Trend Following:

Performance, Risk and Correlation Characteristics

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Overview

I.   OVERVIEW

The growth in demand for hedge funds since 1995 has been significant. During this period, the assets invested in hedge funds grew from an estimated $100 billion to over $500 billion. Ultimately, the sustainability of this growth depends upon the relative and absolute investment performance of the hedge fund industry. Hedge funds provide sophisticated investors with access to virtually every investable asset class combined with the expertise needed to manage these complex investments.   These investors receive positive returns, enhanced diversification when combined with stocks and bonds, low volatility, and protection against significant drawdowns.   This paper discusses systematic trend following, a hedge fund style that has a 20 year track record of producing positive annual returns with low to negative correlation to most other asset classes and hedge fund strategies. Exhibit I compares the ZCM/MAR Trend Following Index versus the S&P 500 and the Lehman Treasury Bond Index since 1983.

NAV Chart
Jan 1, 1983 - Jan 31, 2003

EXHIBIT I
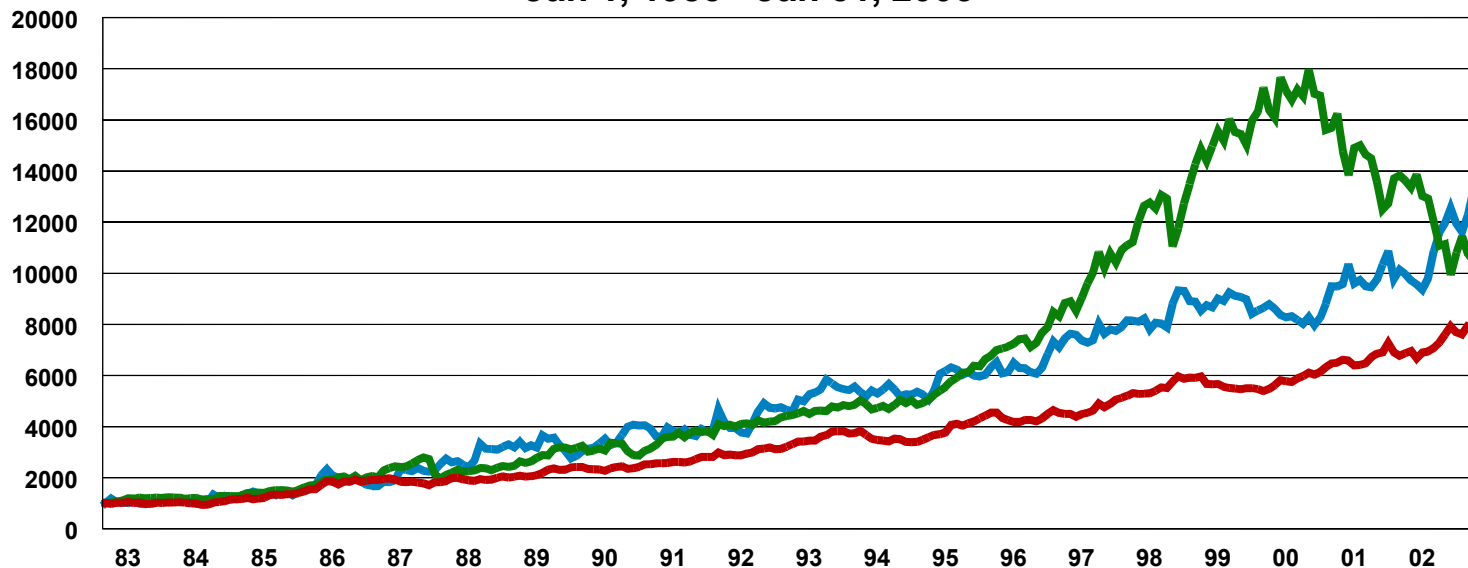
Legend:
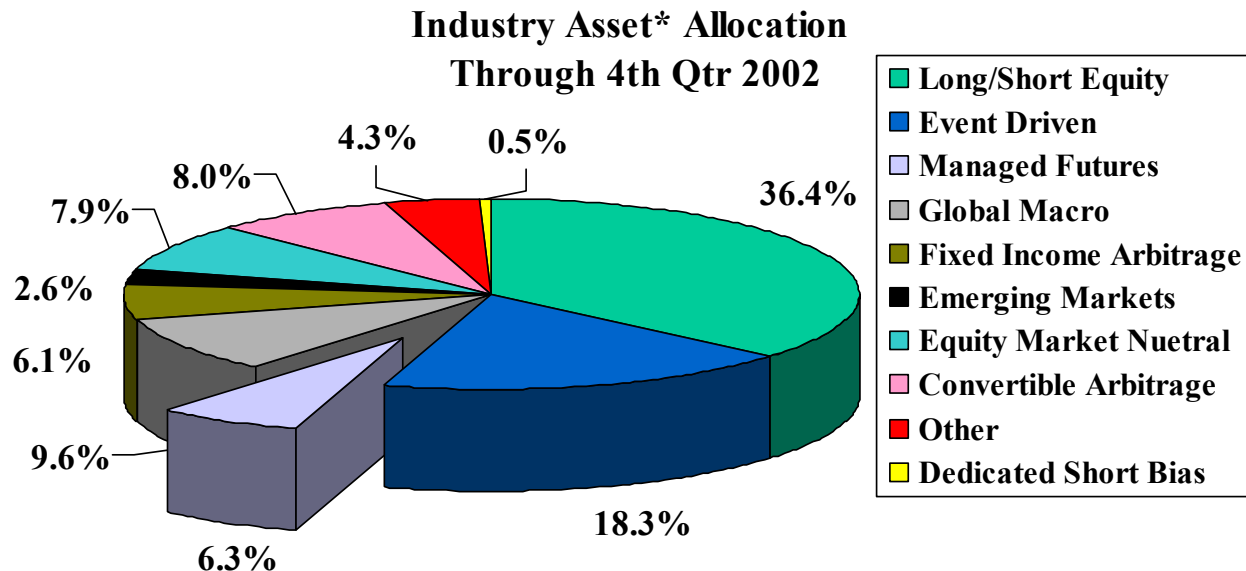- S&P 500 Total Return Index
- Lehman Brothers Treasury Bond Index
- ZCM/MAR-Trend-Follower Advisors Index

This paper discusses how trend following achieves positive performance and why it should continue to be a viable strategy. This document examines trend following in the context of a diversified fund of funds portfolio, i.e, a portfolio of investments in various hedge fund strategies. The analysis given here implies that trend following should be given a larger allocation in fund of funds portfolios than is traditionally assumed.

Systematic trend following is a "macro" strategy which trades futures and forward contracts in the currency, fixed income, equity, and commodity markets. A trend following program may trade as many as 80 different markets globally on a 24 hour basis. Trend followers try to capture long term trends, typically between 1 and 6 months in duration when they occur. Currently, there is over $40 billion allocated to the managed futures industry, with a significant percentage being devoted to trend following. Exhibit II presents the hedge fund industry percentage asset allocation as of December, 2002.

EXHIBIT II

Industry Asset* Allocation
Through 4th Qtr 2002

Legend	
■	Long/Short Equity
■	Event Driven
□	Managed Futures
■	Global Macro
■	Fixed Income Arbitrage
■	Emerging Markets
■	Equity Market Nuetral
■	Convertible Arbitrage
■	Other
□	Dedicated Short Bias

4.3% 0.5% 8.0% 7.9% 36.4% 2.6% 6.1% 9.6% 6.3% 18.3%

While trend following has a large investor base, the strategy may not be as broadly understood as many other hedge fund strategies. This publication is designed for the institutional fund of funds manager and other asset allocators who are either investors in these strategies, or are considering such an investment, and are looking to increase their understanding of them.

*Managed Futures data from Barclay Map and all other data based on estimates from Tass and other industry databases.

The futures and currency markets are the most liquid markets in the world and are accessed daily by hedgers, traders and investors. Futures and currency markets enable market participants to adjust their risk profiles almost continuously. Trend following strategies benefit from these conditions, as it enables them to diversify across many different asset classes while being able to accommodate large capacity. The ability of trend following strategies to succeed depends on two obvious but important assumptions about markets. First, it assumes that price trends occur regularly in markets. While trends do not exist in all markets most of the time, they do exist in most markets some of the time. Secondly, it assumes that trading systems can be created to profit from these trends. The basic trading strategy that all trend followers try to systematize is to "cut losses" and "let profits run".

Graham Capital has a long history of creating and investing in trend following trading strategies. In our experience, institutions and funds, who have or are deciding whether to invest in trend following, often seek better understanding about several issues. They are:

• How does trend following work?
• What is the risk-return performance of trend following on a stand alone basis?
• What are the benefits of trend following in a portfolio of other hedge fund strategies?

The paper will discuss each of these topics in order.

Section II
# Trend Following and Sources of Returns

II. TREND FOLLOWING AND SOURCES OF RETURN

A. Returns Have "Long Option" Profile[1]

Trend following has had positive returns over a 20 year period because trends occur in virtually all markets some of the time. Trend followers create quantitative models to capture these long term trends while limiting the cost of doing so. These models create an expected return profile similar to being long options. A strategy has a long option profile when the strategy limits downside losses while potentially achieving very large upside returns. For example, trend followers use stop losses to achieve limited downside exposures on their positions.   Exhibit III presents the return profiles of a hypothetical long option position compared to an actual long futures trade with a "stop loss".

EXHIBIT III
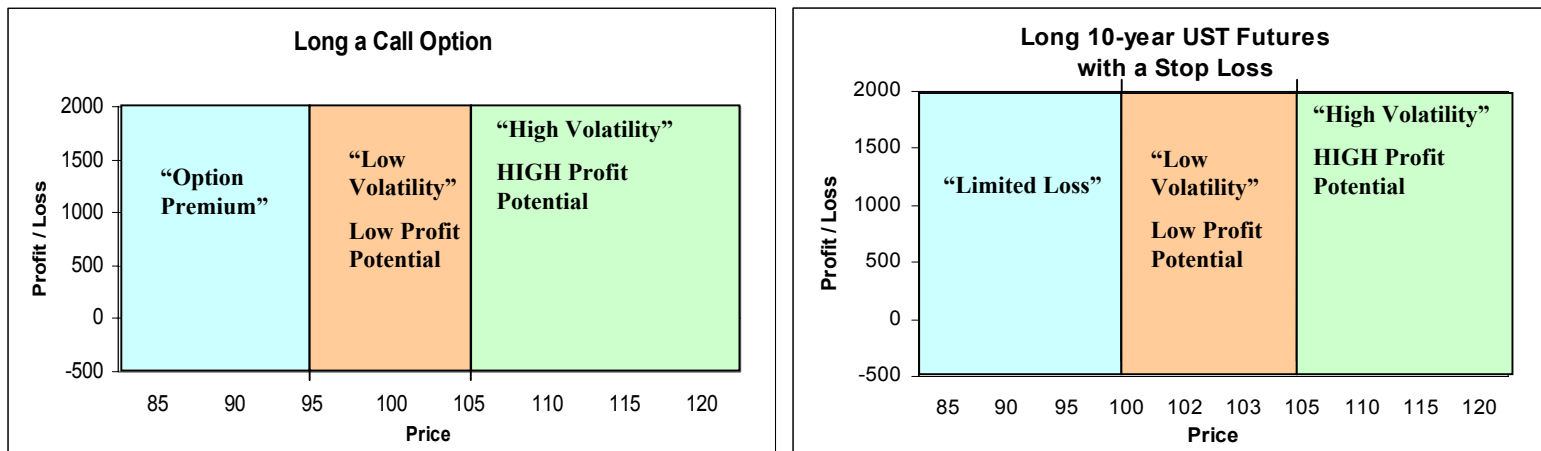
Of course, actual options have a defined maturity, while a single trend following trade is "path dependent." That is, rather than a fixed duration, its maturity is a function of how long it takes the price to reach the model's exit point. Trend followers are not trying to synthetically replicate individual options. Rather, a trend follower uses a combination of individual market strategies and portfolio design to create a synthetic portfolio of options.

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[1] "The Risk in Hedge Fund Strategies: Theory and Evidence from Trend Followers" William Fung and David A. Hsieh. The authors demonstrate that trend following returns are highly correlated with buying straddles (calls and puts) on markets, in particular, "look back" straddles.

A trend follower achieves positive returns by correctly targeting market direction and minimizing the cost of this portfolio. Thus, while trend following is sometimes referred to as being "long volatility", trend followers technically do not trade volatility, although they often benefit from it.

This return profile is also reflected in the strategy's volatility statistics. Trend followers have a significantly higher upside volatility than downside volatility. For example, the MAR trend following index has an upside volatility of 2.80% and a downside volatility of 2.05%. Strategies that exhibit this profile will usually also have "positive skew".

Trend followers will generally capture almost every ex-post long term trend that appears in any market; however, there is a cost to capturing these trends. The cost occurs when trends seem to appear but end up reversing. The amount of that cost equals the distance between the entry price of buying/selling the particular futures contract, and the stop loss price of the particular model. This trading approach is similar to being long options because the stop loss creates a limited downside, and the continuation of the trend creates the large upside. This is why the phrase for this approach to trading is to "cut losses" and to "let profits run". Of course, if trends continually fail to materialize, these limited losses can accumulate to large losses. This is also true for any option purchase strategy. For trend followers, the "option premium" is "paid" for after an unsuccessful trade is closed when a stop loss has been reached. The premium can also be "paid" after markets have moved a great deal, profits have been made, and a reversal causes a trailing stop to be hit, and some of the profits reversed. Exhibit IV provides an illustration of a trailing stop being hit after a major move in the DAX.

EXHIBIT IV

DAX Futures Contract (Back-Adjusted)
Feb, 2001 - Oct, 2001

Trend-follower Sells DAX

Trend-follower Covers Short
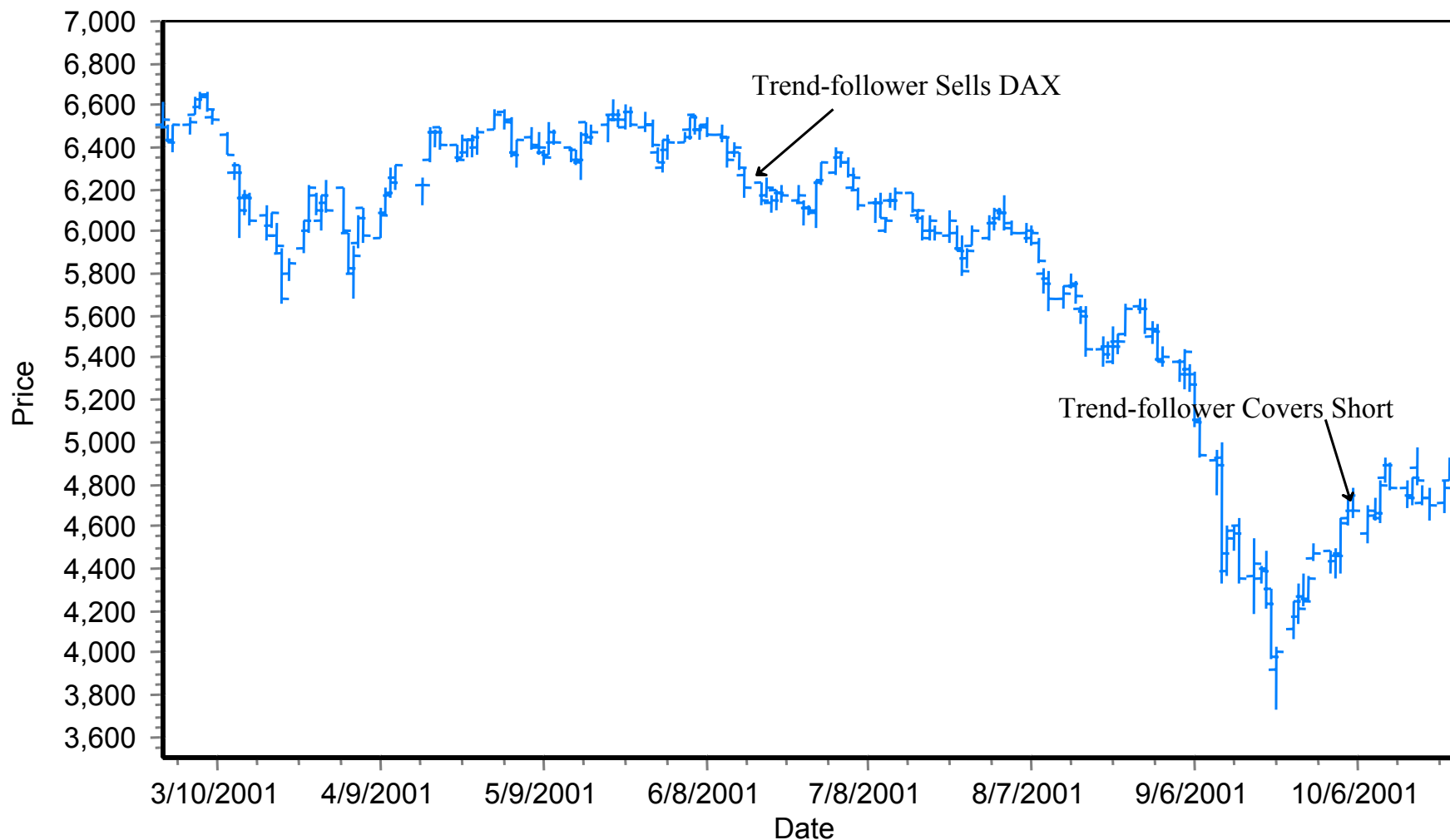
In general terms, it is easy to describe what a trend follower is trying to do, and the general way profits and losses are made. In effect, trend followers engage in a kind of long option replication strategy. Each trend follower has their own methods and models, and, as with any financial statistical activity, changing market structures will lead to evolutionary changes in models. The long option return profile, however, is common to all trend following programs.

B.   Trend Following and Quantitative Models

Trend followers use proprietary financial models to achieve returns as do many hedge fund strategies and other financial markets activities. Some hedge fund styles which rely heavily, or exclusively, on quantitative models include: statistical arbitrage, convertible arbitrage, volatility arbitrage, mortgage arbitrage, and fixed income arbitrage. Other financial markets activities which also rely heavily on statistical modeling include; reinsurance, securitization (including collateralized debt obligations, asset backed securities, and collateralized mortgage obligations), credit insurance, and asset allocation modeling and approaches.

All of these financial activities create strategies or financial instruments that can be invested in. Virtually all of them are traded or created by institutions or funds using proprietary trading models. Each of these proprietary financial models is a variation of known methodologies documented in financial literature. The same is true for trend following. There is an excellent range of academic literature documenting methodologies used by trend followers.[2] A Bloomberg terminal can access 30 different statistical measures used by trend followers and other statistical traders. These appear for virtually every instrument quoted by Bloomberg that has a price series.

There are also certain trend following strategies that provide investors with complete model transparency. Some examples include "passive" strategies. Passive strategies are usually either long or short in all traded markets at all times at fixed predetermined weights. They will use models which are more simple than "active" trend following, which is much more selective in getting long or short various markets. However, these passive strategies do provide investors with insight into trend following.

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[2] "Trading Systems and Methods" Perry J. Kaufman. Kaufman provides an excellent overview of trend following and other systematic programs in this 700 page text and provides an 11 page bibliography.

While trend followers use proprietary statistical modeling, investors still have access to its general principles. The methods used by trend followers are well documented in financial literature and can be intuitively understood. What distinguishes one manager from another, as with all investing, is how these methods are adapted and applied through time. Quantitative strategies need not be more opaque to investors than qualitative ones.

C. Speculators, Hedgers, and "Zero Sum" Trading[3]

Most securities trading can be thought of as a "zero sum" game. Futures trading, in particular, is subject to this characterization. Since futures markets are literally "derivative" instruments, and are created by the act of buying and selling, it is easy to describe a market where all futures traders' profits add up to zero. If all futures traders were just speculators trading only with each other, and only had positions in futures markets, then, by definition, all profits and losses would sum to zero (plus the interest earned on margin cash).

Applied to the world of "real" financial assets, however, this does not mean that all traders will either have absolute losses or absolute gains adding up to zero. For example, if two 60/40 Equity/Bond portfolio managers change their weightings in the market to 65/35 and 55/45 respectively, the latter will "lose" relative to the former if the equity market rises more than the bond market. However, if both markets rise, then both investors will earn an absolute positive return. One could say that relative to a 60/40 benchmark, one trader was a winner and the other trader was a loser.

To the extent the futures markets are dominated by speculators, the likelihood of total returns tending toward zero is increased. The opportunity for futures speculators as a whole to earn positive returns ultimately comes from the activity of hedgers who are an integral part of the futures market. Hedgers are usually thought of as operating businesses that hedge interest rate, currency and commodity risk. However, many active investors, traders, market makers, and arbitragers trade futures and options in conjunction with underlying financial assets.

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[3] "Some thoughts on Sources of Return to Managed Futures" Richard Spurgin. "Quantitative Analysis of Hedge Fund and Managed Futures Return and Risk Characteristics" Thomas Schneeweis and Richard Spurgin. Both articles discuss sources of returns for managed futures relating to the existence of hedgers.

Relative to futures speculators, such as trend followers, these traders also function as "hedgers". It is useful to discuss some examples because the financial community is a great source of hedging activity, which ultimately provides speculators, as a whole, with profit opportunity.

Convertible arbitrage traders buy convertible bonds and hedge interest rate and equity risk by shorting equities and interest rate instruments. The objective in convertible arbitrage is to realize the value of imbedded equity options in the convertible bond while not taking any market risk. To hedge equity risk, the entire convertible arbitrage market is selling equity in a rising market and buying equity in a falling market. While natural equity holders will be on the other side, any imbalance in supply and demand will cause specialists and market makers to take positions. This creates the potential for these intermediaries to hedge in the futures or options markets. When they do, they could be on the opposite side of the market as a trend follower entering a trade. A convertible arbitrage trader's interest rate hedging creates analogous opportunities for trend followers in bond futures markets.

Many equity investors sell index calls to generate income. The options market maker delta hedges in the futures markets. Like the convertible arbitrage trader, the options market maker is selling into rising markets and buying into falling markets, again potentially providing a buying or selling opportunity to trend followers. An institutional investor may keep a balanced 60/40 mix in equities and bonds. Every time the portfolio manager rebalances they are buying bonds or equities as they fall (relative to each other) and selling bonds or equities as they rise. They may hedge this directly in cash markets or indirectly in the bond or equity futures markets. If the former, this "program" activity may still find its way to the futures markets as bond dealers and equity market makers hedge their books.

Index arbitrage traders are continuously trading the basis between the cash markets and the futures markets. Every time they enter a trade, the arbitrager is buying or selling futures against the cash markets. They are indifferent to the direction of the market. From the perspective of the futures speculator, the index arbitrager is a "hedger". The same is true for a government bond trader who does basis trades between the bond and futures markets. A U.S. dollar based Global Macro trader may be taking a long position in non-dollar fixed income instruments. However, if the trader only wants interest rate exposure, they will sell the foreign currency and buy the dollar. If the dollar is trending down, the Macro trader is providing a trading opportunity to the trend follower.

Additionally, of course, operating businesses also engage in hedging activity in futures markets. They may hedge interest rates in anticipation of selling debt or investing cash. Cross border trade flows create an enormous amount of currency hedging outside the context of price speculative activity. Commodity growers and producers are continually using commodity futures to hedge price risk. The purpose of all hedging activity is to shed unwanted price risk of some kind. Market makers, investors, arbitragers, traders and businesses all engage in this activity. As these risks are transferred to the futures markets it creates opportunities for speculators, trend followers and non-trend followers alike, to trade in a non-zero sum environment. Only an assumption that there are always offsetting hedgers simultaneously on the other side of all other hedging activity would make this untrue.

Nor does one have to make the case, as economists since Keynes have, that there is a "natural risk premium" provided to speculators for assuming this risk transfer. It does mean, however, that investors in futures based strategies should have ample opportunity to earn a return greater than zero. The "zero sum game" hypothesis of futures trading, while true in one sense, is largely irrelevant in practice when assessing trend followers, due to the ubiquitous presence of global hedging activity. The long track record of trend followers empirically supports this conclusion.

D.   Summary

Trend following tends to create a long option, high upside volatility, positive skew return profile in global interest rate, currency, commodity, and equity markets. It uses statistical financial modeling with known quantitative techniques to capture long term trends and has a twenty year track record demonstrating its viability. Since futures markets consist of a wide variety of hedgers, speculators in these markets have an opportunity, in totality, to earn greater than a zero return. The documented historical record of trend following indicates this results in a positive expected return significantly higher than zero.

Section III
Returns and Volatility of Returns

III. RETURNS AND VOLATILITY OF RETURNS[4]

A. Annual Volatility vs. Annualized Volatility

Hedge fund data generally has much has less specificity compared with the historical price data of futures and cash markets themselves. Investors can access historical daily and even "tick" data in the cash and futures markets. Most hedge fund data is monthly and often has a relatively short history. Additionally, hedge fund index data often has both survivorship bias and non-transparency. Estimates are that the best of the hedge fund indices may overstate historical returns while the limited transparency of hedge fund portfolios means risk-return analysis can only be done by inference.

However, investors can combine their knowledge of how certain strategies work with the available hedge fund index data to make reasonable judgments. We have chosen the CSFB/Tremont database for hedge fund strategies and the ZCM/MAR trend following index for trend following. The ZCM/MAR trend following index is used because it tracks the specific performance of systematic diversified trend followers. Both indices use a market weighted approach, maintain returns for defunct or non-reporting funds, and only use forward data when a new fund is added. Since CSFB/Tremont only goes back to the beginning of 1994, any comparative data with ZCM/MAR trend following begins in 1994.

On a stand alone basis, the risk-adjusted performance of trend following indices has been lower than some other hedge fund indices. However, in certain important ways, we believe the differences between trend following and other strategies have been overstated and at times misinterpreted by the markets.

To demonstrate this observation, Exhibit V compares the compound annual returns and annualized volatility, and the average rolling 12 month returns and annual volatility of each index.

[4]"The Statistical Properties of Hedge Fund Index Returns and Their Implications for Investors". Chris Brooks and Harry M. Kat. "Stocks, Bonds and Hedge Funds: Not a Free Lunch" Guarav S. Amin and Harry M. Kat. The articles stress the importance of factoring skew, kurtosis and autocorrelation into risk-reward analysis for hedge funds. Traditional mean variance analysis will tend to understate risk for high autocorrelation, negatively skewed, and high kurtosis strategies.

EXHIBIT V

For period Jan 1, 1994 to Jan 31, 2003

Listed by Browse Name	Compound Annual Return	Annualized Volatility of Monthly Returns	Average Rolling 12 Month Return	Volatility of Rolling 12 Month Returns
CSFB/Tremont Multi-Strategy	9.25%	4.68%	1.05%	0.53%
CSFB/Tremont Equity Market Neutral	10.99%	3.17%	12.11%	4.63%
CSFB/Tremont Fixed Income Arbitrage	6.76%	4.07%	7.70%	6.14%
CSFB/Tremont Event Driven	10.65%	6.24%	11.66%	9.19%
CSFB/Tremont Convertible Arbitrage	10.49%	4.88%	11.63%	9.57%
ZCM/MAR-Trend-Follower Advisors Index	**10.03%**	**14.44%**	**9.87%**	**10.57%**
CSFB/Tremont Long/Short Equity	11.48%	11.42%	14.51%	15.06%
CSFB/Tremont Dedicated Short Bias	0.49%	18.25%	0.06%	15.10%
CSFB/Tremont Global Macro	14.23%	12.59%	17.12%	16.12%
CSFB/Tremont Emerging Markets Index	4.83%	18.40%	7.29%	23.74%

Exhibit VI compares monthly upside volatility, monthly downside volatility, skew and kurtosis for each of the hedge fund indices. Skew measures the statistical likelihood of a return in the tail of a distribution being higher (positive skew) or lower (negative skew) than that predicted by a normal distribution. Kurtosis ("fat tails") measures the statistical likelihood of there being more returns (high kurtosis) or less returns (low kurtosis) in the tails of distributions than that predicted by normal distributions.

EXHIBIT VI

For period Jan 1, 1994 to Jan 31, 2003

Listed by Browse Name	Monthly Volatility* Upside	Monthly Volatility* Downside	Upside / Downside	Skew	Excess Kurtosis
CSFB/Tremont Equity Market Neutral	0.73	0.38	1.93	0.14	0.06
CSFB/Tremont Multi-Strategy	0.80	1.36	1.71	-1.29	3.13
CSFB/Tremont Dedicated Short Bias	3.96	2.60	1.52	0.85	2.00
ZCM/MAR-Trend-Follower Advisors Index	**2.80**	**2.05**	**1.36**	**0.32**	**0.02**
CSFB/Tremont Long/Short Equity	2.51	2.08	1.20	0.25	2.95
CSFB/Tremont Global Macro	2.56	2.41	1.07	-0.03	1.62
CSFB/Tremont Emerging Markets Index	3.27	3.81	0.86	-0.48	3.25
CSFB/Tremont Convertible Arbitrage	0.73	1.42	0.51	-1.59	4.02
CSFB/Tremont Event Driven	0.92	2.35	0.39	-3.32	21.22
CSFB/Tremont Fixed Income Arbitrage	0.44	1.57	0.28	-3.21	15.82

*Volatility relative to zero return.

Exhibit VII shows the autocorrelation of each strategy's returns, based on one month lag, two month lag and three month lag. Autocorrelation is simply the correlation of a given month's returns relative to a previous month's returns.

EXHIBIT VII

Index Name	One Month Lag	Two Month Lag	Three Month Lag
CSFB/Tremont Convertible Arbitrage	0.569	0.434	0.159
CSFB/Tremont Fixed Income Arbitrage	0.409	0.102	0.027
CSFB/Tremont Event Driven	0.344	0.149	0.031
CSFB/Tremont Emerging Markets Index	0.299	0.010	-0.020
CSFB/Tremont Equity Market Neutral	0.300	0.193	0.092
CSFB/Tremont Long/Short Equity	0.159	0.060	-0.046
CSFB/Tremont Dedicated Short Bias	0.067	-0.073	-0.035
CSFB/Tremont Global Macro	0.055	0.046	0.085
CSFB/Tremont Multi-Strategy	-0.034	0.075	0.184
ZCM/MAR Trend-Follower Advisors Index	0.066	-0.111	-0.075
S&P 500 Total Return Index	-0.021	-0.040	0.097

As shown in Exhibits VI and VII, the four strategies with the largest skew, highest kurtosis and lowest upside/downside volatility (i.e., fixed income, event driven, convertible arbitrage and emerging markets) also had the highest autocorrelation. While there is no necessary statistical link between autocorrelation and these other measures (e.g., Equity Market Neutral has high autocorrelation, but no skew or kurtosis and a high upside downside volatility ratio) they appear to go together with certain trading strategies. As we will discuss below, high positive autocorrelation seems to be linked to strategies which have what we call a "short option" profile. This short option profile, in certain strategies, will also create negative skew and high kurtosis. Conversely, the two strategies with small negative autocorrelation, trend following and dedicated short bias, had a high upside/downside volatility ratio and positive skew. This is more consistent with a "long option" profile strategy.

EXHIBIT VIII

Browse Name	Modified Sharpe Ratio* (Monthly)	Modified Sharpe Ratio** (Rolling)	% Difference
ZCM/MAR-Trend-Follower Advisors Index	0.69	0.93	34.8%
CSFB/Tremont Emerging Markets	0.26	0.31	19.2%
CSFB/Tremont Multi-Strategy	1.98	1.99	0.5%
CSFB/Tremont Long-Short Equity	1.01	0.96	-5.0%
CSFB/Tremont Global Macro	1.13	1.06	-6.2%
CSFB/Tremont Event Driven	1.71	1.27	-25.7%
CSFB/Tremont Equity Market Neutral	3.47	2.61	-24.8%
CSFB/Tremont Fixed Income Arbitrage	1.66	1.25	-24.7%
CSFB/Tremont Convertible Arbitrage	2.15	1.22	-43.3%
CSFB/Tremont Dedicated Short Bias	0.03	0.00	N/A

* Annualized Return ÷ Annualized Volatility **Mean Annualized Return ÷ Annualized Volatility

Exhibit VIII compares modified Sharpe ratios for the various strategies. What stands out here in particular is that for some of the strategies there is a significant difference in the Sharpe ratios, when calculated using monthly annualized versus rolling 12 month data. The change in the Sharpe ratio of trend following compared to, for example, convertible arbitrage is significant. Sharpe ratios are usually calculated using "annualized" monthly volatility numbers.[*] This may lead to misleading inferences for strategies with returns that have high autocorrelation. This "annualization" process is most appropriate when predicting annual volatility for strategies whose monthly returns are uncorrelated to each other. Sharpe ratios calculated this way can understate or overstate actual annual risk when the underlying monthly returns of the strategy have positive or negative autocorrelation.

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[*] The "annualization" of a monthly volatility number is calculated by multiplying the monthly volatility number by an "annualization factor". This factor is sometimes called the "square root of time" (in this instance that would mean $\sqrt{12}$, or 3.46).

Long-short equity and global macro had upside/downside ratios closer to one and skews and autocorrelation closer to zero. Their Sharpe ratios stayed approximately the same. Equity market neutral seems to have an entirely different pattern. It has no skew or kurtosis and its absolute volatility numbers are very low. It also had high autocorrelation which explains why its Sharpe ratio, while still high, declined using the rolling annual method.

Strategies with high autocorrelation, negative skew, positive kurtosis and higher downside volatility will tend to have more losses (kurtosis) of greater magnitude (skew) than predicted by the "annualization" method used to calculate most Sharpe ratios. Therefore, these strategies may have overstated risk-adjusted performance when this method is used. Conversely, it appears that strategies with higher upside volatility, positive skew, positive kurtosis and negative autocorrelation will tend to have more gains (kurtosis) of greater magnitude (skew), than predicted by the "annualization" methodology.

When the Sharpe ratio calculation is done on an annual basis using rolling 12 month data, no other statistical calculation is performed and no assumptions are made about the nature of each strategies historical return profile. It is simply the annual Sharpe ratio of the strategy. Rolling 12 month returns and volatilities will tend to smooth the impact of the non-symmetrical and autocorrelated monthly returns of different hedge fund strategies. It will, therefore, capture a more representative picture of historical annual risk-reward performance than the "annualization" methodology. In Section IV, we will demonstrate that the use of rolling data may help create more optimal portfolios. The portfolios will have more balance between "long option" profile strategies (e.g., trend following) and "short option" profile strategies (e.g., convertible arbitrage) than when creating optimal portfolios based on monthly data alone.

## B. "Long Option" Profile Strategies and "Short Option" Profile Strategies

Trend following has a higher Sharpe ratio and convertible arbitrage, for example, has a lower Sharpe ratio when annual rolling numbers are used. This is due primarily to the autocorrelation of their monthly returns. Trend following's "long option" profile seems linked to its slight negative autocorrelation, positive skew, and high upside/downside volatility ratio. Convertible arbitrage, on the other hand, has a "short option" profile that appears linked to its positive autocorrelation, negative skew, high kurtosis, and low upside/downside volatility ratio. Exhibit VIII graphically depicts the monthly return distributions of both the trend following and the convertible arbitrage indices.

EXHIBIT IX

Convertible Arbitrage
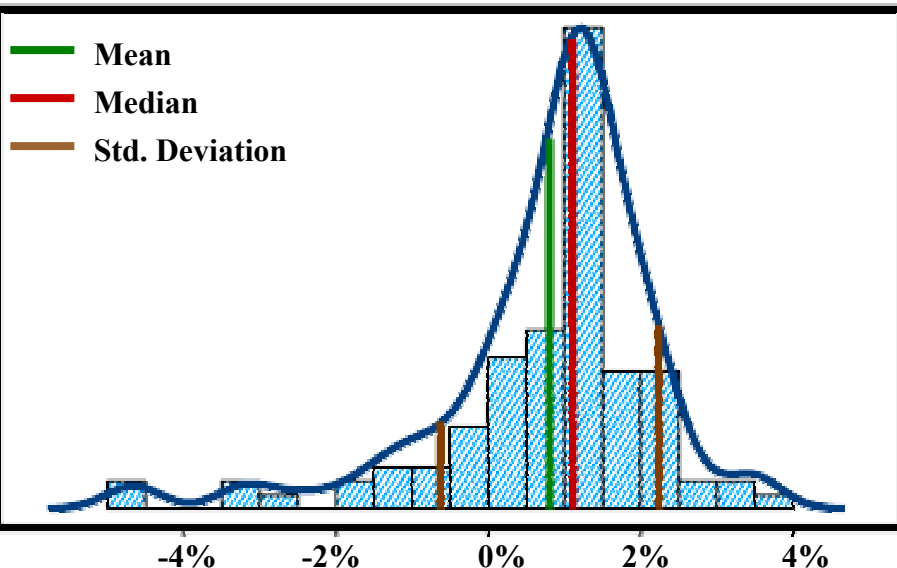
Trend-Following
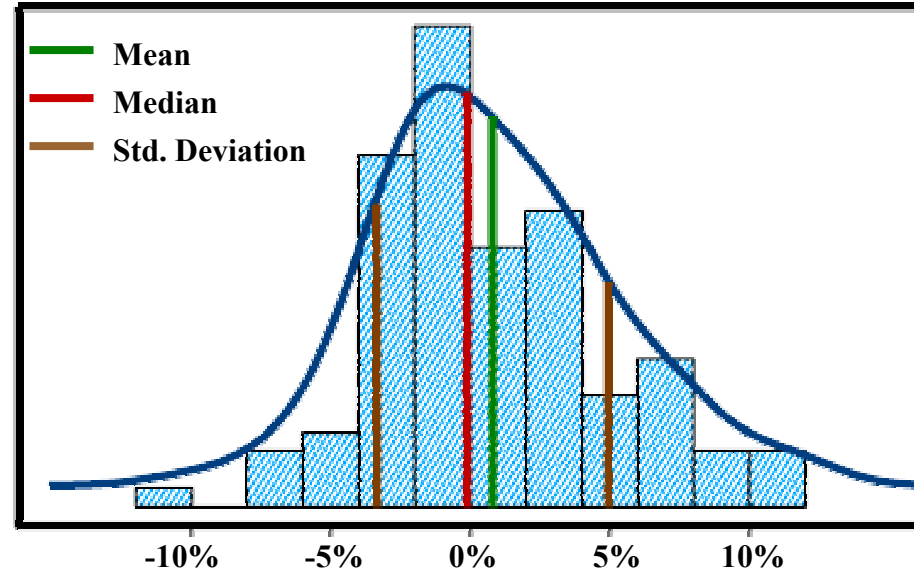
It is not necessarily apparent why a particular hedge fund strategy should tend to exhibit "optionality" or non-normal return distributions. As mentioned, there is not enough data or transparency in hedge fund indices to make definitive statements about return distributions and what causes them. Many apparent tendencies can be the result of sampling error due to lack of sufficient data. However, some strategies appear to be "designed" to have a certain distribution of returns.

Previously we explained why trend following has a long option profile. Many other hedge fund strategies clearly exhibit a "short option" profile. Credit oriented and convergence strategies and certain market neutral strategies often fit this description. Fixed income and mortgage arbitrage, emerging markets debt, risk arbitrage, distressed debt, convertible arbitrage (particularly strategies that assume significant credit risk) and mean reverting market neutral statistical arbitrage strategies are examples of strategies which can also exhibit optionality.[5] These strategies are sometimes referred to as being "short volatility". Technically, like trend following, most of these strategies do not trade volatility; however, they can be hurt by extreme volatility. To get a better understanding of what it means for a strategy to have a "short option" profile we will analyze credit oriented convertible arbitrage, and risk arbitrage.

A strategy exhibits a "short option" profile if it has a high percentage of limited upside trades or months and a low percentage of larger downside trades or months. Corporate bonds fit this description perfectly. They have a limited upside return because they earn a defined fixed coupon and are usually callable if interest rates decrease very much. In exchange for receiving a fixed cash flow, the corporate bondholder assumes a larger downside risk due to potential credit deterioration, or bankruptcy. Convertible bonds are hybrid securities whose value is typically 85% corporate bond and 15% equity option. For an arbitrager, a convertible bond has both a "short option" profile (corporate bond) and a "long volatility" (imbedded equity option) profile. However, if credit quality severely deteriorates, the bond value dominates. That is, the arbitrager will lose more money on the "bond" than made on "volatility". Additionally, convertible bonds, particularly lower credits, are not as actively traded as underlying equity markets. Monthly prices, and therefore returns, can appear more stable and consistent than they really are.[6] Of course, as the annual numbers show, convertible arbitrage still has had good risk-adjusted returns. However, "annualized" volatility numbers understate the risk of convertible arbitrage.

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[5] "Risk of Hedge Fund Strategies: Theory and Evidence from Fixed Income Funds" William Fung and David A. Hsieh. Conference on Innovation in Finance, Vanderbilt University April 11, 2002. The authors make the point that many fixed income and credit oriented strategies can be modeled as a short position in look back straddles on interest rate spreads.

[6] Brooks and Kat, ibid. The authors also discuss autocorrelation being linked to lower liquidity strategies.

The same point can be made about risk arbitrage (a major component of the CSFB/Tremont event driven index). Risk arbitragers buy equity of an acquisition target once a deal has been announced and hope to earn the remaining deal spread, while risking the much larger loss from the deal not closing. Since a very high percentage of deals close, risk arbitrage will have a high percentage of limited upside winning trades and a low percentage of large downside losing trades. Risk arbitrage has also had good risk adjusted returns. However, its "annualized" volatility numbers understate the strategy's risk.

The return profile of trend following produces the opposite impact on volatility numbers when presented on an actual annual basis than on an "annualized" monthly basis, i.e., its volatility declines. Its profile is in contrast to short option profile strategies. That is, trend following will tend to exhibit relatively more frequent negative monthly returns; however, it will also have relatively less frequent but higher upside performance. The optionality of the different strategies appears linked to the autocorrelation phenomenon and may explain why their actual annual Sharpe ratios are closer to each other than implied by the "annualization" methodology commonly used. Again, the reason is the "annualization" calculation assumes monthly returns are not correlated with each other which, for strategies with optionality, appears to be a false assumption.

C.   Summary

This section has suggested that rolling annual data better captures the historical annual risk-reward profile of hedge fund strategies. This idea will be supported by evidence presented in the following section. Rolling data also gives a good historical statistical picture of the likelihood of performance over any 12 month period. Since investors invest at any point during the year, and are likely to have at least a one year time horizon, the rolling annual method provides a reasonable probability distribution of performance, based on history, for that period.

The autocorrelation of strategies appears linked historically with their optionality characteristics. This will have important implications for portfolio construction. The annualization method of calculating Sharpe ratios appears likely to result in over allocating to "short option" strategies. This may lead to portfolios with potentially larger drawdowns, as will be seen in the optimizations performed in Section IV.

Section IV
Correlation of Returns and Portfolio Construction

IV. CORRELATION OF RETURNS AND PORTFOLIO CONSTRUCTION

A. Trend Following and Correlation

Exhibit X shows the correlation of trend following with the CSFB/Tremont indices, the S&P 500 and the Lehman Brothers Bond Index based on both monthly and the 12 month rolling data. Both approaches produce similar results.

EXHIBIT X

Correlation Analysis
Jan. 1, 1994 - Jan 31, 2003

ZCM/MAR Trend-Follower Advisors Index Versus:	Monthly	Annual
CSFB/Tremont Convertible Arbitrage	-0.12	-0.19
CSFB/Tremont Dedicated Short Bias	0.30	0.44
CSFB/Tremont Emerging Markets Index	-0.19	-0.15
CSFB/Tremont Equity Market Neutral	0.17	-0.01
CSFB/Tremont Event Driven	-0.22	-0.14
CSFB/Tremont Fixed Income Arbitrage	-0.01	0.09
CSFB/Tremont Global Macro	0.33	0.36
CSFB/Tremont Long/Short Equity	-0.10	-0.41
CSFB/Tremont Multi-Strategy	-0.05	-0.14
Lehman Brothers Treasury Bond Index	0.39	0.47
S&P 500 Total Return Index	-0.27	-0.09

Exhibits XI shows the correlation of all strategies to the S&P 500 during positive and negative performing months for the S&P.

EXHIBIT XI

Correlation Analysis
Jan. 1, 1994 - Jan. 31, 2003

S&P 500 Total Return Index Versus:	Down Months	Up Months	Difference
ZCM/MAR-Trend-Follower Advisors Index	-0.55	-0.16	0.39
CSFB/Tremont Equity Market Neutral	0.23	0.33	0.10
CSFB/Tremont Dedicated Short Bias	-0.56	-0.48	0.08
CSFB/Tremont Multi-Strategy	-0.01	-0.11	-0.10
CSFB/Tremont Global Macro	0.09	-0.05	-0.14
CSFB/Tremont Long/Short Equity	0.39	0.24	-0.15
CSFB/Tremont Convertible Arbitrage	0.30	0.06	-0.24
CSFB/Tremont Emerging Markets Index	0.49	0.12	-0.37
CSFB/Tremont Event Driven	0.58	0.13	-0.45
CSFB/Tremont Fixed Income Arbitrage	0.26	-0.25	-0.51

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Exhibit XII looks at the best and worst performing months of the S&P 500 since 1987 and compares the returns of the ZCM/MAR trend following index with the S&P 500 as well as their correlation.

EXHIBIT XII

WORST	S&P Total Return Index MONTHLY	ZCM/MAR Trend-Follower Advisors MONTHLY
Oct-87	-21.59%	1.84%
Aug-98	-14.46%	11.49%
Sep-02	-10.87%	4.81%
Feb-01	-9.12%	1.03%
Aug-90	-9.04%	8.81%
Nov-87	-8.32%	11.33%
Sep-01	-8.08%	6.03%
Nov-00	-7.88%	6.79%
Jul-02	-7.80%	6.79%
Jun-02	-7.12%	10.75%
Jan-90	-6.71%	3.13%
Mar-01	-6.34%	8.17%
Aug-01	-6.26%	3.04%
Apr-02	-6.06%	-2.16%
Dec-02	-5.88%	5.65%
Aug-97	-5.60%	-4.77%
Sep-00	-5.28%	-3.79%
Jan-00	-5.02%	1.60%
Average:	**-8.41%**	**4.47%**
Correlation Coefficient:		**-0.206**

BEST	S&P Total Return Index MONTHLY	ZCM/MAR Trend-Follower Advisors MONTHLY
Jan-87	13.51%	10.01%
Dec-91	11.44%	22.03%
Mar-00	9.78%	-2.73%
May-90	9.75%	-7.06%
Jul-89	9.03%	1.20%
Oct-02	8.80%	-4.80%
Oct-98	8.13%	-0.19%
Jul-97	7.96%	8.64%
Dec-87	7.78%	8.18%
Apr-01	7.77%	-7.42%
Nov-01	7.67%	-10.02%
Nov-96	7.56%	7.02%
Jan-89	7.33%	7.03%
Feb-98	7.21%	-0.55%
Feb-91	7.15%	-0.68%
Nov-90	6.46%	0.32%
Sep-98	6.41%	6.21%
Oct-99	6.33%	-6.35%
Average:	**8.34%**	**1.71%**
Correlation Coefficient:		**0.386**

Finally, Exhibit XIII graphs the rolling 12 month return of trend following versus the S&P 500 since 1983.

EXHIBIT XIII

Rolling Returns
Jan 83 to Jan 03
Rolling window size of 12 months

S&P 500 Total Return Index

ZCM/MAR-Trend-Follower Advisors Index

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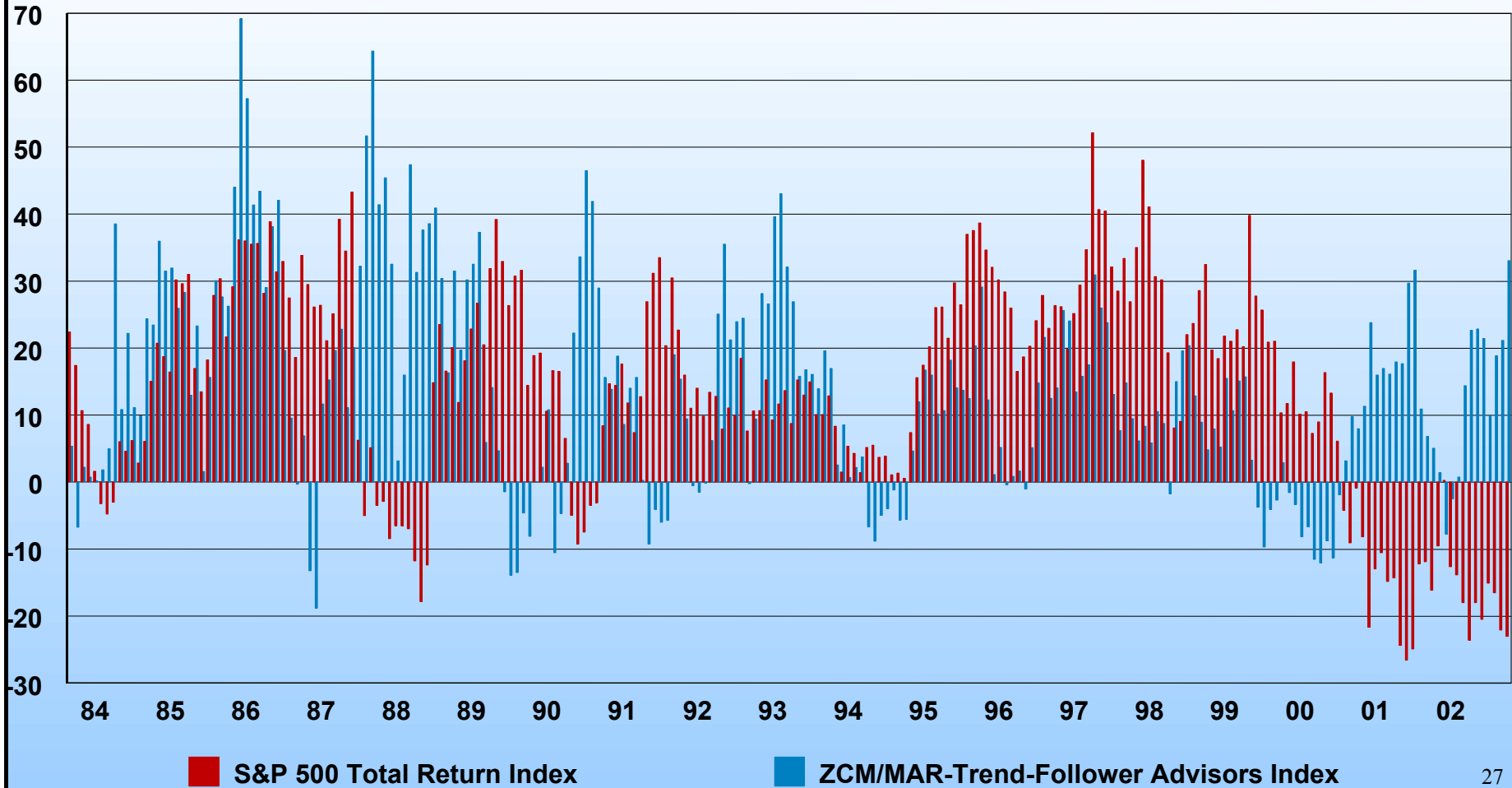
The correlation characteristics of trend following with the equity market and other hedge fund strategies is compelling for investors seeking portfolio diversification. Trend following has had positive correlation during strong periods for the S&P 500 and negative correlations during very weak periods for the S&P 500. This is what one should expect from a "long option" strategy. Trend following also has had a negative correlation to equities in bear markets while other hedge fund strategies have generally exhibited positive correlation to the S&P 500 during these same periods. While trend following has had positive returns in up and down equity markets, its greatest value to a diversified hedge fund portfolio is its strong tendency to earn positive returns during bear markets for equities.

B.   Trend Following and Bear Markets

The long option profile of trend following creates the opportunity to make large gains when markets move consistently in one direction. The stop loss models, which create this long option profile, also explain why these strategies will not have equivalent sized extended losses when significant reversals occur. The reason trend following performs so well when equity markets perform worst is both straightforward and almost tautological: some of the best trends occur in financial markets when equity markets perform poorly. This should not be surprising. When equity markets decline sharply it usually occurs during a time of a developing strong consensus about macroeconomic conditions. Depending on the perceived severity of these conditions, global financial markets will move in tandem in a highly correlated way.

The most recent example of this was the second and third quarter of 2002. A weaker than expected economic outlook in the U.S. began to create a steady decline in forward short-term interest rates, and interest rates generally, beginning in March. Combined with an expanding and worse than expected U.S. current account deficit, this created a climate for a weakening dollar. This was reinforced by a belief, already in place, that the dollar was fundamentally overvalued. The perception was that non-U.S. investors no longer had an expected rising equity market to justify the dollar's perceived overvaluation, due to the weaker economic environment. Since the U.S. has consistently run a very large and expanding current account deficit, the dollar tends to decline during times of perceived U.S. economic weakness. Equity investors, conditioned for a flat or weak equity market, responded very negatively to the repeated mini-shocks of various corporate accounting scandals. Interest rates fell, the dollar declined and the equity market declined.

A self-reinforcing cycle was created. The Fed, which was already in a neutral posture with regard to raising rates, was perceived to be even less inclined to do so as the equity markets fell, causing interest rates to decline even further. While the specific story is always different, the tendency for global macro markets to move in tandem is quite strong during a time of very negative equity markets.

Exhibit XIV lists the "peak to valley" changes in the dollar, interest rates, and the S&P 500 in each of the eight worst S&P quarters since 1987. Most of these periods of severe equity downturns were accompanied by a declining dollar and falling interest rates. The 3rd quarter of 1990 also had a 200% move up in crude oil, which occurred during the Iraq – Kuwait conflict (1990's "event"). In bear markets, there tends to be a strong consensus regarding economic conditions and these often impact markets in a highly correlated way.

EXHIBIT XIV

Date	Dollar Index	2 yr US Treasury Bond	S&P 500	ZCM/MAR Trend Following
Start	Peak/Valley	Peak/Valley	Peak/Valley	% Return
Dec-87	-13.5%	-173 bp	-31.3%	22.66
Sep-90	-6.2%	-54 bp	-18.4%	21.19
Dec-00	-7.6%	-93 bp	-12.0%	19.13
Sep-98	-6.6%	-123 bp	-19.3%	16.22
Jun-02	-10.2%	-96 bp	-15.1%	13.58
Mar-01	8.3%	-96 bp	-18.6%	9.23
Sep-01	-7.6%	-148 bp	-21.9%	8.81
Sep-99	-5.7%	37 bp	-10.6%	-2.80

C.   Bear Markets and "Events"

For markets to move in tandem there has to be a common perception or consensus about economic conditions which drives it. When a major "event" occurs in the middle of such a consensus, such as the Russian debt default of August 1998, the terrorist attacks of September 11, 2001, or the corporate accounting scandals of 2002, it will often accelerate existing trends already in place. Although it is impossible to prove a negative, an argument can be made that comparable events (for example the Russian default), would have had much less impact if they occurred when economic conditions were perceived as improving. For example, Argentina had the largest debt default in history. It defaulted December 21, 2001. Markets hardly reacted. The S&P 500 was up 19% from the September lows, the Conference Board's Consumer Confidence Index, which came out the next week, was up strongly. There was a wide consensus that the economy was close to bottoming out and that a rebound by mid-2002 was likely. If Argentina had defaulted in August 1998, the impact in the markets would likely have been significant.

The point of this example is that "events" do not happen in a vacuum. They are often defined as "events" because markets are already preconditioned to fear bad news. This is the reason trend following rarely gets caught on the wrong side of an "event". Additionally, the stop loss trading style will limit exposure when it does. When equity markets reach strong negative consensus regarding its long term outlook, any reinforcing news will drive the trend further. The series of corporate accounting frauds in the second quarter of 2002 are the "events" of the latest bear market which helped drive the market down even further.   In an optimistic economic environment, these occurrences might have been perceived as aberrations rather than symptomatic of a larger problem. Paradoxically, bear markets cause "events" more than "events" cause bear markets.

In summary, trend following, has a low correlation to most other hedge fund strategies. It also has a high negative correlation to equity markets during periods of perceived crisis in those markets. We believe this occurs because a global consensus emerges about macroeconomic conditions which cause various markets, particularly currencies, interest rates and equities to move in tandem. When this consensus is further confronted by an "event", such as a major country default, the "event" will reinforce the crisis mentality already in place and drive those trends toward their final conclusion. Because trend following generally can be characterized as having a "long option" profile, it typically benefits greatly when these occurrences happen.

D. Trend Following and Portfolio Construction

As discussed in Section III, the "annualization" method for calculating Sharpe ratios produces misleading results for hedge funds with autocorrelation. The 12 month rolling analysis performed in Section III implies that the annualization of monthly data results in highly overstated Sharpe ratios for hedge fund strategies with positive autocorrelation. Since these strategies also seem to be characterized by short optionality, the risk measurement methodology has important implications for portfolio construction. If the measurement methodology relies on annualized returns and volatilities, it will tend to over allocate to "short option" profile strategies (e.g., fixed income or convertible arbitrage) and under allocate to "long option" profile strategies, (e.g., trend following), as a whole, when constructing high Sharpe ratio portfolios.

This can be demonstrated by performing comparative optimizations. The analysis in this section consists of four different pairs of optimizations (eight in total). The first two pairs optimizes the nine CSFB/Tremont hedge fund and the ZCM/MAR trend following indices. The first two optimizations compare the absolute highest Sharpe ratio portfolios using two different methods. One portfolio is optimized to create the highest annualized monthly Sharpe ratio and the other portfolio is optimized to create the highest rolling annual Sharpe ratio. These portfolios produce very different results which are then compared across a variety of monthly statistics. The second "pair" of optimizations sets a target rate of return of 10% for the same ten indices and again performs the same comparative analysis to find the highest Sharpe ratio portfolios using the two different methods of calculating these ratios.

The next two pairs of optimizations are performed on the same data, except the three lowest return indices are eliminated (dedicated short bias, emerging markets, and fixed income). Again, the optimizations compare the absolute highest Sharpe ratio portfolios using the two methods: optimizing based on the highest annualized monthly Sharpe ratio and optimizing based on the highest rolling annual Sharpe ratio. The final optimization sets a target rate of return of 11% for the reduced set of indices and again performs the same comparative analysis.

The data used for all optimizations were for the period beginning January 1994 and ending January 2003. The only constraint put on the optimizations was that no strategy could be allocated less than 5% or more than 30%. Each portfolio was rebalanced monthly to achieve the initial weightings on an ongoing basis. "Portfolio 1" is always the designation for the four optimized portfolios creating the highest annualized monthly Sharpe ratio. "Portfolio 2" is always the designation for the four optimized portfolios creating the highest rolling annual Sharpe ratio.

The first analysis below seeks to find the highest absolute Sharpe ratio by optimizing among the nine total indices. Portfolio 1 was optimized using the traditional method which optimized based on monthly returns, volatility and correlations. Portfolio 2 was optimized based on rolling annual returns, volatility and correlations.

Exhibit XV compares returns and Sharpe ratios for the two portfolios.

EXHIBIT XV

	Portfolio One Monthly Optimization	Portfolio Two Rolling 12 Month Optimization
Returns		
Annualized Monthly	9.44%	9.61%
Rolling Annual	10.24%	9.85%
Volatility		
Annualized Monthly	2.77%	3.33%
Rolling Annual	5.18%	4.52%
Modified Sharpe		
Annualized Monthly	3.41	2.89
Rolling Annual	1.97	2.18

By definition, Portfolio 1 had a higher Sharpe ratio when calculated using annualized monthly returns and monthly volatilities. Conversely, also by definition, Portfolio 2 had a higher Sharpe ratio when calculated using rolling annual returns and rolling annual volatility.

The two methods for calculating the Sharpe ratio results in very different answers. For example, Portfolio 1's Sharpe ratio declines from 3.41 to 1.97 simply by changing the method of calculation to using rolling annual returns and rolling annual volatility. When the "annualized" monthly Sharpe ratios are compared, Portfolio 1 appears better: 3.41 vs. 2.89. However, when the rolling annual Sharpe ratios are compared Portfolio 2 appears better: 2.18 vs. 1.97. As stated in the previous section, we believe the rolling 12 month numbers gives a more accurate picture of actual historical Sharpe ratios.

GRAHAM CAPITAL MANAGEMENT
Global Alternative Investment Strategies

As seen in Exhibit XVI Portfolio 1 has a 9.2% allocation to convertible arbitrage and a 5% allocation to trend following, while Portfolio 2 has a 5% allocation to convertible arbitrage and an 16.3% allocation to trend following. Is there another way to compare the two portfolios, besides the two methods of calculating Sharpe ratios, to get a sense of which one has the better risk-reward performance?

EXHIBIT XVI
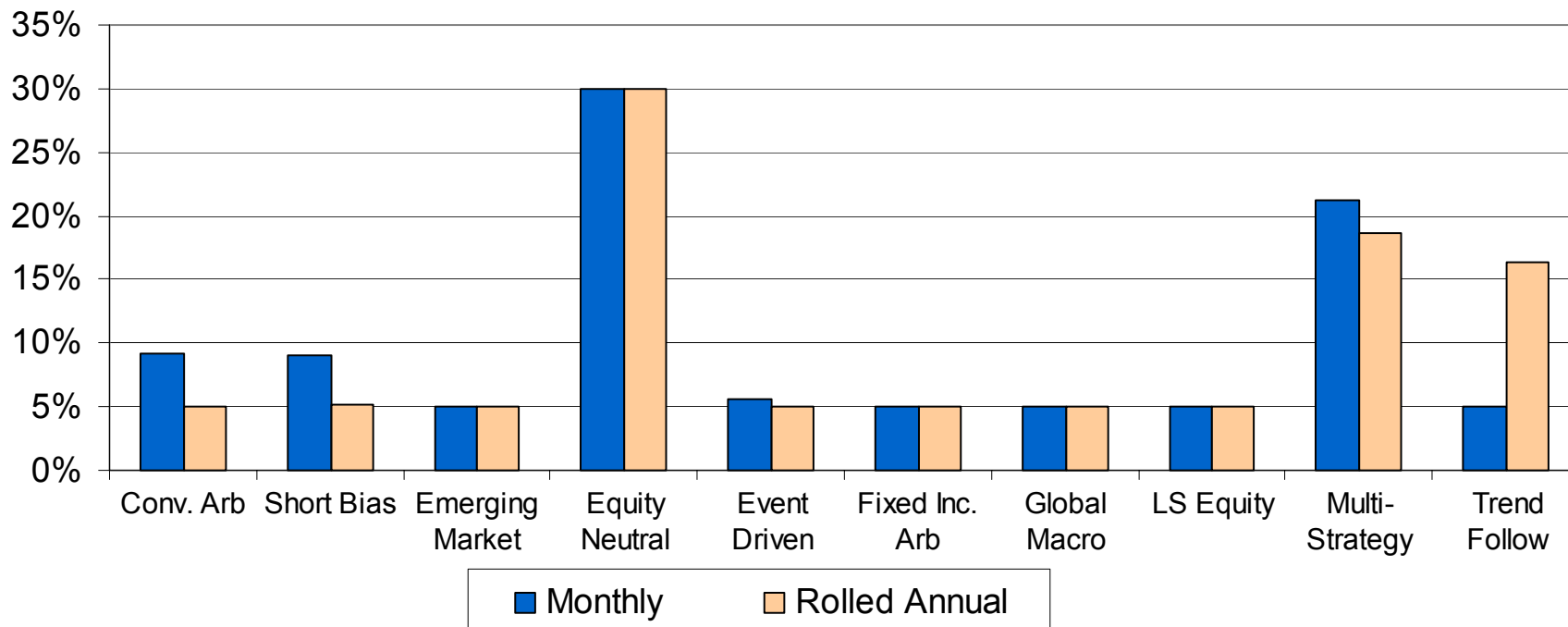
To determine this, the two portfolios were evaluated by comparing their monthly performance since 1994 using a variety of different measures. Exhibit XVII gives the results.

EXHIBIT XVII

	Portfolio One Monthly Optimization	Portfolio Two Rolling 12 Month Optimization
Monthly Returns		
Mean	0.76%	0.77%
Median	0.77%	0.66%
Volatility		
Upside	0.63%	0.79%
Downside	0.50%	0.42%
Ratio	1.26	1.88
Sortino Ratio*	5.54	6.67
MAX Drawdown	3.50%	1.34%
Calmar Ratio	2.71	7.19
Skew	-0.18	0.28
Kurtosis	0.78	-0.13
Avg. Win	0.98%	1.10%
Avg. Loss	-0.38%	-0.41%
Winning Months/Year	10.00	9.40

*Annualized Return/Annualized Downside Volatility

As can be seen in this exhibit, Portfolio 2 does appear to have better statistical performance. Portfolio 2 had a higher upside volatility, lower downside volatility, higher average winning month, lower average losing month, positive skew, lower kurtosis, higher Sortino ratio and a significantly lower maximum drawdown. Portfolio 1 was superior in that it had 10 winning months per year vs. 9.4 winning months per year for Portfolio 2. For any investor with longer than a few month time horizon, Portfolio 2 appears superior. Yet as seen in Exhibit XV, the traditional method of calculating Sharpe ratios makes it appear as if Portfolio 1 had the best risk reward performance. Optimizing using rolling annual data created a superior portfolio because, through its natural smoothing effect, it better captured the impact of autocorrelation, skew, kurtosis and upside/downside volatility. It created a portfolio with superior performance characteristics than the traditional method which is biased toward "short option" profile strategies.

The second pair of optimizations was performed on the same hedge fund indices, except in this instance the annual returns were set equal at 0.80% per month (about 10% per year). The same constraints of a minimum 5% and a maximum 30% was used. The results are presented in Exhibits XVIII, XIX, and XX. As can be seen from the data, the same pattern exists as in the first optimization. Once again, as seen in Exhibit XVIII, the two methods for calculating Sharpe ratios for Portfolio 1 results in significantly different results. The annualized monthly method produces a 3.21 Sharpe ratio versus 1.74 for the rolling annual method. For Portfolio 2, the Sharpe ratios are similar using either method. The annualized monthly method makes Portfolio 1 appear better, while the rolling annual method makes Portfolio 2 appear better. Portfolio 2 had a rolling annual Sharpe ratio of 2.14 versus 1.74 for Portfolio 1.

EXHIBIT XVIII

	Portfolio One Monthly Optimization	Portfolio Two Rolling 12 Month Optimization
Returns		
Annualized Monthly	10.03%	10.03%
Rolling Annual	11.41%	10.46%
Volatility		
Annualized Monthly	3.12%	4.05%
Rolling Annual	6.56%	4.89%
Modified Sharpe		
Annualized Monthly	3.21	2.47
Rolling Annual	1.74	2.14

Exhibit XIX shows that Portfolio 1 has a large allocation to convertible arbitrage and a low allocation to trend following while Portfolio 2 allocates a large amount to trend following. The difference between the two portfolios comes from a reduction in convertible arbitrage, and an increase in trend following and long-short equity.

EXHIBIT XIX
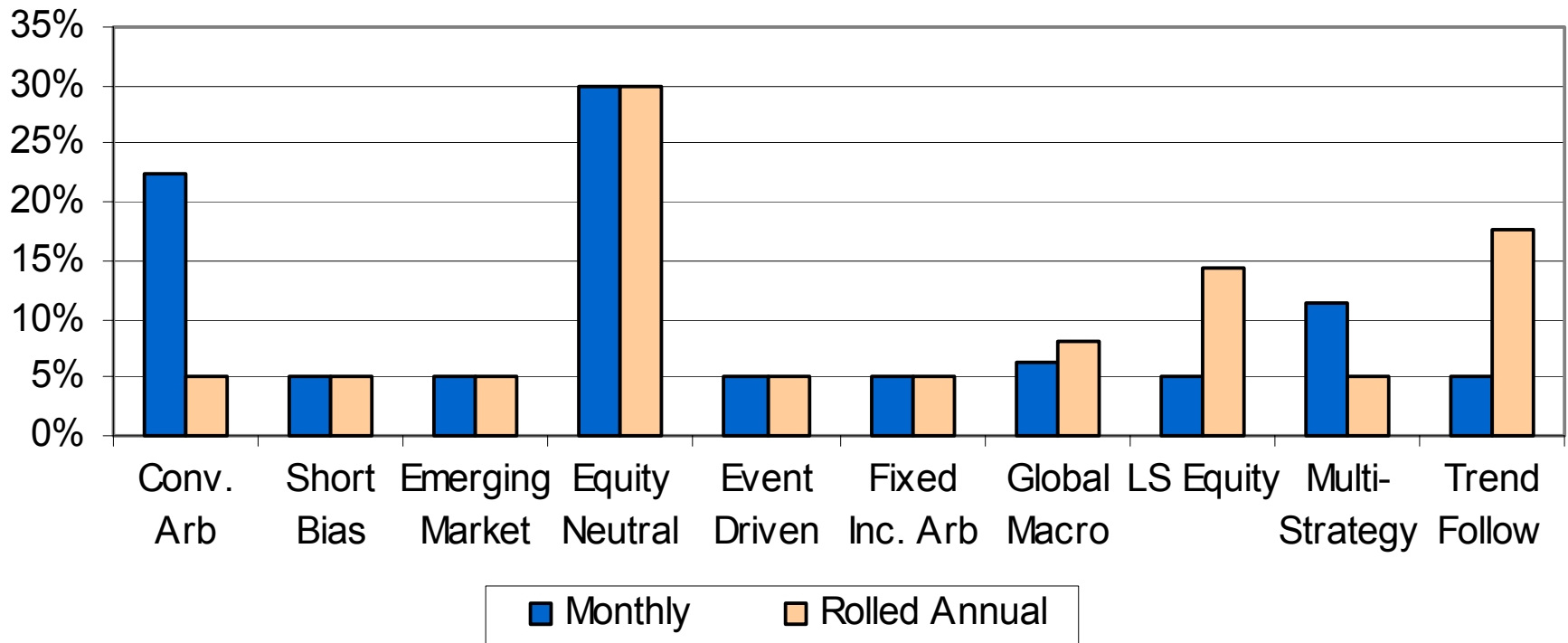
As can be seen in Exhibit XX, Portfolio 2 has a better risk-reward profile than does portfolio 1. Portfolio 1 has more winning months per year but Portfolio 2 has better upside volatility, lower max drawdown, a higher Sortino ratio, higher average winning month, lower average losing month, positive skew and lower kurtosis. It appears that Portfolio 2, which has the higher allocation to trend following, is the better risk-adjusted portfolio.

EXHIBIT XX

	Portfolio One Monthly Optimization	Portfolio Two Rolling 12 Month Optimization
Monthly Returns		
Mean	0.80%	0.80%
Median	0.79%	0.60%
Volatility		
Upside	0.68%	0.95%
Downside	0.64%	0.47%
Ratio	1.06	2.02
Sortino Ratio	4.51	6.21
MAX Drawdown	3.98%	1.76%
Calmar Ratio	2.51	5.68
Skew	-0.33	0.46
Kurtosis	1.23	0.20
Avg. Win	1.07	1.30%
Avg. Loss	-0.55%	-0.52%
Winning Months/Year	10.0	8.7

In the third pair of optimizations, the three worst performing portfolios were eliminated from the data. Emerging market, dedicated short bias and fixed income were taken out of the optimizations. The portfolio was constructed with convertible arbitrage, equity market neutral, event driven, global macro, long-short equity, multi-strategy and trend following. Again, two comparative optimizations were performed. Portfolio 1 was constructed using monthly data and Portfolio 2 was constructed using rolling annual data. In this optimization the portfolios with the highest absolute Sharpe ratios were chosen using the two methods. A 5% minimum and 30% maximum were imposed as constraints.
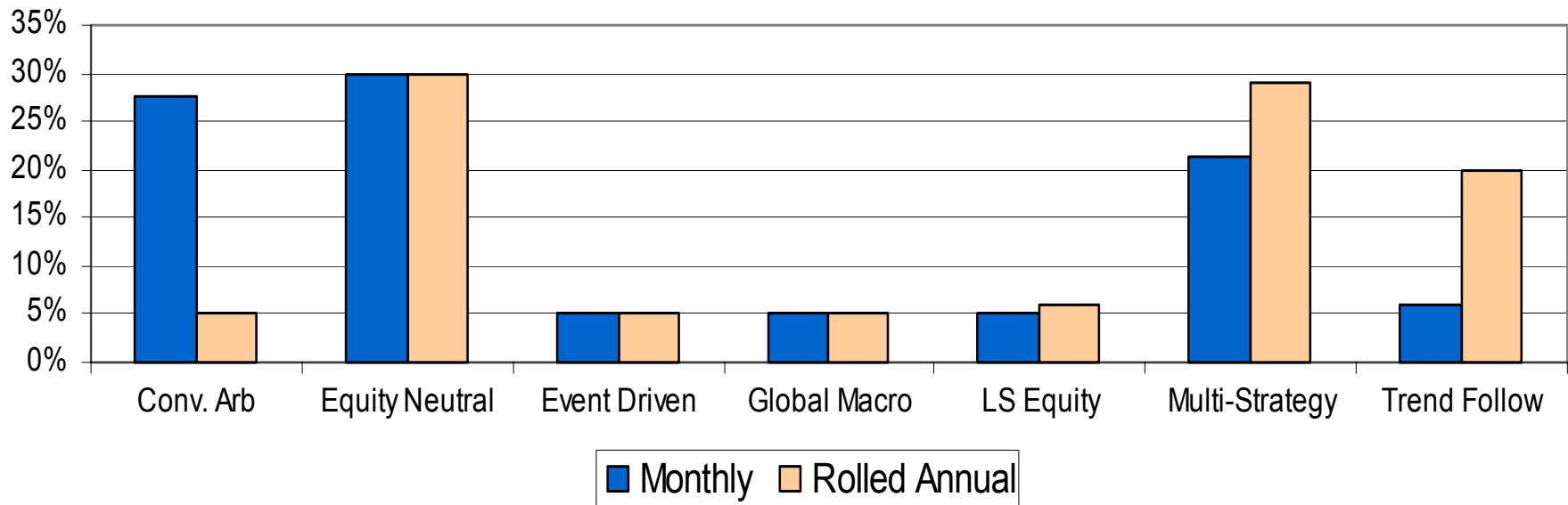
EXHIBIT XXI

	Portfolio One Monthly Optimization	Portfolio Two Rolling 12 Month Optimization
Returns		
Annualized Monthly	10.64%	10.24%
Rolling Annual	12.31%	10.50%
Volatility		
Annualized Monthly	3.19%	3.64%
Rolling Annual	6.76%	4.30%
Modified Sharpe		
Annualized Monthly	3.34	2.81
Rolling Annual	1.82	2.44

Again, the most interesting result in Exhibit XXI, is the difference in the Sharpe ratio for Portfolio 1 when calculated using the two different methods. Portfolio 2 has similar Sharpe ratios regardless of the method used and once again the rolling annual method produced a better Sharpe ratio of 2.44 vs. a 1.82 Sharpe ratio for Portfolio 1.

As shown in Exhibit XXII, trend following had a higher allocation in Portfolio 2 than Portfolio 1, again coming largely from convertible arbitrage, a "short option" profile strategy.

EXHIBIT XXII

When the two portfolios in Exhibit XXIII were compared side by side using monthly data, Portfolio 2 has the better risk-reward profile. Upside/downside volatility, Sortino ratio, max drawdown, skew, kurtosis, average win, and average loss were all better in Portfolio 2. Again, for a time horizon longer than a few months, the risk-reward profile of Portfolio 2 seems better.

EXHIBIT XXIII

	Portfolio One Monthly Optimization	Portfolio Two Rolling 12 Month Optimization
Monthly Returns		
Mean	0.85%	0.82%
Median	0.88%	0.76%
Volatility		
Upside	0.69%	0.83%
Downside	0.62%	0.43%
Ratio	1.11	1.93
Sortino Ratio	4.93	6.94
MAX Drawdown	4.29%	2.40%
Calmar Ratio	2.49	4.29
Skew	-0.40	0.23
Kurtosis	0.77	0.01
Avg. Win	1.10%	1.18%
Avg. Loss	-0.64%	-0.61%
Winning Months/Year	10.2	9.6

Lastly, the final optimization was performed using the same reduced set of hedge fund strategies as the previous optimization. In this instance the returns were set equal to 0.88% per month (about 11% per year). As can be seen from the next three exhibits, the results of this set of optimizations is effectively the same as the previous three performed above.

EXHIBIT XXIV

	Portfolio One Monthly Optimization	Portfolio Two Rolling 12 Month Optimization
Returns		
Annualized Monthly	11.09%	11.09%
Rolling Annual	12.97%	11.61%
Volatility		
Annualized Monthly	3.64%	4.88%
Rolling Annual	7.36%	5.08%
Modified Sharpe		
Annualized Monthly	3.05	2.27
Rolling Annual	1.76	2.29

As seen in Exhibit XXIV, Portfolio 1 has a much higher annualized monthly Sharpe ratio than it does rolling annual. Similarly, again, Portfolio 2 has a similar Sharpe ratio regardless of the method used and a higher rolling annual ratio than Portfolio 1.

As with the other three optimizations, Portfolio 2 has a higher allocation to trend following. As expected, the increase in trend following comes primarily at the expense of the "short option" profile strategy, convertible arbitrage.
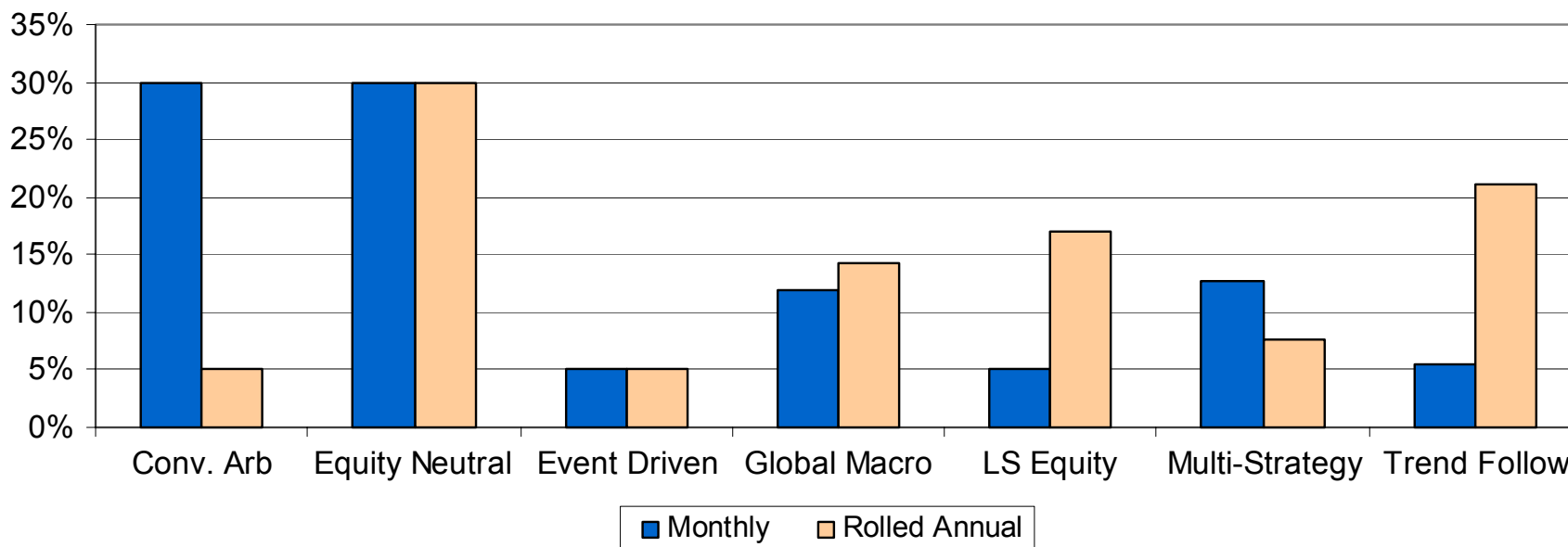
EXHIBIT XXV

Exhibit XXVI below compares the two portfolios on the same set of measures as the previous portfolios. Portfolio 2, which was optimized using rolling annual numbers, has the same improved portfolio characteristics as do the other portfolios with a greater trend following allocation: higher Sortino ratio, lower max drawdown, positive skew, lower kurtosis, higher upside/downside volatility ratio, etc. As with the other optimizations, Portfolio 2 had one less winning month per year than Portfolio 1.

EXHIBIT XXVI

	Portfolio One Monthly Optimization	Portfolio Two Rolling 12 Month Optimization
Monthly Returns		
Mean	0.88%	0.88%
Median	0.84%	0.66%
Volatility		
Upside	0.78%	1.18%
Downside	0.73%	0.57%
Ratio	1.07	2.07
Sortino Ratio	4.38	5.60
MAX Drawdown	5.87%	2.13%
Calmar Ratio	1.89	5.21
Skew	-0.29	0.55
Kurtosis	1.31	0.26
Avg. Win	1.21%	1.43%
Avg. Loss	-0.67%	-0.71%
Winning Months/Year	9.9	8.9

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Each of the four optimizations that solved for the highest rolling annual Sharpe ratio resulted in a portfolio with better risk-reward performance for investors with a time horizon longer than a few months. This supports the proposition that the rolling annual method is more accurate than the annualization method for calculating Sharpe ratios for hedge fund strategies. These portfolios all had higher allocations to trend following, lower maximum drawdowns and higher Sortino ratios. Contrary to certain investor perceptions, increased allocations to trend following appears to create a more risk averse portfolio. A portfolio with a higher probability of a lower drawdown should be considered preferable to the investor, everything else being equal. Conversely, if one wanted, through leverage, to set the maximum drawdown of the four "Portfolio 2's", equal to that of the four "Portfolio 1's," the investor would have achieved a materially higher return at the same drawdown level.

The above analysis is obviously not meant to suggest these optimized weights are what is actually recommended for a particular portfolio. This ultimately depends on a variety of factors including individual manager selection, relative risk weightings in each strategy, forward forecasts of market conditions for each strategy, and targeted absolute return and risk levels. However, we do believe that an analysis which includes the positive portfolio characteristics of trend following, as presented in this document, will result in investors having improved performance by allocating to trend following.

E. Summary

Trend following, due to its "long option" profile, has positive correlation to equity markets when the latter performs extremely well and negative correlation when the equity markets do poorly. However, trend following strategies' greatest value to a well-diversified portfolio occurs when equity markets perform their worst. The reason is that trend following is one of only two strategies that has significant negative correlation to equity markets when they decline severely. Most other hedge fund strategies, except for short selling, have had positive correlation with bear equity markets.

The correlation qualities of trend following, while recognized by the hedge fund community, have at times nevertheless been undervalued. We feel this is due to the tendency of the industry to not sufficiently factor autocorrelation, skew, kurtosis, and upside/downside volatility into risk-reward analysis. This document shows that the rolling annual method is an effective way to capture these statistical features. When these are factored in, trend following's unique "long option" and negative correlation profile can be seen to add significant value to a diversified portfolio of hedge fund investments.

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The method developed in this paper, which uses rolling annual data, is both intuitive and easy to implement and brings out the value of trend following. Despite trend following's relatively higher stand alone volatility, when added to a diversified portfolio of hedge funds, it helps to create a more risk averse portfolio for time horizons longer than a few months.

Section V
Conclusion

V. CONCLUSION

As long as trends appear in global markets, trend followers will earn positive returns. Additionally, as long as hedgers exist, there will be ample opportunity and capacity for futures traders as a whole to be profitable.

While trend following, on a stand alone basis, has had a higher volatility profile than many other hedge fund strategies, this difference may have been overstated. When calculating Sharpe ratios by "annualizing" monthly volatility numbers, one does not capture the the autocorrelation of returns inherent in many hedge fund strategies. The practical effect of this has been to over value "short option" profile strategies and undervalue "long option" profile strategies when evaluating risk-reward performance. By using a rolling 12 month methodology, which tends to smooth data, one can effectively capture the impact of optionality in measuring the risk-reward profile of a strategy.

Trend following's second unique quality, which is related to its "long option" return profile, is its correlation characteristics. It is one of the only strategies which is negatively correlated to stocks during negative equity markets and which also exhibits an increase in correlation when equity markets are very positive. However, its largest benefit to a diversified portfolio of hedge funds arises from its high negative correlation when the equity market declines.

Proper hedge fund portfolio construction requires forecasting returns, correlation, volatility, as well as individual hedge fund and overall portfolio optionality. This paper has provided evidence, through a rolling 12 month methodology, that portfolios which are constructed with a meaningful allocation to trend following can create more risk averse investments. If portfolio construction relies only on monthly returns, volatility and correlations, they may ignore the effects of autocorrelation, skew, kurtosis and upside/downside volatility, thus creating sub-optimal portfolios for time horizons longer than a few months. Asset allocaters should explicitly factor in these statistical elements when determining their optimal portfolios. If they do, it will likely result in a higher allocation to trend following than previously considered.

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