A Benchmark for Commodity Trading Advisor Performance

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Abstract

This article describes a passive index that can be used as a benchmark for certain commodity trading advisors (CTAs). The index is designed to benchmark the performance of diversified trend-followers. Diversified CTAs trade in a number of derivatives markets, including commodity, currency, interest rate, and equity derivatives markets. Trend followers follow momentum strategies that are designed to capture longer-term trends in asset prices. The index uses a momentum trading strategy that takes hypothetical long and short positions in a number of commodity, currency, and fixed income futures contracts. Results indicate that the passive index has returns that are highly correlated with the return of the average CTA. As such, this index can be useful in performance measurement and attribution as well as in the creation of multi-manager CTA portfolios.

A Benchmark for Commodity Trading Advisor Performance

This article describes an index that can be used as a benchmark for certain commodity trading advisors (CTAs). Benchmarks are used for three main purposes. One is to serve as a proxy for the return to some asset class. An index can be used to decide how to allocate investments among a number of asset classes. A second use is to provide a means of evaluating the performance of a particular manager. A third use is to provide a direct means of investing in the asset class. It is difficult to create an index that satisfies all three of these goals. An index created primarily with the first objective in mind will tend to be broad-based, in an effort to include a cross-section of assets and strategies. An index designed primarily to evaluate managers will tend to include fewer assets and be focused on a particular strategy or investment style. An index designed as an investment vehicle will emphasize simplicity in order to minimize the transaction costs associated with replicating the strategy.

The CTA index described in this paper is designed primarily to evaluate the performance of a group of CTAs known as diversified trend-followers. Diversified CTAs trade in a number of derivatives markets, including commodity, currency, interest rate, and equity derivatives markets. Trend-followers follow momentum strategies that are designed to capture longer-term trends in asset prices. This index, called the Trend-Following Index (TFI), employs the same trend-following strategy across a number of commodity and interest rate futures contracts. Not all CTAs are diversified trend-followers. Some follow strategies that are unrelated to momentum, such as fundamental economic analysis, to determine which assets to buy or sell. Other CTAs use trend-following strategies but limit their trading to a small subset of futures contracts such as currency or agricultural futures. The TFI index will not be an appropriate benchmark for the performance of these CTA funds.

A number of private firms produce indexes that are designed to track the performance of diversified trend-following CTAs, including Managed Accounts Reports (MAR), Barclay Investor Services, and Tass. Indexes produced by these firms are called active indexes, because the indexes are based on the actual reported performance of a number of individual CTAs. However, an individual investor cannot follow a strategy that replicates the returns to these active indexes. There are two reasons for this. First, the firms that create these indexes do not make the composition of the

indexes public. Second, many of the CTAs represented in the index are closed to new investors, so it would be impossible for a new investor to replicate the index even if the composition was made public.

Momentum strategies involve buying assets that are rising in price and selling assets that are falling in price. One of the most common momentum strategies is a moving-average strategy. This strategy involves buying assets that are above the recent average price and selling short those assets that are below the recent average. Some passive indexes have been created that replicate the performance of a moving average trading strategy in futures markets. One such index is the MLM index, produced by Mount Lucas Management (MLM). The MLM index tracks the performance of a 12-month moving average strategy applied to about 25 commodity, currency, and interest rate futures contracts. Another passive index has been proposed by Lequeux and Acar (1998). This index, called the FXDX, tracks the performance of a momentum strategy applied to a number of currency futures markets. Both of these indexes follow fixed, published strategies and the returns can be exactly replicated (less fees and transactions costs) by an investor.

Another passive index, the Goldman Sachs Commodity Index (GSCI), is widely followed as a benchmark for commodity investment. However, trend-following CTAs take long and short positions depending on their belief about the direction of the trend. The GSCI only holds long positions. Thus while the GSCI may be a suitable benchmark for a buy-and-hold investment strategy, it has been shown to be a poor benchmark for CTA performance (see Schneeweis and Spurgin, 1997).

The primary difference between existing passive indexes and the TFI index is in emphasis. The MLM and GSCI were designed primarily as investment vehicles -- passive indexes that would be available to investors looking to diversify into managed futures without having to select individual managers. As a result, these indexes are easy to implement but do not offer a high correlation with active CTA programs. Conversely, the TFI index was designed specifically to maximize the historic correlation with actively managed CTA indexes. As such, it can be used as an effective benchmark to evaluate the performance of individual CTAs and portfolios of CTAs. Because it does not rely on reported returns by CTAs, the TFI index can be updated daily, while active indexes are only compiled monthly.

Index Construction

Asset Selection: The TFI index takes positions in six actively traded futures contracts. Those contracts are German Marks (CME)[1], Japanese Yen (CME), Crude Oil (NYMEX), Gold (COMEX), Corn (CBT), and Treasury Bonds (CBT). This is considerably fewer than are included in the GSCI or MLM. The decision to limit the number of contracts to a few, highly liquid contracts was driven by the fact that CTAs tend to focus on these markets rather than smaller, less liquid contracts. Also, many of the smaller contracts are highly correlated with contracts that are in the index.

Asset Allocation:

The TFI follows a dynamic allocation strategy. Allocations to each of the six contracts are updated daily based on a measure of historic volatility. The objective of the strategy is to equally weight the index based on relative risk. For example, if the sample standard deviation of crude oil returns is three times that of gold, then three times as many dollars will be allocated to gold as to crude. In this way the contribution of each commodity to the overall index return is independent of the level of volatility in the contract. As a contract becomes more volatile, its allocation decreases. Conversely, if a contract becomes less volatile, its allocation increases. The goal is to have $1/6^{th}$ of the risk allocated to each contract on each day.

This approach differs from other indexes. Existing indexes hold fixed weights in each contract and do not allocate based on changes in volatility. However, CTA strategies typically incorporate risk management strategies that will reduce nominal exposure to a commodity if volatility increases. As such, the TFI approach is more consistent with the observed CTA behavior.

Estimating Historic Volatility

The method of estimating historic volatility incorporates the average of the trading range. As shown by Spurgin and Schneeweis (1999), the trading range provides an historic volatility estimate that is more accurate than the standard close-to-close estimator and is also less sensitive to the occasional outsized return. A period of 200 trading days is used to estimate volatility. The equation for the volatility of an individual commodity is

$$\hat{s}^2 = \frac{\left(\sum l_i / N\right)^2}{\left(8/p\right)}, \qquad (1)$$

where l is the observed trading range for the session and N is the number of sessions used. In this study, N=200.

Computing the Asset Allocations

In order to insure equal risk in each commodity, the percentage allocation (x_i) to each of the n commodities must satisfy two constraints.

$$\begin{aligned} x_i \, s_i &= C \\ \sum_{i=1}^{n} x_i &= 1 \end{aligned} \tag{2}$$

The solution to this system of equations is

$$x_i = \frac{1}{n} \frac{1}{s_i} . \tag{3}$$

Allocations are calculated at the conclusion of each day's trading. There is a 1-day lag between computation of the allocations and the implementation. The lag is inserted because the allocations are not known until trading has ceased, so it would not be possible to trade the strategy without some lag. Allocations are in dollars as opposed to the number of contracts. The actual number of contracts purchased will depend on the price of the underlying commodity and the face value of the individual contract. For purposed of constructing the index, it is assumed that all contracts are infinitely divisible, so no attempt is made to round the purchases and sales to the nearest contract. The dynamic allocation strategy implicitly results in a rebalancing each day based on return as well as volatility. If the value of one contract increases (decreases) its allocation will decrease (increase) even if volatility remains constant. This is because the allocation strategy is determined in dollars rather than units of the underlying assets.

Exhibit 1 shows the range of allocations during the test period from July, 1997 to May, 1998. The average allocation to the Yen was highest at 23% and crude oil was lowest at 8.1%. However, there was considerable variation in the allocations, with the maximum allocation for each commodity at least twice, and often more than three times the minimum allocation. The average allocation to each commodity almost exactly mirrors the *ex post* allocation based on the standard deviation of the entire sample. Despite considerable variation in the allocations through time, on average the exposure to each contract is within 1 percent of the actual measured risk over the time period.

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[1] The DM will be replaced with the Euro

Exhibit 1. Asset Allocation, 1988-1997

	D-Mark	Gold	Corn	Crude Oil	T-Bond	Yen
Average Allocation (Observed)	20.3%	18.1%	11.5%	8.1%	19.0%	23.0%
Maximum Allocation	26.7%	28.4%	17.0%	12.8%	23.7%	29.1%
Minimum Allocation	12.1%	10.9%	5.7%	4.3%	13.6%	13.8%
Standard Deviation (Full Sample)	7.8%	9.3%	13.9%	20.2%	8.2%	6.9%
Ex-Post Allocation	20.6%	17.1%	11.5%	7.9%	19.6%	23.3%
Difference from Observed	-0.3%	1.0%	0.0%	0.2%	-0.6%	-0.3%

Roll-over Strategy

All futures-based indexes need a strategy for rolling positions from one contract to the next. Different indexes have solved this problem different ways. For example, the Commodity Research Bureau (CRB) index uses an exponential average of all traded contracts. The MLM index assumes all contracts are rolled on the last business day before the expiration month. The GSCI index follows a similar strategy, but rolls take place in equal amounts over the first five days of the expiration month. Since nearby contracts are generally more volatile than back months, the choice of a roll strategy will have implications for the performance of the TFI. The GSCI, for example, has a very short average expiration. This leads to higher volatility but also, if contracts are tend to be in backwardation, earn the highest roll return.

The TFI index uses a continuous roll strategy. It holds positions in the two nearby contracts, and each day sells some of the front contract and rolls the position into the next-out contract. The roll strategy is linear -- if there are 90 days between the start of the nearby expiration month and the start of the next-out expiration month, then 1/90 of the position will be rolled each day (3/90 will be rolled over the weekend). This strategy is employed in order to provide the smoothest possible return series from which to generate a trend-following system. The proportion of each contract held in the nearby contract on date *t* is given by

$$p_t = \frac{\#\text{ days until 1st day of nearby contract expiration month}}{\#\text{ days from last expiration to nearby expiration}}, \qquad (4)$$

and the proportion held in the next out contract is $1-p_t$. At the end of each day $(p_{t-1} - p_t)$ is rolled from the nearby contract to the next-out contract. If *NB* denotes the nearby contract and *NX* is the next-out contract, then the spot index on date *t* is given by

$$spot_t = NB \cdot p_t + NX \cdot (1 - p_t) \qquad (5)$$

The 1-day spot index return is calculated as

$$index\ return_t = \frac{s_t - s_{t-1}}{s_{t-1}} \tag{6}$$

The roll return for each day is

$$roll\ return_t = (NX - NB) \cdot (p_{t-1} - p_t) \tag{7}$$

The total return is equal the index return plus the roll return

$$total\ return_t = spot\ return_t + roll\ return_t \tag{8}$$

The trading range for each date, which is used for calculating historic volatility, also follows a rolling strategy. The range for each date is calculated as

$$range_t = (high_{NB} - low_{NB})p_t + (high_{NX} - low_{NX})(1 - p_t) \tag{9}$$

Trading Strategy

The TFI index follows a momentum strategy in each of the six futures contracts. An *x*-day momentum strategy takes a long position if the total return index on date *t* is higher than it was on date *t-x*. Otherwise the strategy takes a short position[2]. Some CTAs use short-term momentum systems and others use longer-term signals. A trading strategy that combines short, medium, and long term strategies was found to maximize the correlation between the TFI and the MAR CTA index. The number of days used to compute the momentum indicator are 15 for the short-term, 27 days for the medium-term, and 55 for the long-term momentum strategy.

Each strategy has an equal weight. Thus all three strategies must be positive to take a 100% long position. If two of the three are positive and the other negative, a 33.3% long position is taken. If two are negative the index will be 33.3% short, and if all are negative it will be 100% short. One result of combining the strategies is that the index is not fully invested in the individual commodities. Exhibit 2 shows the percentage of days that the strategy was partly and fully invested in the underlying contract.

[2] A momentum strategy is similar to, but not identical to a moving average strategy. A moving average will be long if the index is above the average index value of most recent x days, and short otherwise.

Exhibit 2. Exposure of Index to Each Underlying Contract

	Dmark	Gold	Corn	Crude	Tbond	Yen
100% Long	30%	17%	31%	35%	39%	26%
33% Long	19%	19%	20%	20%	20%	18%
33% Short	18%	22%	20%	19%	17%	21%
100% Short	32%	43%	29%	26%	23%	35%
Full Exposure	62%	59%	59%	61%	63%	61%
Partial Exposure	38%	41%	41%	39%	37%	39%
Avg. Exposure	75%	73%	73%	74%	75%	74%
Average Index Exposure:		74.0%				

Note: Average Exposure is Full Exposure + 1/3 Partial Exposure

Index Exposure

Index Exposure	**0.333**	**0.444**	**0.556**	**0.667**	**0.778**	**0.889**	**1.000**
Percent of Days	0.3%	4.4%	13.2%	25.4%	30.8%	20.3%	5.7%
Avg. Exposure	74.0%						
StDev Exposure	13.8%						

On average, the TFI has a 74% exposure to each market. The degree of exposure depends on the correlation between the individual strategies. The higher the correlation, the greater the average exposure (if the strategies were uncorrelated, the expected average exposure would be 50%). The average exposure of the individual commodities ranges from 73% to 75%, suggesting the strategies have about the same correlation across the different commodities.

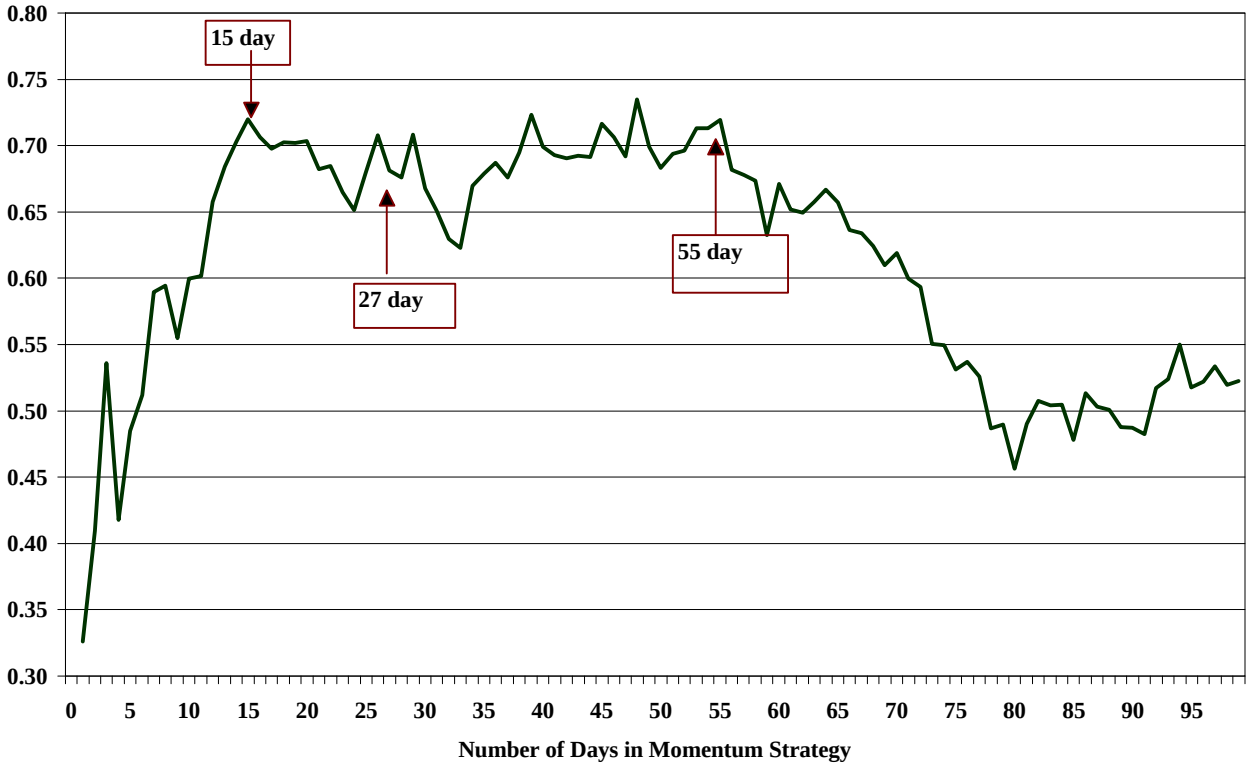
The overall exposure of the index to the underlying contracts can be as low as 33% (of all six strategies hold partial positions) to 100% (if all strategies are fully exposed). Exhibit 2 shows that there is not much variation in the overall exposure of the index. Over half of days the index exposure is either .666 or .777, and exposure above 90% or less than 55% occurs only about 10% of the time. The fact that the contract is not fully exposed to the underlying contracts lowers the overall risk level of the index. This is because the allocation to each contract, which is based on historical volatility, is independent of the trading strategy. Thus the allocations determine the maximum amount of risk that will be taken in each commodity, but the strategy may determine that less risk is taken.

This feature of the TFI -- leverage changes based on the performance of the underlying contracts -- is similar to the strategy employed by most CTAs. While most other indexes such as the MLM or GSCI hold a constant leverage

level (the GSCI is always 100% long, and the MLM is always 100% invested with a combination of long and short positions), CTAs will adjust their leverage level through time.

The choice of 15, 27, and 55 days for the three momentum strategies was made to maximize the correlation coefficient with the MAR CTA index. As can be seen in Exhibit 3, the correlation with MAR is low for momentum strategies that are shorter than 10 days. The correlation peaks at 0.72 for the 15-day strategy and then remains fairly constant until 55 days. Then it drops off rapidly. The strategy employed by the TFI uses the end points of the high-correlation plateau from Exhibit 3 as well as a point in the middle. Combining these three strategies together results in a correlation coefficient with indexes of active CTA performance of about 0.8. The correlation with the capitalization-weighted MAR index is 0.79, and the correlation with the equal-weighted index is 0.81.

Exhibit 3. Correlation of Different Strategies with MAR CTA Index



Historical Performance of the TFI

The hypothetical performance of the index was calculated for the 10-year period from January, 1988 to December, 1997. Index performance is compared to a number of active CTA performance indexes as well as asset class benchmarks. Results are reported in Exhibit 4.

Exhibit 4: Hypothetical INDEX Performance, January, 1988 to December, 1997

						MAR CTA Indexes				
1988-1997	*INDEX*	*S&P 500*	*MLM*	*GSCITOT*	*TBILL*	*DollarWt*	*EqualWt*	*Currency*	*Finanical*	*TrendFollow*
Average Annual Return (%)	11.58	16.74	8.98	10.51	5.60	12.77	10.28	13.44	14.16	11.62
Annual Standard Deviation (%)	5.61	11.99	5.56	15.05	0.50	12.88	14.08	15.15	12.88	19.62
Excess Return (%)	5.99	11.14	3.38	4.91	0.00	7.17	4.68	8.44	8.56	6.02
Sharpe Ratio	1.07	0.93	0.61	0.33	0.00	0.56	0.33	0.56	0.66	0.31
Minimum Monthly Return (%)	-2.47	-9.59	-4.12	-10.38	0.23	-6.19	-6.82	-8.17	-8.95	-10.96
Maximum Monthly Return (%)	9.47	10.85	6.62	20.65	0.67	19.52	26.08	16.36	18.37	24.93
Correlation With INDEX	-	0.12	0.41	0.02	0.12	0.79	0.81	0.53	0.60	0.79
Correlation With SP500	0.12	-	-0.12	-0.20	0.03	0.09	0.11	0.01	0.18	0.12
Correlation With MLM	0.41	-0.12	-	0.15	0.16	0.43	0.44	0.06	0.14	0.39
Correlation With MAR Index	0.79	0.09	0.43	-0.02	0.01	-	0.94	0.74	0.82	0.97
Alpha vs INDEX (Annual)		6.45	0.97	4.54		-3.26	-5.74	-1.52	0.42	-9.91
Beta vs INDEX		0.28	0.39	-0.02		1.86	2.04	1.69	1.38	2.82

The TFI holds only futures contracts, and thus requires no direct investment except for margin requirements. As is true for other commodity indexes such as the GSCI and MLM, the TFI is constructed on a fully collateralized basis. This means that the investor is assumed to pledge enough capital to fully fund the face value of the futures contracts purchased[3]. This capital is further assumed to be held in Treasury bills, earning the Treasury Bill rate. This rate is added to the return from the trading strategy. Calculating returns in this way, the average annual return of the TFI is 11.58% with an annualized standard deviation of 5.61%. The return to the futures component alone is given in the Excess Return column as 5.99%. No commissions, bid-ask spread or other market imperfections are assumed. Thus the reported return and Sharpe ratio for the TFI cannot be directly compared to actively managed assets which are net of management fees as well as transactions costs.

Exhibit 4 compares the pro forma returns of the TFI with a number of other passive benchmarks (MLM, GSCI, Tbill, SP500) and also with several measures of active CTA performance compiled by MAR. The returns generated by the TFI are not very high on a nominal basis, but on a risk-adjusted (Sharpe ratio) basis, the TFI outperforms all the other indexes. There are considerable differences in the standard deviation of the TFI and the active CTA indexes. This

[3] The amount of capital assumed is the *maximum* amount that may be needed if all contracts are fully invested. If some of the contracts are less than fully invested, which is almost always the case, then the index is more than 100% collateralized. With the average exposure of the index at about 75%, this would imply an average collateralization of 133%.

is because CTAs typically use leverage levels of 2 or 3 to 1 ($1 in invested capital is used to purchase $200-$300 face value of futures contracts). Since the TFI is, on average, only about 0.75 times leveraged ($1 in invested capital purchases $0.75 in face value of futures contracts) the volatility of returns is considerably less.

The correlation coefficient between the TFI and the measures of CTA performance are high (MAR Dollar-Weight 0.79, Equal-weight 0.81, MAR Trend-Follow 0.79). The correlation with MAR Currency and Financial Indexes is not as strong at 0.53 and 0.60, respectively. However, a sub-index constructed by combining just the Dmark and Yen strategies as a correlation of .72 with the MAR Currency Index. The TFI index has a higher correlation with active CTA programs than other passive indexes such as the MLM and GSCI. The MLM has a correlation of just .43 with the MAR Dollar-Weight and .39 with the Trend-Following index. Furthermore, the correlation between the TFI and the MLM index is only .41. Thus although both indexes are designed to capture the return to a trend-following strategy in futures markets, their returns are not highly correlated. The GSCI has a correlation of -.02 with the MAR CTA index. A long-only index is not well suited to capture the returns generated by CTAs.

In addition to correlation, the other statistic of interest is the beta. The beta is estimated using excess returns.

$$\left(benchmark\ return_t - rf_t\right) = a + b\left(index\ return_t - rf_t\right) + e_t \qquad (10)$$

If the returns are highly correlated, then the beta coefficient can be interpreted as a leverage coefficient.[4] For the MAR Equal-weight index the estimated beta is 2.04. For the trend-following index it is 2.82, and for the MAR Dollar-weight it is 1.84. Thus these performance measures reflect a leverage factor of roughly 2-3 times that of the fully collateralized TFI.

The TFI can be levered by assuming additional funds are borrowed at the risk-free rate and invested in the strategy (or, alternatively, by posting less than 100% collateral against the derivatives positions. Based on the beta measured for the MAR Dollar-Weight Index, a leverage factor of 1.8 was employed to illustrate using the index for performance measurement. If the TFI is a good performance benchmark, then it should offer a low tracking error with the active index and a similar risk/return profile.

Exhibit 5 shows the monthly performance for the unlevered TFI in Panel 1. The MAR performance is in Panel 2. Panel 3 contains the TFI values at 1.8 times leverage. Panel 4 shows the tracking error between MAR and the levered

[4] The regression beta is $r_{AB}\, s_A / s_B$, so as the correlation tends towards 1, the beta is simply a standard deviation (or leverage) ratio.

TFI. Exhibit 5 demonstrates the similarities between the two performance measures. The returns in Panel 2 (MAR) and Panel 3 (levered TFI) have the same sign 76% of the time. They have the same sign in each of the 10 calendar years and cross-sectionally in each of the 12 months. Furthermore, both indexes have similar extreme values. For example the leveraged TFI and MAR both have large gains in June, 1988 (16.5%, 19.5%) and May, 1989 (8.0%, 10.2%) and experience sizable losses in January, 1991 (-4.9%, -4.0%). However, there are a number of months that exhibit sizable deviations, including December, 1991 (5.4%, 13.5%), May, 1990 (-1.0%, -6.2%), and March 1996 (5.5%, 0.7%).

The standard deviation of the monthly tracking errors is 2.28%, meaning that about 68% of TFI values should be within 2.28% of the MAR Index and 95% should be within 4.56%. Empirically, this prediction holds up well in the sample, with 4 of 120 tracking error observations less than 4.56% (about 96%) and 67.5% less than 2.28%. To put this level of tracking error in perspective, McCarthy and Spurgin (1998) report that the standard deviation of the monthly tracking error between the SP500 and the Fidelity Magellan fund is 1.52%. The TFI tracks the MAR Index with an average error about 50% larger than the average error between the SP500 and the Magellan fund.

The returns of the MAR and TFI indexes are comparable. Over the 10-year period the leveraged index gains 36% more in total return than MAR, which amounts to 30 basis points per month. This difference is not statistically different from zero (t-statistic of -1.44), so no conclusions can be drawn from the relative returns. However, the correlation coefficient and the beta are highly statistically significant. We can say with a high degree of confidence that MAR and TFI are capturing the same underlying return process.

Exhibit 5. Comparison of MAR CTA, INDEX, and Relative Tracking Error

INDEX (UNLEVERED)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*	*StDev*
1988	-1.54	2.20	-0.53	-0.10	1.63	9.47	-1.47	1.00	1.97	1.81	1.67	-0.08	16.04	2.88
1989	3.54	-0.29	1.36	1.04	4.74	-0.02	0.74	-1.23	-0.94	-0.61	3.27	0.96	12.59	1.90
1990	0.26	0.75	2.80	2.84	-0.26	1.12	1.98	3.77	3.46	1.18	0.06	-0.55	17.39	1.49
1991	-2.47	0.62	2.11	-1.01	-0.09	1.44	-0.96	-0.23	1.54	0.40	-0.25	3.17	4.26	1.54
1992	-1.89	0.26	1.70	-0.09	0.78	1.08	2.68	1.14	-1.48	0.62	1.23	-0.10	5.92	1.28
1993	-0.86	1.46	0.88	0.82	1.72	1.30	1.90	-0.65	0.36	0.58	2.32	2.66	12.49	1.08
1994	-1.25	0.96	1.64	0.81	-0.73	1.15	0.98	-2.16	0.15	0.34	-0.06	-1.04	0.78	1.15
1995	-0.02	1.61	4.22	0.76	1.38	-0.26	0.95	2.44	0.48	1.74	-0.35	2.50	15.45	1.33
1996	1.30	-0.39	3.26	2.29	0.02	0.74	0.35	0.15	2.44	1.84	1.74	0.50	14.24	1.13
1997	4.25	1.77	0.04	0.88	0.19	2.45	2.24	-0.75	1.19	-0.67	2.82	2.26	16.67	1.52
By Month	1.32	8.94	17.50	8.23	9.38	18.48	9.39	3.48	9.16	7.24	12.45	10.28	Average (Monthly)	
StDev	2.27	0.87	1.44	1.12	1.58	2.78	1.35	1.78	1.51	0.92	1.34	1.51	0.97	1.62

MAR Dollar-Weighted Index

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*	*StDev*
1988	-5.35	1.68	-1.21	-3.00	7.20	19.52	-4.97	1.69	0.76	1.50	0.14	-1.98	15.98	6.66
1989	3.74	-3.12	2.14	-1.27	10.24	-0.46	0.98	-3.75	-2.28	-4.49	2.63	3.58	7.94	4.15
1990	3.15	2.05	2.93	4.54	-6.19	1.36	5.42	6.27	2.91	1.79	0.81	-0.90	24.13	3.26
1991	-3.96	-0.36	5.52	-0.33	-0.91	1.95	-3.69	0.05	4.17	-0.65	0.24	13.51	15.55	4.72
1992	-5.75	-3.01	-0.25	-2.29	0.44	5.63	7.92	3.91	0.57	2.28	1.25	-1.26	9.44	3.80
1993	0.79	6.93	-1.36	3.19	1.12	2.60	4.53	-0.27	-1.00	-0.14	-0.42	2.17	18.12	2.48
1994	-2.77	-2.55	2.83	-1.31	2.90	3.58	-2.12	-3.19	1.55	0.01	1.59	-1.21	-0.70	2.45
1995	-2.14	4.12	7.87	1.68	0.90	-1.61	-2.03	1.29	-1.52	0.37	1.58	3.56	14.05	2.96
1996	3.27	-4.87	0.72	4.62	-1.82	0.70	-1.31	0.30	2.57	5.51	5.54	-1.59	13.63	3.25
1997	2.96	2.44	-0.11	-1.27	-1.01	0.36	5.23	-4.17	1.32	-0.63	1.59	2.87	9.58	2.48
By Month	-6.07	3.31	19.08	4.56	12.87	33.62	9.95	2.14	9.04	5.55	14.94	18.75	Average (Monthly)	
StDev	3.80	3.74	3.00	2.83	4.65	6.04	4.47	3.34	2.05	2.56	1.68	4.67	1.06	3.72

INDEX (1.8 LEVERAGE FACTOR)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*	*StDev*
1988	-3.30	3.43	-1.48	-0.72	2.41	16.51	-3.17	1.28	3.01	2.72	2.48	-0.68	22.49	5.19
1989	5.85	-1.05	1.92	1.35	7.99	-0.56	0.80	-2.74	-2.22	-1.62	5.36	1.20	16.28	3.42
1990	-0.07	0.81	4.51	4.57	-1.00	1.49	3.04	6.27	5.73	1.64	-0.37	-1.44	25.18	2.67
1991	-4.87	0.70	3.40	-2.20	-0.55	2.20	-2.11	-0.78	2.43	0.39	-0.75	5.45	3.32	2.80
1992	-3.66	0.19	2.79	-0.41	1.15	1.70	4.60	1.83	-2.85	0.92	1.98	-0.39	7.86	2.30
1993	-1.75	2.43	1.40	1.27	2.89	2.14	3.21	-1.38	0.44	0.85	3.95	4.59	20.05	1.95
1994	-2.45	1.49	2.72	1.19	-1.59	1.78	1.47	-4.20	-0.05	0.27	-0.49	-2.25	-2.13	2.08
1995	-0.43	2.50	7.21	0.98	2.10	-0.84	1.33	4.02	0.51	2.76	-0.99	4.16	23.32	2.40
1996	2.01	-1.03	5.53	3.78	-0.32	0.98	0.28	-0.08	4.06	2.96	2.79	0.56	21.52	2.04
1997	7.30	2.84	-0.28	1.23	0.02	4.06	3.69	-1.70	1.80	-1.54	4.72	3.70	25.85	2.73
By Month	-1.37	12.31	27.72	11.05	13.09	29.48	13.15	2.53	12.85	9.34	18.69	14.90	Average (Monthly)	
StDev	4.06	1.58	2.60	1.99	2.80	4.97	2.50	3.17	2.68	1.65	2.39	2.77	1.36	2.90

TRACKING ERROR BETWEEN MAR and LEVERED INDEX

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*	*StDev*
1988	-2.05	-1.75	0.27	-2.28	4.79	3.00	-1.80	0.41	-2.25	-1.22	-2.34	-1.30	-6.51	2.30
1989	-2.11	-2.07	0.22	-2.62	2.25	0.10	0.18	-1.01	-0.06	-2.87	-2.73	2.38	-8.34	1.84
1990	3.22	1.24	-1.58	-0.03	-5.18	-0.13	2.38	0.00	-2.82	0.15	1.18	0.54	-1.05	2.27
1991	0.91	-1.06	2.12	1.86	-0.37	-0.25	-1.58	0.83	1.74	-1.04	0.99	8.07	12.23	2.54
1992	-2.09	-3.21	-3.04	-1.88	-0.71	3.93	3.31	2.08	3.42	1.36	-0.73	-0.86	1.59	2.58
1993	2.54	4.49	-2.76	1.92	-1.77	0.45	1.31	1.11	-1.45	-0.99	-4.37	-2.43	-1.93	2.56
1994	-0.32	-4.04	0.11	-2.50	4.49	1.80	-3.59	1.01	1.60	-0.26	2.08	1.04	1.42	2.48
1995	-1.72	1.62	0.67	0.69	-1.20	-0.78	-3.36	-2.73	-2.03	-2.39	2.57	-0.60	-9.26	1.83
1996	1.26	-3.84	-4.81	0.84	-1.50	-0.29	-1.58	0.38	-1.49	2.55	2.75	-2.15	-7.88	2.35
1997	-4.35	-0.40	0.17	-2.50	-1.02	-3.70	1.54	-2.46	-0.48	0.91	-3.14	-0.84	-16.26	1.86
By Month	-4.70	-9.00	-8.64	-6.49	-0.22	4.13	-3.19	-0.39	-3.81	-3.79	-3.75	3.85	Average (Monthly)	
StDev	2.40	2.71	2.11	1.89	3.05	2.13	2.41	1.57	2.04	1.68	2.62	3.07	-0.30	2.28

Conclusion and Suggestions for Using the Index

The index was designed to satisfy two primary uses. First, it provides a means of evaluating the performance of an individual trend-following CTA or a portfolio of such CTAs. Descriptive statistics for an individual manager or fund of funds such as alpha, beta, and tracking error should be useful statistics in analyzing relative performance. Ultimately, it may be possible to tie manager compensation to performance relative to the benchmark return as opposed to the current practice of compensating managers based on absolute return. The second use of this index is to provide a daily, rather than monthly, performance measure. Most CTAs report returns on a monthly basis, and all reporting services such as MAR and Barclay report performance monthly. There is currently no means of evaluating performance on an intramonth basis. This index, with its high correlation to the actively managed indexes, can be used as an intramonth proxy for aggregate CTA performance.

The index was constructed to maximize correlation with broad measures of CTA performance. This was accomplished by constructing a diversified trend-following index using six futures contracts. The resulting correlation with MAR CTA indexes is about 0.80. It would be surprising if this figure holds at 0.80 going forward. The optimization procedure that selected the optimal strategy is almost certain to have over-fit the historical data to some degree. . The historical data set used to construct the index ended with December, 1997. It will soon be possible to conduct robust, out-of-sample tests to determine if the correlation between the TFI and active indexes has held up. It is worth noting that correlations above 0.70 were observed before an attempt was made to optimize the strategy, so it seems reasonable to assume a correlation of at least 0.70 going forward. A correlation of 0.70 would imply an r-square of 0.49, which in turn means that about half of the variation in the MAR Indexes can be explained by this model

This index represents a starting point, not an ending point in the creation of effective benchmarks for CTAs. Further research is needed to determine if the results obtained using a broad index of CTA performance hold up with individual CTAs. Research is also needed to identify if this index is useful in the formation of multi-manager CTA portfolios. Refinements to the index itself should come along one of two lines. First, modifications should be made to the trading strategy and the rollover strategy to make the index more investible. Although it is technically investible in current form, the strategy would be very difficult to replicate. Second, subindexes such as agriculture, energy, and currency should be created in order to provide a benchmark for trend-following CTAs who trade in specific markets.

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