%
VW Public Funds	0.137	8.6	0.118	10.1	0.212	7.6%
VW Hedge Funds					1.581	21.1%
VW Funds of Hedge Funds					1.447	13.3%
S&P 500 (large-cap)	0.714	16.7	0.584	17.5	0.917	16.0%
Long-Term Corporate Bonds	0.803	13.2	0.869	16.6	0.778	10.2%
Intermediate-Term Govt. Bonds	0.774	10.4	0.871	12.7	0.703	8.4%
Long-Term Government Bonds	0.651	13.1	0.665	15.7	0.678	10.8%
Russell 2000 (small-cap)	0.462	14.4	0.340	14.6	0.599	14.2%

RS: randomly selected, single-CTA, pool, fund, hedge fund, or fund of hedge fund portfolios.
EW: equally weighted portfolio; VW: value-weighted portfolio.
Annual Sharpe ratios are computed from monthly observations: multiply the monthly Sharpe ratio by the square root of 12.
Average annual returns are the average monthly returns multiplied by 12.

V. HEDGE FUNDS AND MANAGED FUTURES AS PORTFOLIO ASSETS

An alternative way to view hedge funds and managed futures is as asset classes in a diversified portfolio, in which case we want to examine whether inclusion of these assets would enhance portfolio performance. A reason to think that the inclusion of hedge funds and managed futures funds would enhance portfolio performance is that the returns earned by these funds typically have a relatively low correlation with the returns on more traditional asset classes, such as stocks and bonds.

Exhibit 3 shows the simple correlation coefficients between the returns on alternative hedge fund and managed futures investments and the returns on other asset classes. The correlations between hedge funds and stocks range between 0.37 and 0.71 in the 1989-1996 period, while the correlations between managed futures returns and stocks are close to zero. In particular, the returns on a VW of pools are negatively correlated with S&P 500 common stock returns in all time periods, although the correlation coefficient is never significantly different from zero.

It is also notable that correlations between the returns on hedge funds and managed futures funds invest-

EXHIBIT 3

Correlation Coefficients Between Managed Futures and Hedge Fund Returns and Returns on the Standard Asset Class Investments 1982-1996 and Subperiods 1982-1988 and 1989-1996

	Managed Futures						Hedge Funds			
	EW CTAs	EW Pools	EW Funds	VW CTAs	VW Pools	VW Funds	EW Hedge Funds	EW Funds of Funds	VW Hedge Funds	VW Funds of Funds
1982:1-1996:12										
S&P 500 (large-cap)	–0.01	–0.03	0.08	0.02	–0.05	0.08	0.66**	0.72**	0.63**	0.78**
Long-Term Corporate Bonds	0.07	0.07	0.06	0.06	0.09	0.09	0.23**	0.30**	0.31**	0.33**
Intermediate-Term Government Bonds	0.04	0.03	0.05	0.03	0.04	0.08	0.18**	0.27**	0.29**	0.28**
Long-Term Government Bonds	0.11	0.09	0.11	0.10	0.14*	0.15**	0.21**	0.28**	0.31**	0.33**
Treasury Bills	0.09	0.09	0.05	0.04	0.06	0.02	0.00	–0.01	–0.08	–0.02
Russell 2000 (small-cap)	–0.08	–0.10	–0.02	–0.06	–0.13*	–0.03	0.75**	0.75**	0.60**	0.78**
CRB Index***	0.13*	0.06	0.06	0.01	–0.03	0.02	–0.05	0.10	0.04	0.03
Mount Lucas Management Index	0.37**	0.35**	0.45**	0.42**	0.36**	0.42**	–0.01	–0.08	0.03	–0.08
1982:1-1988:12										
S&P 500 (large-cap)	–0.01	–0.06	0.06	0.03	–0.02	0.06	0.66**	0.86**	0.77**	0.87*
Long-Term Corporate Bonds	0.03	0.01	0.00	0.01	0.07	0.03	0.19*	0.30**	0.29**	0.32**
Intermediate-Term Government Bonds	–0.03	–0.05	–0.03	–0.05	0.01	0.00	0.16	0.27**	0.29**	0.28**
Long-Term Government Bonds	0.08	0.04	0.06	0.05	0.13	0.10	0.19*	0.28**	0.28**	0.32**
Treasury Bills	–0.06	–0.03	–0.02	–0.02	–0.02	0.00	–0.10	–0.15	–0.16	–0.13
Russell 2000 (small-cap)	–0.05	–0.08	0.02	–0.01	–0.08	0.00	0.76**	0.91**	0.80**	0.88**
CRB Index***	0.17*	0.06	0.12	0.02	–0.04	0.07	–0.09	0.09	0.07	0.01
Mount Lucas Management Index	0.37**	0.33**	0.48**	0.46**	0.36**	0.46**	0.05	–0.14	0.02	–0.12
1989:1-1996:12										
S&P 500 (large-cap)	–0.02	0.01	0.12	0.01	–0.11	0.14	0.71**	0.37**	0.43**	0.57**
Long-Term Corporate Bonds	0.15	0.19*	0.21**	0.18*	0.11	0.25**	0.29**	0.29**	0.35**	0.38**
Intermediate-Term Government Bonds	0.14	0.16	0.21**	0.17	0.10	0.25**	0.22**	0.28**	0.30**	0.33**
Long-Term Government Bonds	0.16	0.21**	0.23**	0.20*	0.15	0.27**	0.24**	0.29**	0.37**	0.37**
Treasury Bills	0.14	0.10	0.08	0.05	0.15	0.04	–0.02	0.05	–0.01	0.05
Russell 2000 (small-cap)	–0.20**	–0.16	–0.11	–0.16	–0.26**	–0.10	0.81**	0.38**	0.30**	0.57**
CRB Index***	0.00	0.04	–0.10	–0.04	0.00	–0.13	0.05	0.13	0.01	0.09
Mount Lucas Management Index	0.34**	0.37**	0.36**	0.33**	0.36**	0.30**	–0.22**	0.10	0.04	0.01

EW: equally weighted portfolio; VW: value-weighted portfolio.
*Significant at the 10% level. **Significant at the 5% level. ***CRB Index returns are the CRB Future Price Index returns plus monthly T-bill returns.
Test statistic $t(n-2) = r/[(1-r^2)/(n-2)]^{(0.5)}$.
For 1982-1996, the critical values at the 5% and 10% level are 1.9759 and 1.6551, respectively.
For 1982-1988, the critical values at the 5% and 10% level are 1.9886 and 1.6632, respectively.
For 1989-1996, the critical values at the 5% and 10% level are 1.985 and 1.6609, respectively.

ments are generally quite low, although they have risen to about 0.20 to 0.40 in 1989-1996 (see Exhibit 4). The low correlations between the returns on hedge funds and managed futures funds suggest that they constitute distinct asset classes, so that including both of them in a diversified portfolio could enhance portfolio performance.

A criterion for determining whether inclusion of a particular asset or asset class in a portfolio will enhance portfolio performance is whether inclusion of that asset class raises the portfolio's Sharpe ratio. That will be true for any asset or asset class that satisfies the condition:

Sharpe Ratio of Candidate Asset ≥

Correlation Coefficient × Sharpe Ratio of Portfolio (2)

where the correlation coefficient reflects the correlation between the returns on the asset or asset class in question and the returns on the existing portfolio.[13]

This criterion takes into consideration both the level of an asset's returns and the correlation of those returns with the returns on other assets in the portfolio. For the special case where the correlation between an asset's returns and the portfolio's returns is zero (as is the case for many managed futures funds), Equation (2) reduces to the simple condition:

Sharpe Ratio of Candidate Asset ≥ 0 (3)

which will be satisfied as long as the expected return on the asset is greater than the risk-free rate of return. See Elton, Gruber, and Rentzler [1987].

Using this criterion, minimum (or break-even) returns can be computed for each alternative hedge fund and managed futures investment. These are the returns that would be required for them to be included in a diversified stock and bond portfolio, and are calculated by rewriting Equation (2) and solving for the required rate of return:

$$\left[\frac{R_c - R_f}{\sigma_c}\right] \geq \rho_{pc}\left[\frac{R_p - R_f}{\sigma_p}\right] \tag{4}$$

$$R_c \geq \rho_{pc}\left[\frac{\sigma_c}{\sigma_p}\right](R_p - R_f) + R_f \tag{5}$$

where

R_c = the average monthly rate of return on investment c;
R_f = the average monthly riskless rate of return;
σ_c = the standard deviation of monthly rates of return on investment c;
ρ_{pc} = the simple correlation between the monthly returns on investment c and the monthly returns on portfolio p;
R_p = the average monthly rate of return on portfolio p; and
σ_p = the standard deviation of monthly rates of return on portfolio p.

Exhibit 5 shows the required rates of return for the alternative hedge fund and managed futures investments for given R_f, σ_c, R_p, σ_p, and ρ_{pc}. These returns are calculated for two time periods and for two hypothetical portfolios: one that is 100% invested in S&P 500 common stocks, and one that is a mix of 60% S&P 500 stocks and 40% long-term corporate bonds.

Break-even returns for randomly selected, single-fund portfolios of either hedge funds or managed futures funds are not shown in Exhibit 5, because these portfolios are substantially inferior to the other hedge funds and managed futures. In particular, while the expected returns on single-fund portfolios cannot exceed the returns on EWs, the returns volatility of these portfolios is always much greater than the returns volatility of an EW or a VW.[14]

Exhibit 5 also provides actual returns on the different investments. If the actual return on a particular investment exceeds the break-even return for that investment, the inclusion of that investment in a diversified portfolio will enhance portfolio performance (or raise the portfolio's Sharpe ratio). Over the entire 1982-1996 period, as well as for the subperiod 1982-1988, all EWs and VWs of hedge funds and managed futures funds satisfy this criterion. In 1989-1996, however, an EW of public funds fails to satisfy this criterion, and a VW of public funds barely satisfies it.[15]

VI. OPTIMAL PORTFOLIO ALLOCATIONS

Our results raise the issue of what portfolio allocations should be given to hedge funds and managed futures to optimize portfolio performance. Elton and Gruber [1987] show that, when the objective is to max-

Exhibit 4

Correlation Coefficients Between Managed Futures and Hedge Fund Returns 1982-1996 and Subperiods 1982-1988 and 1989-1996

1982:1-1996:12	EW CTAs	EW Pools	EW Funds	VW CTAs	VW Pools	VW Funds	EW Hedge Funds	EW Funds of Funds	VW Hedge Funds	VW Funds of Funds
EW CTAs	1.00									
EW Private Pools	0.93**	1.00								
EW Public Funds	0.90**	0.89***	1.00							
VW CTAs	0.91**	0.91**	0.95**	1.00						
VW Private Pools	0.84**	0.86**	0.82**	0.90**	1.00					
VW Public Funds	0.89**	0.86**	0.96**	0.96**	0.87**	1.00				
EW Hedge Fund	–0.03	–0.06	0.00	–0.03	–0.10	–0.01	1.00			
EW Funds of Hedge Funds	0.03	0.00	0.07	0.03	–0.03	0.07	0.76**	1.00		
VW Hedge Funds	0.13*	0.09	0.22**	0.18*	0.13*	0.23**	0.56**	0.73**	1.00	
VW Funds of Hedge Funds	0.04	0.01	0.11	0.08	0.01	0.11	0.76**	0.94**	0.73**	1.00
Subperiods* 1982:1-1988:12 and 1989:1-1996:12**	**EW CTAs**	**EW Pools**	**EW Funds**	**VW CTAs**	**VW Pools**	**VW Funds**	**EW Hedge Funds**	**EW Funds of Funds**	**VW Hedge Funds**	**VW Funds of Funds**
EW CTAs	1.00	0.96**	0.92**	0.96**	0.84**	0.91**	–0.09	0.27**	0.41**	0.20**
EW Private Pools	0.92**	1.00	0.92**	0.94**	0.90**	0.89**	–0.05	0.31**	0.45**	0.22**
EW Public Funds	0.91**	0.89**	1.00	0.96**	0.77**	0.97**	0.01	0.33**	0.47**	0.27**
VW CTAs	0.91**	0.90**	0.94**	1.00	0.83**	0.95**	–0.07	0.26**	0.45**	0.19*
VW Private Pools	0.85**	0.85**	0.83**	0.92**	1.00	0.76**	–0.17**	0.24**	0.42**	0.14
VW Public Funds	0.90**	0.86**	0.96**	0.97**	0.91**	1.00	0.03	0.34**	0.52**	0.28**
EW Hedge Fund	–0.05	–0.08	–0.02	–0.03	–0.09	–0.02	1.00	0.69**	0.44**	0.78**
EW Funds of Hedge Funds	–0.04	–0.08	0.00	–0.02	–0.1	0.01	0.78**	1.00	0.65**	0.91**
VW Hedge Funds	0.02	–0.06	0.10	0.04	0.00	0.10	0.64**	0.82**	1.00	0.70**
VW Funds of Hedge Funds	0.00	–0.05	0.06	0.05	–0.03	0.08	0.76**	0.94**	0.80**	1.00

EW: equally weighted portfolio; VW: value-weighted portfolio.

*Significant at the 10% level.

**Significant at the 5% level.

***Correlations for 1982-1988 are below the diagonal, and those for 1989-1996 are above the diagonal.

Test statistic $t(n-2) = r/[(1-r^2)/(n-2)]^{(0.5)}$.

For 1982-1996, the critical values at the 5% and 10% level are 1.9759 and 1.6551, respectively.

For 1982-1988, the critical values at the 5% and 10% level are 1.9886 and 1.6632, respectively.

For 1989-1996, the critical values at the 5% and 10% level are 1.985 and 1.6609, respectively.

Exhibit 5

Break-Even Analysis for Managed Futures and Hedge Fund Investments (%)

	1982:1-1996:12			1982:1-1988:12			1989:1-1996:12		
	100% Stocks	60% Stocks 40% Bonds	Average Return	100% Stocks	60% Stocks 40% Bonds	Average Return	100% Stocks	60% Stocks 40% Bonds	Average Return
EW CTAs	6.16	6.51	23.16	7.38	7.52	34.32	5.03	5.49	13.32
VW CTAs	6.63	6.92	13.80	7.93	8.01	18.00	5.38	5.99	10.08
EW Pool	5.86	6.23	18.36	6.77	6.76	28.68	5.37	5.95	9.36
VW Pool	5.86	6.20	16.68	7.34	7.64	19.80	4.29	4.71	13.92
EW Funds	7.25	7.53	9.84	8.27	8.35	14.04	6.51	7.05	6.25
VW Funds	7.27	7.67	8.64	8.24	8.48	10.08	6.66	7.29	7.56
EW Hedge Funds							9.28	9.27	16.39
VW Hedge Funds							9.13	9.62	21.10
EW Funds of Hedge Funds							6.61	6.76	11.24
VW Funds of Hedge Funds							8.16	8.39	13.30

EW: Equally weighted portfolio; VW: Value-weighted portfolio.
Stocks: S&P 500 (large-cap).
Bonds: Long-term corporate bonds.

imize a portfolio's Sharpe ratio, optimal portfolio allocations can be obtained by solving the following:[16]

$$\text{Max } \gamma_p = \frac{R_p - R_f}{\sigma_p} \tag{6}$$

subject to

$$R_p = \sum_{i=1}^{N} \omega_i R_i, \ \sum_{i=1}^{N} \omega_i = 1, \ \omega_i \geq 0 \ \text{ for all i} \tag{7}$$

where

γ_p = the Sharpe ratio of portfolio p;
R_p = the expected rate of return on portfolio p;
R_f = the risk-free rate of return;
σ_p = the standard deviation of monthly rates of return on portfolio p;
ω_i = the proportion of asset i in portfolio p; and
R_i = the expected rate of return on asset i.

We estimate optimal portfolio allocations for both unconstrained and constrained portfolios.[17] In constrained portfolios, minimum and maximum portfolio allocations for stocks and bonds are designated to be between the minimum and maximum U.S. capital market value weights for those asset classes in the 1970-1984 period.

The *minimum* allocations are 45% for large-capitalization stocks (S&P 500), 4% for small-capitalization stocks (Russell 2000), 8% for intermediate-term government bonds, 7% for long-term government bonds, and 9% for long-term corporate bonds.[18] Taken together, therefore, a constrained portfolio requires that at least 73% of the portfolio's assets be invested in traditional stock and bond investments, leaving a maximum of only 27% that can be allocated to alternative asset classes such as hedge funds and managed futures.

The optimum portfolio allocations for managed futures for the period 1982 through 1996, when hedge funds are not included, are shown in Exhibit 6. When hedge funds are included, the optimal allocations are shown only for the period 1989 through 1996 because data on hedge funds are relatively sparse prior to 1989 (see Exhibit 7).

To evaluate the benefits of incorporating hedge funds and managed futures investments into a diversified stock and bond portfolio, the performance of the portfolios is compared to that of a benchmark optimal portfolio that does not include either hedge funds or man-

EXHIBIT 6
Optimal Portfolio Allocations, 1982-1996

	1	2	3	4	5	6	7	8	9	10
					1982:1-1996:12 Unconstrained					
Managed Futures										
EW CTAs		0.29						0.29		0.29
EW Private Pools			0.21					0.00		0.00
EW Public Funds				0.06				0.00		0.00
VW CTAs					0.14				0.00	0.00
VW Private Pools						0.28			0.28	0.00
VW Public Funds							0.02		0.00	0.00
Standard Assets										
S&P 500 (large-cap)	0.26	0.19	0.21	0.24	0.22	0.20	0.25	0.19	0.20	0.19
Long-Term Corporate Bonds	0.31	0.05	0.08	0.29	0.20	0.04	0.30	0.05	0.04	0.05
Intermediate-Term Govt. Bonds	0.43	0.47	0.51	0.41	0.44	0.48	0.42	0.47	0.48	0.47
Long-Term Government Bonds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Russell 2000 (small-cap)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Returns	12.9%	15.4%	13.6%	12.7%	12.8%	13.5%	12.8%	15.4%	13.5%	15.4%
Standard Deviation	7.1%	6.9%	6.4%	6.8%	6.5%	6.1%	7.0%	6.9%	6.1%	6.9%
Sharpe Ratio	0.922	1.325	1.129	0.932	0.998	1.183	0.923	1.325	1.183	1.325
Change		43.7%	22.5%	1.1%	8.2%	28.3%	0.1%	43.7%	28.3%	43.7%

	1	2	3	4	5	6	7	8	9	10
					Constrained					
Managed Futures										
EW CTAs		0.27						0.27		0.27
EW Private Pools			0.27					0.00		0.00
EW Public Funds				0.06				0.00		0.00
VW CTAs					0.17				0.00	0.00
VW Private Pools						0.27			0.27	0.00
VW Public Funds							0.02		0.00	0.00
Standard Assets										
S&P 500 (large-cap)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Long-Term Corporate Bonds	0.17	0.09	0.09	0.17	0.17	0.09	0.17	0.09	0.09	0.09
Intermediate-Term Govt. Bonds	0.20	0.08	0.08	0.20	0.10	0.08	0.20	0.08	0.08	0.08
Long-Term Government Bonds	0.14	0.07	0.07	0.08	0.07	0.07	0.12	0.07	0.07	0.07
Russell 2000 (small-cap)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Average Returns	14.2%	17.3%	16.0%	14.0%	14.6%	15.5%	14.2%	17.3%	15.5%	17.3%
Standard Deviation	9.3%	9.3%	9.3%	9.0%	9.1%	8.7%	9.2%	9.3%	8.7%	9.3%
Sharpe Ratio	0.854	1.229	1.084	0.908	0.962	1.102	0.902	1.229	1.102	1.229
Change		43.9%	26.9%	6.3%	12.6%	29.0%	5.6%	43.9%	29.0%	43.9%

EW: equally weighted portfolio; VW: value-weighted portfolio.
Constrained optimizations have restrictions on weights as follows: S&P 500 - 45% to 65%; long-term corporate bonds - 9% to 17%; intermediate-term government bonds - 8% to 20%; long-term government bonds - 7% to 19%; and Russell 2000 - 4% to 8%.
See Ibbotson, Siegel, and Love [1985].

aged futures. For 1982-1996, for example, the benchmark unconstrained optimal portfolio consists of 26% common stocks, 31% long-term corporate bonds, and 43% intermediate-term bonds; and has an average annualized return of 12.9%, an annualized standard deviation of monthly returns of 7.1%, and a Sharpe ratio of 0.922 (Exhibit 6, column 1).

Columns 2 through 7 in Exhibit 6 show, for both unconstrained (top panel) and constrained (bottom panel) portfolios, the optimal allocations when each alternative managed futures investment is separately included in the portfolio. Column 8 provides the optimal allocations when EWs of all alternative managed futures investments are included in the portfolio, and column 9 shows the allocations when VWs of all alternative managed futures investments are included. Finally, column 10 provides the optimal allocations when all managed futures investments are permitted to enter the portfolio simultaneously.

For unconstrained portfolios, the dominant managed futures investments are an EW of CTAs and a VW of pools, which receive allocations of 29% and 28%, respectively (Exhibit 6, columns 8 and 9). The inclusion of either investment raises the Sharpe ratio of the portfolio by from 28.3% to 43.7% compared to the benchmark unconstrained optimal portfolio.

For constrained portfolios, the same two managed futures investments receive similar allocations and improve portfolio performance by similar amounts (lower panel, columns 8 and 9). Public funds enter the optimal portfolio only when other managed futures investments are excluded, and receive allocations of 6% or less (columns 4 and 7).

Finally, when all managed futures investments are allowed to enter the portfolio simultaneously, an EW of CTAs dominates all other managed futures investments in both unconstrained and constrained portfolios, receiving allocations of 29% and 27%, respectively, which are the maximum allocations permitted alternative asset classes under constrained optimization (column 10).

Exhibit 7 provides an identical analysis when hedge funds are also included in the portfolio for the period 1989 through 1996. In unconstrained portfolios, both managed futures and hedge funds receive substantial portfolio allocations. In particular, when all managed futures and hedge fund investments are permitted to enter the portfolio simultaneously, a VW of pools and an EW of hedge funds together receive 91% of the portfolio allocation, and the Sharpe ratio of the resulting portfolio increases by 125%, rising from 0.979 to 2.205 (column 16). Thus, the introduction of managed futures and hedge funds effectively replaces the portfolio allocations formally given to common stocks and bonds. (Compare columns 1 and 16 in Exhibit 7, top panel.)

For constrained portfolios, managed futures and hedge funds each receive the maximum permissible allocation for alternative investments: 27% (Exhibit 7, bottom panel, columns 14 and 15). Most important, both receive allocations in the optimal portfolios: A VW of pools receives an 8% allocation, and a VW of hedge funds receives a 19% allocation (Exhibit 7, bottom panel, column 16). They are, therefore, complementary rather than substitute investment products. Including them both in the portfolio increases the Sharpe ratio of the constrained portfolio by 34.1%, from 0.964 to 1.293 (bottom panel, column 16).[19]

Thus, both hedge funds and managed futures funds have return characteristics that make them attractive portfolio assets. A VW of private pools and an EW of CTAs are the dominant managed futures investments, while both hedge funds and funds of hedge funds provide attractive portfolio investments. Most important, including both managed futures and hedge fund investments in a portfolio significantly improves portfolio performance.

VII. HEDGE FUNDS AND MANAGED FUTURES VERSUS PASSIVE INDEX STRATEGIES

Since the hedge fund and managed futures fund investments examined are essentially different kinds of hedge fund and managed futures indexes (EW or VW of funds), a fundamental question is whether these investments outperform passive equity and commodity index trading strategies that attempt to replicate what hedge funds and managed futures funds do. We explore several equity and commodity index strategies that may be viewed as substitutes for investing in hedge funds and managed futures.

Managed futures funds primarily trade futures and derivatives contracts, and typically pursue trend-following or "market momentum" strategies (Fung and Hsieh [1997b]). Most employ some type of technical trading methodology to identify impending upward or downward price trends, and then take either long or short futures positions to capitalize on the anticipated rising or falling prices. Thus, to the extent that managed futures funds can profit from price trends, we would

EXHIBIT 7

Optimal Portfolio Allocations, 1989-1996

							Unconstrained									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Managed Futures																
EW CTAs		0.39										0.22		0.00		0.00
EW Private Pools			0.18									0.00		0.00		0.00
EW Public Funds				0.00								0.00		0.00		0.00
VW CTAs					0.18								0.00	0.00		0.00
VW Private Pools						0.48							0.21	0.48		0.28
VW Public Funds							0.00						0.00	0.00		0.00
Hedge Funds																
EW Hedge Funds								0.80				0.70			0.64	0.63
EW Funds of Hedge Funds									0.84			0.00			0.00	0.00
VW Hedge Funds										0.74			0.25		0.28	0.05
VW Funds of Hedge Funds											0.84		0.41		0.00	0.00
Standard Assets																
S&P 500	0.47	0.25	0.41	0.47	0.41	0.22	0.47	0.00	0.07	0.10	0.00	0.00	0.07	0.22	0.00	0.00
Long-Term Corporate Bonds	0.46	0.10	0.26	0.46	0.31	0.00	0.46	0.00	0.10	0.09	0.13	0.00	0.00	0.00	0.00	0.00
Intermediate-Term Govt. Bonds	0.07	0.18	0.14	0.07	0.08	0.21	0.07	0.20	0.00	0.06	0.02	0.09	0.06	0.21	0.07	0.04
Long-Term Govt. Bonds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Russell 2000 (small-cap)	0.00	0.08	0.01	0.00	0.01	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00
Average Returns (%)	12.8	12.9	12.2	12.8	12.5	13.2	12.8	14.8	11.5	18.8	12.8	15.0	15.2	13.2	17.1	15.6
Standard Deviation (%)	7.7	6.1	6.8	7.7	7.0	5.6	7.7	5.3	4.0	8.4	5.2	4.8	5.8	5.6	6.0	4.7
Sharpe Ratio (%)	0.979	1.250	1.021	0.979	1.031	1.423	0.979	1.808	1.548	1.604	1.458	2.028	1.717	1.423	1.988	2.20
Change (%)		27.6	4.3	0.0	5.2	45.4	0.0	84.6	58.1	63.8	48.9	107	75.3	45.4	103.0	125

EXHIBIT 7
Continued

	Constrained															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Managed Futures																
EW CTAs		0.27										0.15		0.00		0.00
EW Private Pools			0.19									0.00		0.00		0.00
EW Public Funds				0.00								0.00		0.00		0.00
VW CTAs					0.19								0.00	0.00		0.00
VW Private Pools						0.27							0.08	0.27		0.08
VW Public Funds							0.03						0.00	0.00		0.00
Hedge Funds																
EW Hedge Funds								0.27				0.12			0.00	0.00
EW Funds of Hedge Funds									0.27			0.00			0.00	0.00
VW Hedge Funds										0.27			0.19		0.27	0.19
VW Funds of Hedge Funds											0.27		0.00		0.00	0.00
Standard Assets																
S&P 500	0.50	0.45	0.45	0.50	0.45	0.45	0.48	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Long-Term Corp. Bonds	0.17	0.09	0.17	0.17	0.17	0.09	0.17	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Intermediate-Term Govt. Bonds	0.20	0.08	0.08	0.20	0.08	0.08	0.20	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Long-Term Govt. Bonds	0.09	0.07	0.07	0.09	0.07	0.07	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Russell 2000 (small-cap)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Average Returns (%)	12.9	13.7	12.7	12.9	12.8	13.8	12.8	14.5	13.1	15.8	13.7	14.1	15.2	13.8	15.8	15.2
Standard Deviation (%)	8.0	7.2	7.4	8.0	7.5	6.9	7.8	7.9	7.1	8.2	7.6	7.3	7.7	6.9	8.2	7.7
Sharpe Ratio (%)	0.964	1.182	1.010	0.964	1.021	1.256	0.964	1.177	1.110	1.288	1.111	1.209	1.293	1.256	1.288	1.293
Change (%)		22.7	4.8	0.0	5.9	30.3	0.1	22.1	15.1	33.6	15.2	25.4	34.1	30.3	33.6	34.1

EW: equally weighted portfolio; VW: value-weighted portfolio.
Constrained optimizations have restrictions on weights: S&P 500 - 45% to 65%; long-term corporate bonds - 9% to 17%, intermediate-term government bonds - 8% to 20%; long-term government bonds - 7% to 19%; and Russell 2000 - 4% to 8%.
See Ibbotson, Siegel, and Love [1985].

expect their returns to be positively related to the incidence and magnitude of either upward or downward price trends in commodity markets.

We use two commodity indexes to capture the potential returns from price trends in commodity markets: the CRB index and the MLM index. The CRB index is a futures price index, and returns on a passive investment in the index represent the returns on equally weighted long positions in twenty-one different commodity futures. Positive CRB index returns can be expected to occur when commodity prices are rising.[20] To capture the total returns on a passive investment in the CRB index, Treasury bill returns must be added to reflect the fact that an investment in a futures index is a fully collateralized investment, so that all moneys are invested in Treasury bills at all times.

An investment in the CRB index, however, may not fully capture what managed futures do, because these funds typically also hold short positions and trade financial futures. The MLM index overcomes these shortcomings. The MLM index is a dynamically constructed, passive, commodity index that permits both long and short positions, and includes financial futures as well as commodity futures. The index employs a simple moving-average technical trading rule to identify either upward or downward price trends in twenty-five major commodity markets, and then simulates taking either a long or a short position in each of these markets, depending on the trading signal.[21]

More specifically, when the prior month-end near-month futures price of a commodity is higher than the twelve-month average of month-end near-month futures prices of that commodity, a long position is taken in that commodity. Otherwise, a short position is taken.

Thus, the total return on the MLM index is the average of the returns on the long and short positions that are taken in each of twenty-five different futures (or commodity) markets, plus the Treasury bill return. Positive returns typically occur when there are significant upward or downward price trends in some of those markets. To the extent that the MLM index can replicate the returns of managed futures funds, therefore, an investment in the MLM index is a substitute for holding managed futures.[22]

Hedge funds, in contrast to managed futures, concentrate their investment activities in traditional asset markets, particularly equity markets. Unlike other equity investment vehicles (such as mutual funds), however, hedge funds pursue both long and short trading strategies, use leverage, and often take concentrated (as opposed to diversified) equity positions (Fung and Hsieh [1997a]). To capture these trading strategies we employ several zero-investment, dynamic, index trading strategies, using three equity indexes:[23] the HML index to represent a strategy of simultaneously buying high book-to-market stocks and selling low book-to-market stocks;[24] the SMB index to represent a strategy of simultaneously buying small-capitalization stocks and selling large-capitalization stocks;[25] and the WML index to represent a strategy of simultaneously buying last year's winners and selling last year's losers.[26] To the extent that these dynamic index strategies replicate hedge fund strategies, they may be viewed as substitutes for holding hedge funds.

To determine whether the index strategies are substitutes for investments in either hedge funds or managed futures, optimal portfolio allocations are recomputed when the alternative equity and commodity indexes are permitted to enter the portfolio as separate asset classes. If these indexes enter the optimal portfolio and either significantly reduce or eliminate the portfolio allocations given to hedge funds and managed futures, they can be viewed as substitute asset classes.

In computing returns on the MLM index, monthly fees and expenses equivalent to 50 basis points a year are subtracted, while no adjustment for expenses is made in the returns on the three equity indexes. We assume that the broker rebate on the short proceeds associated with constructing these indexes is sufficient to cover whatever expenses are incurred in constructing and rebalancing the indexes.

In any case, to the extent that returns on these indexes are overstated, there will be a bias toward eliminating hedge funds and managed futures from the portfolio. If hedge funds and managed futures remain in the portfolio under these assumptions, it is likely that they would receive an even larger portfolio allocation if returns on the three equity indexes were lowered by adjusting for presumed fees and transaction costs.

Exhibit 8 reports the results of this analysis for both unconstrained and constrained portfolios for the period 1989 through 1996. In an unconstrained portfolio, the MLM index receives a 23% allocation, while the three equity indexes together receive a 34% allocation (top panel, column 6). The Sharpe ratio of a portfolio that includes the passive indexes rises significantly from 2.205 to 2.840 (compare Exhibit 7, column 16, with

Exhibit 8

Optimal Portfolio Allocations When Passive Return Indexes are Included, 1989-1996

			Unconstrained			
	1	2	3	4	5	6
Alternative Investments						
EW CTAs		0.00				0.00
EW Private Pools		0.00				0.00
EW Public Funds		0.00				0.00
VW CTAs		0.00				0.00
VW Private Pools		0.26				0.06
VW Public Funds		0.00				0.00
EW Hedge Funds			0.50	0.24	0.56	0.20
EW Funds of Hedge Funds			0.00	0.00	0.00	0.00
VW Hedge Funds			0.24	0.28	0.26	0.10
VW Funds of Hedge Funds			0.00	0.00	0.00	0.00
Proxy Investments						
MLM		0.39				0.23
HML			0.26			0.13
SMB				0.25		0.11
WML					0.11	0.10
Standard Assets						
S&P 500	0.47	0.15	0.00	0.00	0.00	0.02
Long-Term Corporate Bonds	0.46	0.07	0.00	0.00	0.00	0.00
Intermediate-Term Govt. Bonds	0.07	0.03	0.00	0.23	0.08	0.05
Long-Term Govt. Bonds	0.00	0.00	0.00	0.00	0.00	0.00
Russell 2000 (small-cap)	0.00	0.09	0.00	0.00	0.00	0.00
Average Returns	12.8%	11.97%	15.82%	15.03%	16.50%	13.00%
Standard Deviations	7.7%	4.31%	4.68%	4.31%	5.63%	2.74%
Sharpe Ratio	0.979	1.567	2.263	2.276	2.004	2.840
Change		60.0%	131.1%	132.4%	104.6%	190.0%

Exhibit 8, column 6).

Nonetheless, both managed futures and hedge funds continue to receive portfolio allocations. A VW of pools receives a 6% allocation; an EW of hedge funds receives a 20% allocation; and a VW of hedge funds receives a 10% allocation.[27] Thus, the inclusion of the passive equity and commodity indexes does not eliminate managed futures and hedge funds from the portfolio; they still receive a total portfolio allocation of 36%.

A surprising finding is that, as an alternative asset class, commodity indexes receive a total allocation of 29% in an optimal unconstrained portfolio (23% to the MLM index and 6% to a VW of pools). Finally, while the allocations to managed futures and hedge funds are much lower in constrained portfolios, both continue to receive portfolio allocations (Exhibit 8, bottom panel).

Exhibit 9 provides a graphical summary of the effects on the portfolio efficiency frontier of including the different assets in the portfolio.

VIII. SUMMARY AND CONCLUSIONS

This study examines the performance of managed futures and hedge funds, both as stand-alone investments and as assets in diversified stock and bond portfolios. Three investments are examined: investments in randomly selected funds, in an equal-weighted portfolio of all funds (EW), and in a value-weighted portfolio of all funds

EXHIBIT 8
Continued

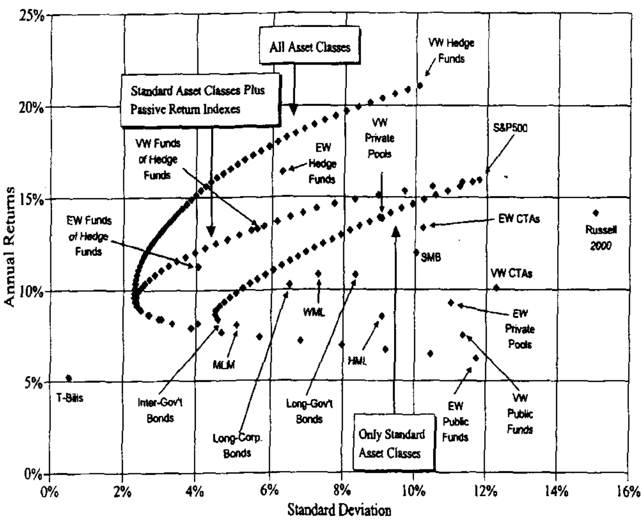
			Constrained			
	1	2	3	4	5	6
Alternative Investments						
EW CTAs		0.00				0.00
EW Private Pools		0.00				0.00
EW Public Funds		0.00				0.00
VW CTAs		0.00				0.00
VW Private Pools		0.27				0.05
VW Public Funds		0.00				0.00
EW Hedge Funds			0.00	0.00	0.00	0.00
EW Funds of Hedge Funds			0.00	0.00	0.00	0.00
VW Hedge Funds			0.20	0.11	0.27	0.06
VW Funds of Hedge Funds			0.00	0.00	0.00	0.00
Proxy Investments						
MLM		0.00				0.00
HML			0.07			0.00
SMB				0.16		0.15
WML					0.00	0.00
Standard Assets						
S&P 500	0.50	0.45	0.45	0.45	0.45	0.45
Long-Term Corporate Bonds	0.17	0.09	0.09	0.09	0.09	0.09
Intermediate-Term Govt. Bonds	0.20	0.08	0.08	0.08	0.08	0.08
Long-Term Govt. Bonds	0.09	0.07	0.07	0.07	0.07	0.07
Russell 2000 (small-cap)	0.04	0.04	0.04	0.04	0.04	0.04
Average Returns	12.93%	13.85%	15.02%	14.52%	15.80%	14.19%
Standard Deviation	8.00%	6.87%	7.57%	6.89%	8.22%	6.63%
Sharpe Ratio	0.964	1.256	1.295	1.350	1.288	1.353
Change		30.3%	34.3%	40.1%	33.6%	40.4%

MLM: Returns on the Mount Lucas Management Index.
HML: Returns on a portfolio of high book-to-market stocks minus portfolio of low book-to-market stocks.
SMB: Returns on a portfolio of small stocks minus portfolio of large stocks.
WML: Returns on a portfolio of past year's winners minus portfolio of past year's losers.
Exclusion rules: Twelve-month rule for CTAs, five-month rule for pools, and six-month rule for funds.

(VW). We find that an EW of CTAs, a VW of pools, and both an EW and a VW of hedge funds and funds of hedge funds make good stand-alone assets. The inclusion of both managed futures and hedge funds in diversified stock and bond portfolios also significantly enhances the performance of those portfolios. Indeed, for unconstrained portfolios, optimal portfolios consist almost entirely of managed futures and hedge fund investments, replacing traditional investments in stocks and bonds.

In addition, even when portfolios are constrained to include substantial amounts of traditional assets, managed futures and hedge funds together receive the maximum permissible portfolio allocation given to alternative asset classes (27%: 19% to hedge funds and 8% to managed futures). Inclusion of these investments in diversified stock and bond portfolio increases the Sharpe ratios of those portfolios by 34.1% for constrained portfolios and by 125.0% for unconstrained portfolios.

EXHIBIT 9
Efficient Frontier 1989-1996



Thus, if the past performance of managed futures and hedge funds can be taken as a good predictor of their future performance, both managed futures and hedge funds should be viewed as attractive alternative asset classes for portfolio managers.

Such an assumption, however, may be more supportable for managed futures than for hedge funds. Our data on managed futures span some fifteen years, during which commodity markets experienced all kinds of vicissitudes. The same cannot be said for hedge funds. The bulk of the hedge fund data covers only the years from 1989 to 1996, one of the greatest bull markets in equities ever seen. It remains to be seen what hedge fund performance will be when equity markets experience the kind of turbulence common to commodity markets.

Finally, we investigate whether various passive equity and commodity index trading strategies can be used in place of investments in hedge funds and managed futures. A primary source of managed futures returns appears to come from trend-following technical trading strategies to identify price trends in commodity futures markets. Hedge fund returns, however, appear to be closely related to traditional equity markets, although the pursuit of short as well as long equity trading strategies and non-equity trading strategies significantly differentiates hedge fund manager strategies from traditional buy-and-hold equity investment strategies.

To determine whether alternative passive equity and commodity index strategies can be viewed as substitutes for hedge funds and managed futures, we compute optimal portfolio allocations for hedge funds and managed futures when the substitute equity and commodity indexes also are permitted to enter the portfolio. We conclude that, while these passive index strategies do enhance portfolio performance, they do not knock hedge funds and managed futures out of the portfolio.

These findings raise a number of issues that warrant further study. First, since it is not realistic to believe that investors could assemble a portfolio consisting of all hedge funds, CTAs, and so forth, and then rebalance those portfolios every month to achieve the designated portfolio weightings, there remains the very practical issue of how to construct more feasible hedge fund and managed futures portfolios for investors. In particular, how many funds should investors hold, and how should those funds be chosen? Holding only one or a few funds, it should be noted, may result in substantially different performance from holding an index of all funds.

Second, the high risk-adjusted returns earned by both hedge funds and managed futures funds raise the issue of what the sources of those returns are. Are these funds capturing market inefficiencies, or do hedge fund and commodity fund managers have superior trading skill? An important subject of future research, therefore, is to determine the sources of hedge fund and managed futures returns.

ENDNOTES

The authors wish to thank Edward Kane for helpful comments, and Richard Oberuc for assistance with the data and for helpful comments on a number of topics. MAR provided the data. All Mr. Liew's work on this article was completed before he joined Morgan Stanley, and should not be taken to reflect the views of that firm.

[1]For a recent study of hedge funds that relies on a smaller data sample, see Brown, Goetzmann, and Ibbotson [1997].

[2]Foreign-based hedge funds differ only in that their clients are non-U.S. residents. There is no reason to think that there should be systematic performance differences between U.S. and foreign-based hedge funds, and our analysis confirms this view.

[3]A pool or fund is not considered to have accepted public funds if it does not have more than 499 investors in the pool and does not have more than 35 "unaccredited" investors. "Unaccredited" investors are those who do not qualify as "accredited" investors. An "accredited" investor

must have a net worth of at least $1 million or an annual income of more than $200,000 for at least two consecutive years. Public funds are registered as securities under SEC regulations and are advertised and sold like any other registered security.

[4]Because reporting by most hedge funds and managed futures funds is on a voluntary basis, MAR data may not include all hedge funds and managed futures funds. Fund managers have an incentive to report their performance, however, in order to attract additional business.

[5]Because profit-based incentive fees are typically levied less frequently than monthly, it is necessary to adopt a uniform accounting convention for fees in order to determine monthly returns net of all fees. In some cases, funds themselves accrue the incentive fees over the relevant months, in which case the monthly data reported to MAR already reflect fee accruals. In other cases, MAR has reported that it spreads the incentive fees over the relevant months to determine monthly returns net of fees.

[6]Returns from standard asset classes are taken from *Stocks, Bonds, Bills, and Inflation: 1996 Yearbook.*

[7]MAR began collecting comprehensive data on CTAs, pools, and funds in 1991, so only data for CTAs, pools, and funds that started operation subsequent to January 1991 are used to estimate the median number of months of prereporting performance data included in the MAR performance histories of CTAs, pools, and funds. Using data for CTAs, pools, and funds that started operations before 1991 would provide an incorrect assessment of the prereporting bias, because it would result in the exclusion of too much data. For example, in the case of a CTA that began operations in 1980 and first reported to MAR in 1991 when MAR began its comprehensive data collection, excluding all data prior to its first reporting to MAR would result in excluding the first eleven years of its performance, which would clearly be unwarranted. Finally, the respective *mean* number of prereporting months is sixteen for CTAs, eight for pools, and nine for public funds. Medians are used rather than means because mean values were subject to a few outlier observations.

[8]Non-survivors are defined as funds that began operations at any time subsequent to April 1979, but ceased operations at some time prior to year-end 1996. Survivors are defined as funds still operating at year-end 1996.

[9]The annual attrition rate is computed as the proportion of funds in existence at the beginning of a year that no longer exist (or are surviving) at the end of the year. CTAs, pools, and funds may cease to exist either because of poor performance or because they voluntarily dissolve or go out of business. It is probable, though, that most cease to exist because of poor performance.

[10]Prior to 1990 (when MAR changed ownership) the MAR data base consisted of only the largest twenty-five CTAs. Smaller CTAs, and CTAs that did not continue operating, were not included. MAR used the unpublished performance records maintained by the previous owners, including the performance records of both surviving and non-surviving CTAs not included in the published data base, to "backfill" the data base for the early years. In backfilling the data, however, it is possible that some non-surviving CTAs were inadvertently excluded.

[11]Other studies, using fewer observations, find similar results. Fung and Hsieh [1997b] find that reported annual CTA returns in the 1980s could be inflated by as much as 3.48 percentage points because of the failure to include non-surviving CTAs in the data. Schneeweis, Spurgin, and McCarthy [1996, p. 768] report that "including non-surviving CTAs...would have reduced annual returns by approximately 1.0-2.5%, increased standard deviation by 1.2-1.4%, and reduced the Sharpe ratios from 16 to 27%." For mutual funds, Brown and Goetzmann [1995] report an annual survivorship bias of about one percentage point.

[12]In an EW, therefore, money is implicitly taken each month from last month's winner and given to last month's losers to maintain an equally weighted portfolio. In a VW, winners receive increasingly higher portfolio weights each month if the total amount under management in the industry remains constant. If new money enters a fund, the VW must be rebalanced at month-end.

[13]It has been shown that every risk-averse investor, regardless of the degree of risk aversion, will be made better off by adding an asset to the portfolio that shifts the efficient frontier of the existing investments upward and/or to the left.

[14]This occurs, of course, because in an EW or a VW there is diversification among individual hedge funds and managed futures funds.

[15]Elton, Gruber, and Rentzler [1987, 1990] and Irwin, Krukemyer, and Zulauf [1992] use this methodology to evaluate investments in public funds, and also find that adding public funds to a diversified portfolio does not enhance performance.

[16]Implicit assumptions are that there can be riskless borrowing and lending at the same rate, that short sales are impossible, and that the portfolio can be dynamically rebalanced to the desired allocations.

[17]Optimization solutions must be obtained using a numerical algorithm because the objective function represented by Equation (6) is non-linear. Although both optimizations are constrained in the sense that the weights must sum to one and be non-negative, we use unconstrained to represent optimizations where the weights are not bound by any other constraint. Irwin, Krukemyer, and Zulauf [1992] argue that constraining the portfolio allocations reduces the estimation error when solving for the optimal portfolio. See Frost and Savarino [1988].

[18]The ranges are as follows: 45% to 65% for large-cap

common stocks; 4% to 8% for small stocks; 8% to 20% for intermediate-term government bonds; 7% to 19% for long-term government bonds; and 9% to 17% for long-term corporate bonds. These ranges come from Ibbotson, Siegel, and Love [1985] and implicitly assume a portfolio of five asset classes.

[19]Separate analyses of the subperiods 1989-1992 and 1993-1996, which are not reported here, confirm these results. Both for unconstrained and constrained portfolios, managed futures and hedge funds receive substantial allocations in both periods.

[20]The CRB index is an equally weighted index of futures prices on twenty-one commodities: cocoa, coffee, copper, corn, cotton, crude oil, gold, heating oil, hogs, live cattle, lumber, orange juice, platinum, pork bellies, soybeans, soybean meal, soybean oil, silver, sugar, unleaded gas, and wheat. It does not include any financial futures. Positive returns on the index may also reflect price backwardation in commodity markets.

[21]The MLM index is produced by Mount Lucas Management, and consists of futures prices on twenty-five commodities: Australian dollar, British pound, Canadian dollar, coffee, copper, corn, cotton, crude oil, German mark, gold, heating oil, Japanese yen, live cattle, natural gas, silver, soybeans, soybean meal, soybean oil, sugar, Swiss franc, T-note 5-year, T-note 10-year, Treasury bonds, unleaded gas, and wheat. In addition, the MLM index return includes the Treasury bill return. We have been told that fees for investors in the MLM index are approximately 50 basis points a year.

[22]If CTAs have trading skill, they should outperform the MLM index. They may be better able to time the market, to successfully alter the size of their respective positions to coincide with impending price trends, or to trade more profitable commodity markets than those in the MLM index.

[23]These indexes have been used in the academic literature to represent risk factors in order to explain equity returns. See Carhart [1997] and Fama and French [1993].

[24]See Rosenberg, Reid, and Lanstein [1985]. Book-to-market values are defined as book value per share divided by the market price per share. The index is created by using equity information obtained from Datastream. We use only stocks that report book-to-market values, market capitalization, and monthly returns for the prior year. The portfolio is value-weighted, rebalanced quarterly, and size- and momentum-neutral. See Liew and Vassalou [1998] for a more detailed explanation.

[25]See Banz [1981] for the size effect in U.S. equities. Market capitalization is computed by multiplying the number of shares outstanding by the market price of the stock. The SMB index is value-weighted, rebalanced quarterly, and value- and momentum-neutral.

[26]See Jegadeesh and Titman [1993] and Asness [1995] for a discussion of stock momentum. Winners are defined as stocks that have had high monthly returns during the past year, excluding the most recent month, and losers are those that have had low returns during the past year, excluding the most recent month. Excluding the last month reduces problems associated with the bid/ask bounce. The WML index is value-weighted, rebalanced quarterly, and size- and value-neutral.

[27]If monthly returns on the equity indexes are reduced by the equivalent of 240 basis points a year to account for transaction costs associated with constructing the indexes, in unconstrained portfolios the allocation given to the three equity indexes falls from 34% to 22%, while the allocation given to hedge funds and managed futures rises from 36% to 49%.

REFERENCES

Asness, Clifford S. "The Power of Past Stock Returns to Explain Future Stock Returns." Working paper, Applied Quantitative Research, 1995.

Banz, Rolf W. "The Relationship Between Return and Market Value of Common Stock." *Journal of Financial Economics*, 9 (1981), pp. 3-18.

Brown, Stephen J., and William N. Goetzmann. "Performance Persistence." *Journal of Finance*, 52 (1995), pp. 679-698.

Brown, Stephen J., William N. Goetzmann, and Roger G. Ibbotson. "Offshore Hedge Funds: Survival and Performance 1989-1995." Working paper, New York University Stern School of Business and Yale School of Management, 1997.

Carhart, Mark M. "On Persistence in Mutual Fund Performance." *Journal of Finance*, 52 (1997), pp. 57-82.

Edwards, Franklin R., and Jimmy Liew. "Hedge Funds vs. Managed Futures as Asset Classes." Working paper, Columbia Business School, 1999.

Elton, E., and M. Gruber. "Professionally Managed, Publicly Traded Commodity Funds." *Journal of Business*, 50 (1987), pp. 175-199.

Elton, E., M. Gruber, and J. Rentzler. "The Performance of Publicly Offered Commodity Funds." *Financial Analysts Journal*, July-August 1990, pp. 23-30.

——. "Professionally Managed, Publicly Traded Commodity Funds." *Journal of Business*, 60, No. 2 (1987).

Fama, Eugene F., and Kenneth R. French. "Common Risk Factors in Returns on Stocks and Bonds." *Journal of Financial*

Economics, 33 (1993), pp. 3-56.

Frost, P.A., and J.E. Savarino. "For Better Performance: Constrain Portfolio Weights." *Journal of Portfolio Management*, 14 (1998).

Fung, William, and David A. Hsieh. "Empirical Characteristics of Dynamic Trading Strategies: The Case of Hedge Funds." *Review of Financial Studies*, 10 (1997a), pp. 275-302.

——. "Survivorship Bias and Investment Style in the Returns of CTAs." *Journal of Portfolio Management*, Fall 1997b, pp. 30-41.

Ibbotson, R.G., L.B. Siegel, and K.S. Love. "World Wealth: U.S. and Foreign Market Values and Returns." *Journal of Portfolio Management*, 11 (1985).

Irwin, Scott H., Terry R. Krukemyer, and Carl R. Zulauf. "The Investment Performance of Public Commodity Pools over 1979-1990." *Journal of Futures Markets*, Vol. 13, No. 7 (1992), pp. 799-820.

Jegadeesh, Narasimhan, and Sheridan Titman. "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency." *Journal of Finance*, 48 (1993), pp. 65-91.

Liew, Jimmy, and Maria Vassalou. "Are Unidentified Factor-Mimicking Portfolios Leading Indicators of Economic Growth? International Evidence." Working paper, Columbia Business School, 1998.

Rosenberg, Barr, Kenneth Reid, and Ronald Lanstein. "Persuasive Evidence of Market Inefficiency." *Journal of Portfolio Management*, 11 (1985), pp. 9-17.

Schneeweis, Thomas, Richard Spurgin, and David McCarthy. "Survivor Bias in Commodity Trading Advisors." *Journal of Futures Markets*, 16 (1996), pp. 757-772.

Stocks, Bonds, Bills, and Inflation: 1996 Yearbook. Chicago: Ibbotson Associates, Inc., 1996.