

Measuring Hedge Fund Risks

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This research paper shows that volatility is an incomplete measure of hedge fund risks, and the Sharpe ratio is also not a reliable index of risk-adjusted performance. The paper uses a dataset of monthly hedge fund index returns provided by TASS, to investigate risk and performance. It demonstrates that hedge funds are highly attractive according to the mean-variance approach. However, they lose most of their attraction when skewness and kurtosis are taken into account. Jarque-Bera test of the normality of hedge fund returns rejects the hypothesis of normality for all the hedge fund categories except Equity Market Neutral and Managed Futures. Consequently, Sharpe ratios overestimate the performance of hedge funds. It also reveals that Equity Market Neutral is the best strategy in term of returns, standard deviation, Sharpe ratio, skewness and kurtosis.

Introduction

Since the 1990s, we have observed a substantial growth of hedge funds. According to Hedge Fund Research (HFR), in 2006, assets under management accounted for \$1.4 tn, and 10,500 hedge funds existed. The European hedge fund industry has enjoyed significant development. Assets under management ranged from \$1 tn in 1995 to \$75 tn in 2002 (Capocci, 2004). Since 2000, investors have been looking for new investments. They are particularly interested in alternative investments. According to Bank of New York and Quirk & Associates LLC, in 2006, investors' demand for hedge funds was \$300 tn against \$60 tn in 2004.

This craze for hedge fund industry and the absence of regulation, emphasize the importance of understanding the risks underlying hedge funds. Volatility and Sharpe ratio are the main risk measure and risk-adjusted performance measure that are used. But, these indicators are not adapted to hedge funds. However, they are widely used. ING Private Banking gives to its potential clients commercial pieces of information, whereby risk is identified to volatility.

Whereas newspapers inform about hedge funds only when some of them have registered extreme losses, presentations made to the investors do not give any information of that kind of risk. According to an Edhec Survey (2004), 84% of the 61 multi-managers interviewed, confused risk with volatility.

The literature about hedge fund returns analysis concludes that the mean-variance approach is not adequate to investigate hedge funds risk and performance.

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Fung and Hsieh (1997), Brooks and Kat (2001), and Amenc and Martellini (2003) demonstrated that the monthly returns distribution of hedge fund strategies present negative skewness and excess kurtosis. According to Kat (2003), volatility underestimates hedge fund risks. Indeed, volatility does not give any information about asymmetric distribution of returns and extreme losses.

But, as noticed by Scott and Horvath (1980), investors are interested in higher moments of the distribution function. Their satisfaction increases with uneven moments (mean and skewness) and decreases with even moments (standard deviation and kurtosis). Kat and Menexe (2003) noticed that, the hedge fund returns distribution disqualifies the use of Sharpe ratio as a risk-adjusted performance measure, as it overestimates the performance of hedge funds.

This paper shows that volatility is not a thorough measure of hedge fund risk, which makes the Sharpe ratio an inadequate gauge of performance.

Firstly, the paper presents hedge funds data, and then makes a comparison between the hedge fund returns and market indexes performance. Secondly, it studies the normal distribution function to see whether the hedge fund returns follow it or not. Finally, it focuses on an alternative risk measure and risk-adjusted performance indicator.

Hedge Funds Data

Due to their private nature, hedge funds do not have to disclose their results. Fortunately, some hedge funds agree to provide some information, but not all of them. Consequently, hedge funds databases do not represent the whole universe of hedge funds, that is, they are not complete. Thus, hedge funds databases are biased. Different sorts of bias have been detected.

- Self-reporting bias means that databases are incomplete. As a matter of fact, funds that have enough assets under management do not need to attract further investors. Thus, they are not willing to disclose their results.
- Database selection bias exists because databases have their own hedge funds selection criterion. According to Lhabitant (2006), only 3% of funds are reported jointly in HFR, MSCI, TASS and CISDM databases.
- Survivorship bias exists because databases incorporate only existing funds in their indexes calculation. Defunct funds are not taken into account. Subsequently, hedge fund indexes returns are overestimated. Fung and Hsieh (2002), assessed the survivorship bias to be 3% for TASS database for the period, 1994-1998.

Heterogeneous approaches of data providers generate different hedge fund performance results.

To perform the empirical analysis, we use 10 CSFB/Tremont monthly performance subindexes split by investment styles and an aggregate index, which encompasses all the hedge fund strategies and spans over the period, January 1994-January 2008.

The CSFB/Tremont indexes are based on the TASS database that tracks 2,600 funds. Then, CSFB/Tremont uses data reported by 650 funds to calculate the 10 indexes. The CSFB/Tremont indexes are asset-weighted indexes and measure the net of fee returns. There are three strict rules for fund selection:

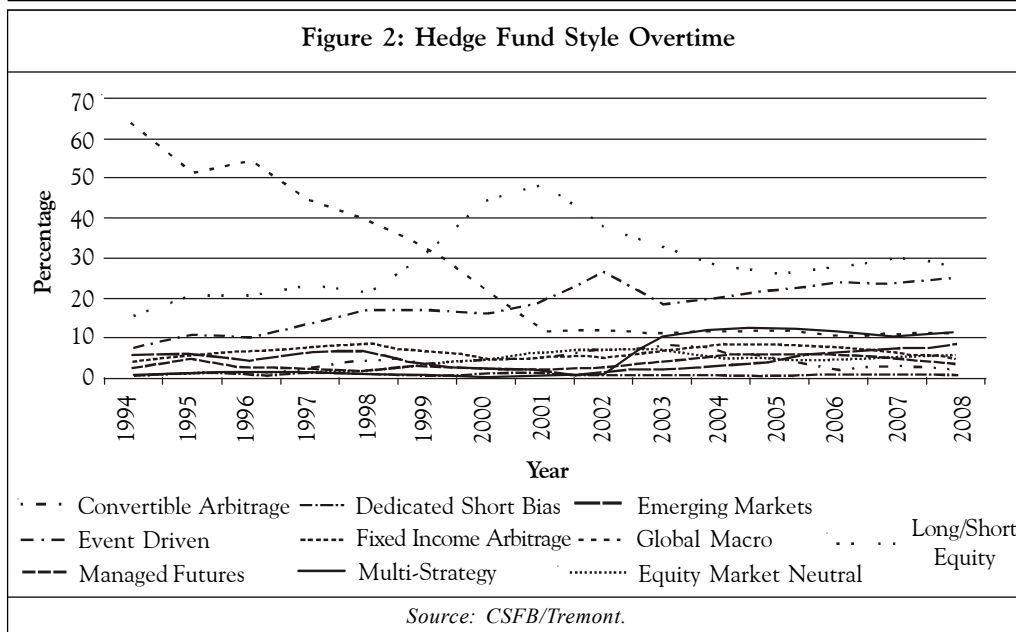
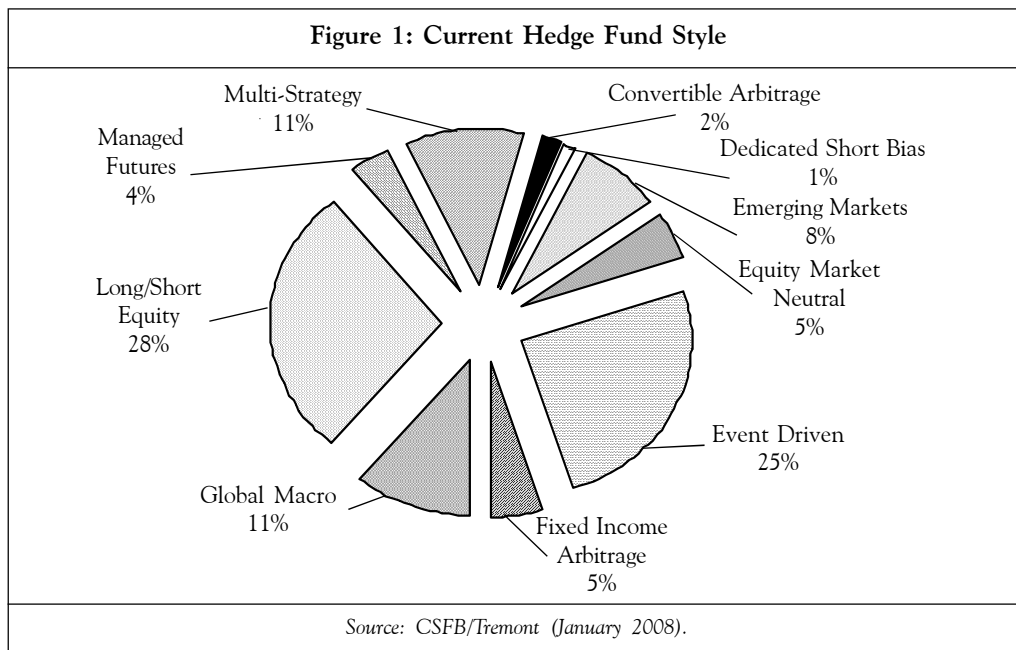
1. Funds must have a minimum of \$10 mn of Assets Under Management (AUM).
2. Funds must have a minimum one-year track record.
3. Funds must have a current audited financial statement.

The 10 CSFB/Tremont indexes are based on 10 different investment styles:

1. Convertible Arbitrage
2. Dedicated Short Bias
3. Emerging Markets
4. Equity Market Neutral
5. Event Driven
6. Fixed Income Arbitrage
7. Global Macro
8. Long/Short Equity
9. Managed Futures
10. Multi-Strategy

Figure 1 reports the number of funds in each category. It is apparent that the representation of hedge fund style is concentrated among the Long/Short Equity (28%) and Event Driven (25%). Dedicated Short Bias style is adopted by only 1% of hedge funds.

Figure 2 depicts that the 1994 trend was towards Global Macro. Indeed, 65% of hedge funds were Global Macro funds against only 11% today. Conversely, the Long/Short and Event Driven strategies have risen to prominence. In 2008, 28% of hedge funds are Long/Short funds and 25% are Event Driven funds.



Market Indexes Data

The paper used five market indexes spanning over the period, January 1994-January 2008, from the Bloomberg database.

To portray the American Stock Market, the paper used the Dow Jones, the Russel 2000, the S&P 500 and the Nasdaq. To describe the European Stock Market, it chose the Dow Jones Euro Stoxx 50 index.

Description of Hedge Fund Strategies

Neither a legal definition of hedge fund strategies, nor an official classification does exist. According to Lhabitant (2006), there are 24 hedge fund index providers and these 24 data providers have their own classification, their own definition. For instance, HFR database computes 33 indexes, whereas VAN Hedge Fund Advisors database calculates 15 indexes. We use the CSFB/Tremont hedge fund indexes. The description of hedge fund strategies are directly taken from the TASS documentation.

Convertible Arbitrage

Convertible Arbitrage funds aim to profit from the purchase of convertible securities and the subsequent shorting of the corresponding stock, when there is a pricing error made in the conversion factor of the security. Managers typically build long positions of convertible and other equity hybrid securities, and then hedge the equity component of the long securities positions by shorting the underlying stock or options. The number of shares sold short usually reflects a delta neutral or market neutral ratio. As a result, under normal market conditions, the arbitrageur generally expects the combined position to be insensitive to fluctuations in the price of the underlying stock.

Dedicated Short Bias

Dedicated Short Bias funds take more short positions than long positions and earn returns by maintaining net short exposure in long and short equities. Detailed individual company research typically forms the core alpha generation driver of Dedicated Short Bias managers, and a focus on companies with weak cash flow generation is common. To affect the short sale, the manager borrows the stock from counterparty and sells it in the market. Short positions are sometimes implemented by selling forward. Risk management consists of offsetting long positions and stop-loss strategies.

Emerging Markets

Emerging Markets funds invest in currencies, debt instruments, equities and other instruments of countries with 'emerging' or developing markets (typically measured by per capita GDP). Such countries are considered to be in a transitional phase between developing and developed status. Examples of emerging markets include China, India, Latin America, much of Southeast Asia, parts of Eastern Europe, and parts of Africa. There are a number of sub-sectors, including arbitrage, credit and event driven, fixed income bias and equity bias.

Equity Market Neutral

Equity Market Neutral funds take both long and short positions in stocks, while minimizing exposure to the systematic risk of the market (i.e., a beta equal to zero is desired). Funds seek to exploit investment opportunities unique to a specific group of stocks, while maintaining a neutral exposure to broad groups of stocks defined, for example, by sector, industry, market capitalization, country, or region. There are a number of sub-sectors including statistical arbitrage, quantitative long/short, fundamental long/short and index arbitrage. Managers often apply leverage to enhance returns.

Event Driven

Event Driven funds invest in various asset classes and seek to profit from potential mispricing of securities related to a specific corporate or market event. Such events can include—mergers, bankruptcies, financial or operational stress, restructurings, asset sales, recapitalizations, spin-offs, litigation, regulatory and legislative changes as well as other types of corporate events.

Event Driven funds can invest in equities, fixed income instruments (investment grade, high yield, bank debt, convertible debt and distressed), options and various other derivatives. Many managers use a combination of strategies and adjust exposures based on the opportunity sets in each sub-sector.

There are three popular sub-categories in Event Driven strategy are: distressed, multi-strategy and risk arbitrage.

Fixed Income Arbitrage

Fixed Income Arbitrage funds attempt to generate profits by exploiting inefficiencies and price anomalies between related fixed income securities. Funds limit volatility by hedging out exposure to the market and interest rate risk. Strategies include leveraging long and short positions in similar fixed income securities that are related either mathematically or economically. The sector includes credit yield curve relative to value trading, involving interest rate swaps, government securities and futures; volatility trading involving options; and mortgage-backed securities arbitrage (the mortgage-backed market is primarily US-based and over-the-counter).

Global Macro

Global Macro funds focus on identifying extreme price valuations, and leverage is often applied on the anticipated price movements in equity, currency, interest rate and commodity markets. Managers typically employ a top-down global approach to concentrate on forecasting how political trends and global macroeconomic events affect the valuation of financial instruments. Profits are made by correctly anticipating price movements in global markets and having the flexibility to use a broad investment mandate, with the ability to hold positions in practically any market with any instrument. These approaches may be systematic trend following models, or discretionary in nature.

Long/Short Equity

Long/Short Equity funds invest on both long and short sides of equity markets, generally focusing on diversifying or hedging across particular sectors, regions or market capitalizations. Managers have the flexibility to shift from value to growth; small to medium to large capitalization stocks; and net long to net short. Managers can also trade equity futures and options as well as equity-related securities and debt, or build portfolios that are more concentrated than traditional long-only equity funds.

Managed Futures

Managed Futures funds (often referred to as CTAs or Commodity Trading Advisors) focus on investing in listed bond, equity, commodity futures and currency markets, globally. Managers tend to employ systematic trading programs that largely rely upon historical price data and market trends. A significant amount of leverage is employed, since the strategy involves the use of futures contracts. CTAs do not have a particular bias towards being net long or net short in any particular market.

Multi-Strategy

Multi-Strategy funds are characterized by their ability to allocate capital based on perceived opportunities among several hedge fund strategies. Through diversification of capital, managers seek to consistently deliver positive returns regardless of the directional movement in equity, interest rate or currency markets. The added diversification benefits reduce the risk profile, help to smoothen returns, reduce volatility, and decrease asset-class and single-strategy risks. Strategies adopted in a Multi-Strategy fund may include, but are not limited to, convertible bond arbitrage, equity long/short, statistical arbitrage and merger arbitrage.

Summary Statistics

According to mean-variance approach, returns should follow a normal distribution. Thus, the mean and the volatility computed in annualized form are together a complete summary of the stochastic properties of returns. Therefore, the two moments of the normal distribution and the Sharpe ratio that combines them exhibit everything that must be known about the strategies. Table 1 presents the summary statistics of the monthly returns of the CSFB/Tremont indexes from January 1994 to January 2008.

Returns

Globally, it can be noticed that hedge fund indexes offer higher mean than stocks. CSFB Global index has a mean return of 10.86%, which is slightly higher than that of stocks.

Amongst investment styles, Global Macro exhibits the highest mean return of 14.07%, followed by Long/Short Equity (11.80%) and Event Driven (11.60%). Dedicated Short Bias is the only strategy that presents negative returns with a mean of -1.41%.

Volatility

Table 1 shows that the standard deviations of stock market indexes are much higher than those of hedge funds.

Nasdaq has an average standard deviation of 25.42%, followed by the Russell 2000 (18.24%) and Dow Jones Euro Stoxx 50 index (18.02%), whereas CSFB Global index exhibits a weak average standard deviation of 7.5%.

Only Dedicated Short Bias (16.82%) and Emerging Markets (15.54%) are more volatile than Dow Jones (14.35%) and S&P 500 (14.05%). The more attractive strategies in term

Table 1: Summary Statistics for the Monthly Returns of the CSFB/Tremont from January 1994 to January 2008			
	Mean* (%)	Standard Deviation** (%)	Sharpe Ratio***
HF Strategies			
Convertible Arbitrage	8.66	4.59	1.03
Dedicated Short Bias	-1.41	16.82	-0.32
Emerging Markets	9.73	15.54	0.37
Equity Market Neutral	9.95	2.81	2.14
Event Driven	11.60	5.57	1.38
<i>Distressed</i>	13.00	6.16	1.47
<i>Multi-Strategy</i>	10.92	6.07	1.15
<i>Risk Arbitrage</i>	7.77	4.13	0.93
Fixed Income Arbitrage	6.25	3.63	0.64
Global Macro	14.07	10.43	0.97
Long/Short Equity	11.80	9.87	0.80
Managed Futures	6.73	11.92	0.23
Multi-Strategy	9.58	4.36	1.30
CSFB Global Index	10.86	7.50	0.92
Stock Exchange Indexes			
Dow Jones	8.56	14.35	0.32
Russel 2000	7.24	18.24	0.18
Nasdaq	8.08	25.42	0.16
S&P 500	7.75	14.05	0.27
Dow Jones Euro Stoxx 50	11.67	18.02	0.43
Note: * Annualized Mean; ** Annualized Standard Deviation; and *** The risk-free rate proxy is US Treasury Bill rate (Bloomberg database).			

of volatility are Equity Market Neutral (2.81%), Fixed Income Arbitrage (3.63%) and Multi-Strategy (4.36%).

Sharpe Ratio

The Sharpe ratio is a measure of risk-adjusted performance. It is defined as the portfolio return above the risk-free rate, adjusted for risk. Risk is estimated by the annualized standard deviation. The higher the ratio the better the performance. The Sharpe ratio formula is:

$$S_p = (E(R_p) - R_f) / \sigma(R_p)$$

$E(R_p)$ = Expected Portfolio Return

R_F = Risk-Free Rate

$\sigma(R_p)$ = Standard Deviation of Portfolio Return

The proxy of the risk-free rate is the US Generic Government 3-months yield.

Table 1 shows that hedge fund indexes have Sharpe ratios much higher than those of stocks. Indeed, CSFB index exhibits a Sharpe ratio of 0.92, whereas the Sharpe ratios of Dow Jones Euro Stoxx 50 and Dow Jones are 0.43 and 0.32 respectively.

Equity Market Neutral has the highest Sharpe ratio of 2.14. Sharpe ratios of Event Driven and Multi-Strategy are also attractive at 1.38 and 1.30 respectively.

These results show why hedge funds are so attractive. As a matter of fact their average mean is higher than those of stocks, their average standard deviation is lower than those of stock market indexes, and their Sharpe ratio is better than those of stocks. Equity_Market Neutral and Event Driven are the two most attractive strategies, because they offer high returns, low volatilities and subsequently good Sharpe ratios.

On the other hand, Global Macro is apparently the best strategy in terms of average mean return (14.07%). It is quite surprising as the number of funds in Global Macro is only 11%. Thus, the flattering returns might be an illusion due to the survivorship bias.

Performance Distribution of Alternative Strategies

By considering only mean and variance, hedge funds dethrone the traditional assets. But has the normal distribution of hedge funds returns been assessed? Do they really follow the normal distribution? If not, the higher moments of the normal distribution function must enter the picture, skewness and kurtosis must be computed. Consequently, volatility then becomes an incomplete measure of hedge fund risks.

The skewness of a normal distribution function is equal to 0. It implies that the distribution is symmetric. A negative skewness indicates that losses are more likely and a positive skewness implies that gains are more likely than in a Gaussian. Investors prefer funds with high skewness. Normal distribution has a kurtosis equal to 3. It is a measure of the probability of extreme returns, since it indicates the thickness of distribution tails. A kurtosis higher than 3 means that extreme returns (either losses or gains) are more likely than they are with normal distribution. That is, the tails of the distribution are fat. Investors usually seek lowest kurtosis.

A glance at the histograms of hedge fund returns (in Appendix A), provides an intuition regarding the deviations from normality. It is not easy to see the potential asymmetry, but it clearly appears that kurtosis is in excess of a normal distribution. Indeed, most of the strategies have significant distribution extremes. On the contrary, Equity Market Neutral and Managed Futures, seem to more or less follow the normal distribution.

Appendix B focuses on the quantile-quantile plots of hedge fund indexes. When scatter plots are along the bisector, the hedge fund indexes follow the normal distribution. Only Equity Market Neutral and Managed Futures seem to follow the normal distribution.

Previously, it was demonstrated that hedge fund indexes are less risky than stocks and bonds. Let us see if this conclusion remains the same when we take into account the skewness and kurtosis (Table 2).

Table 2: Skewness and Kurtosis of Different Hedge Funds Strategies		
	Skewness	Kurtosis
HF Strategies		
Convertible Arbitrage	-1.284	6.054
Dedicated Short Bias	0.830	5.031
Emerging Markets	-0.721	8.202
Equity Market Neutral	0.340	3.531
Event Driven	-3.187	25.379
<i>Distressed</i>	-2.823	22.047
<i>Multi-Strategy</i>	-2.287	17.656
<i>Risk Arbitrage</i>	-1.035	9.013
Fixed Income Arbitrage	-2.954	18.973
Global Macro	0.012	6.403
Long/Short Equity	0.195	7.022
Managed Futures	-0.007	3.203
Multi-Strategy	-1.094	5.775
CSFB Global Index	0.096	5.522

Skewness

The results show that only Equity Market Neutral, Global Macro, Long/Short Equity, Managed Futures and CSFB Global index are symmetric. On the other hand, it can be stressed that Event Driven and Fixed Income Arbitrage present the highest negative skewness values of -3.19 and -2.95 respectively, which denote a high probability of negative returns.

Kurtosis

The results show that returns distributions of only Equity Market Neutral and Managed Futures are normal. On the other hand, Event Driven and Fixed Income Arbitrage present the highest kurtosis values of 25.38 and 18.97 respectively, which denote a high probability of extreme losses.

According to these results, only Equity Market Neutral and Managed Futures returns follow the normal distribution. To support these conclusions, we next consider the Jarque-Bera normality test (Table 3).

Table 3: Results of Jarque-Bera Normality Test			
	Statistic	Probability	Normality
HF Strategies			
Convertible Arbitrage	106.022	0	No
Dedicated Short Bias	45.446	0	No
Emerging Markets	191.428	0	No
Equity Market Neutral	4.829	0.089	Yes
Event Driven	3,592.966	0	No
Fixed Income Arbitrage	1,926.471	0	No
Global Macro	75.220	0	No
Long/Short Equity	106.427	0	No
Managed Futures	0.185	0.912	Yes
Multi-Strategy	81.342	0	No
CSFB Global Index	41.238	0	No

Jarque-Bera Normality Test

This test summarizes the skewness and kurtosis tests. The two hypothesis of the Jarque-Bera test are:

H_0 : Returns distribution is normal

H_1 : Returns distribution is not normal

We calculate Jarque-Bera statistic:

$$s = (n/6) * S^2 + (n/24) * (K-3)^2 \text{ suit } \chi^2_{1-\alpha}(2)$$

where,

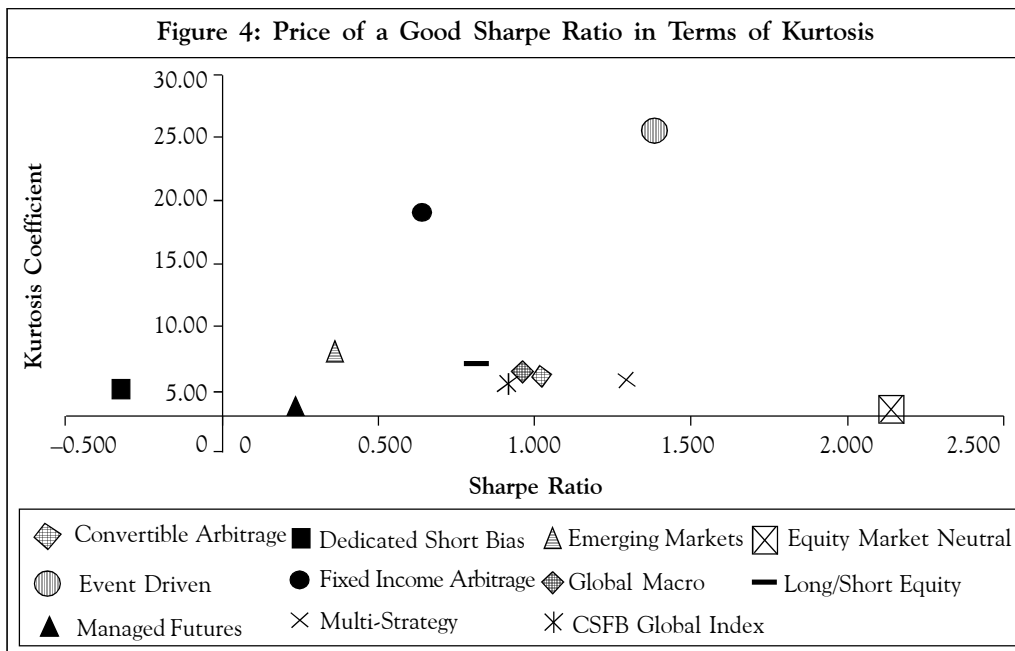
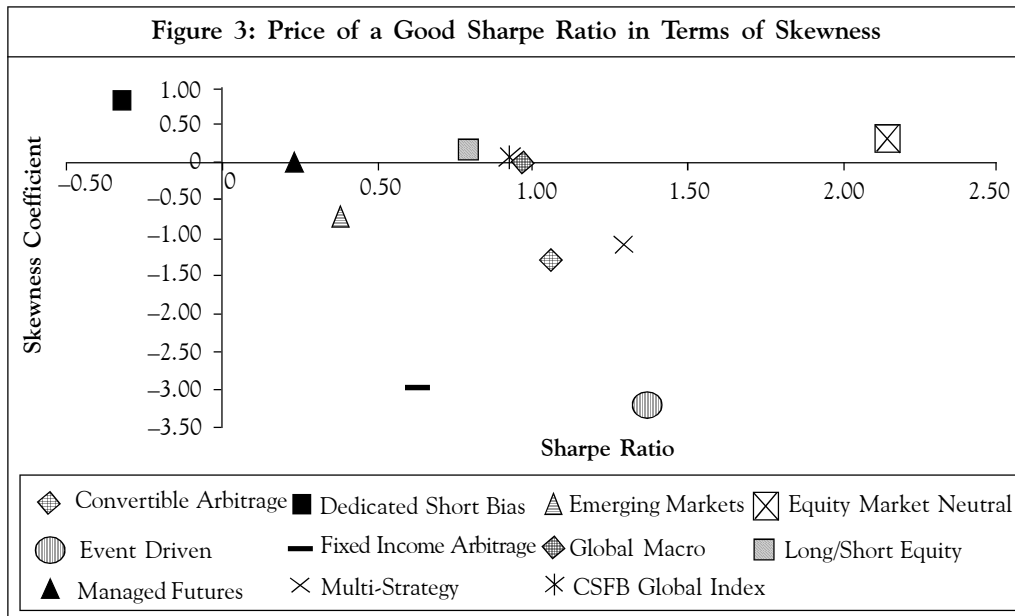
S = Skewness coefficient value

K = Kurtosis coefficient value

n = Number of observations

If s is higher than the theoretical value in chi-square table, with 2 degrees of freedom, at the significance level of 5% (5.99), H_1 is accepted. The results also show that only Equity Market Neutral and Managed Futures statistics are lower than 5.99, at the significance level of 5%.

These results support the conclusion obtained from the skewness and kurtosis tests and histograms and quantile-quantile plots of hedge funds.



On the other hand one can assess the price of a good Sharpe ratio in terms of skewness and kurtosis. Indeed, if one pays attention to Figures 3 and 4, one will see that Event Driven and Fixed Income Arbitrage exhibit a good Sharpe ratio (1.38 and 0.64), but the skewness coefficients are highly negative (-3.19 and -2.95), and the kurtosis coefficients are highly in excess (25.38 and 18.97). Consequently, for most of the strategies, a good Sharpe ratio is associated with the risks of asymmetry and extreme losses. Equity Market Neutral is the only strategy which does not exhibit this pattern.

The evidence shows that gauged by mean-variance approach, hedge fund strategies look very attractive. Indeed, their average means are higher than those of stocks and bonds. Their average standard deviations are lower than those of stock market indexes, and their Sharpe ratios are good. But because skewness and kurtosis are substantial in the hedge fund returns distribution, the performance distribution of hedge fund strategies is far from being normally distributed. Consequently, volatility is absolutely not a relevant measure of hedge fund risks, and thus, Sharpe ratio overestimates its performance.

Alternative Measures: Downside Risk and Sortino Ratio

A suitable response to volatility is downside risk. While volatility considers negative and positive returns, downside risk concentrates on those below an established threshold. Anything below the threshold rate is unacceptable. This indicator takes into account the asymmetric risk. It is computed as:

$$DR = 1/T \sum_{t=0, T} (R_{pt} - MAR)^2$$

$$R_{pt} < MAR \text{ (Minimal Accepted Return)}$$

By replacing volatility by downside risk in the Sharpe ratio formula, we obtain the Sortino ratio. It is defined as the portfolio return above the threshold performance, adjusted for risk measured by downside risk.

Table 4 gives the downside risks and Sortino ratios for hedge fund and stock indexes for MAR level spanning from 0 to 10%.

Stock market indexes are more volatile than hedge fund indexes. Amongst investment styles, Emerging Markets exhibits the highest downside risk at all MAR levels. On the contrary, Equity Market Neutral has the lowest downside risk.

One can say that globally, Sortino ratios of hedge fund indexes are much higher than those of stock markets. Equity Market Neutral strategy has the best Sortino ratio, but its performance decreases as the MAR level increases. The ratio decreases from 8.03 for a MAR equal to 0 to -0.02 for a MAR level of 10%. Only Event Driven, Fixed Income Arbitrage and Multi-Strategy Sortino ratios increase until a MAR level of 1%.

On the other hand, we note that stock market indexes performance is negative for an admittedly high level of MAR level (9%) (except Dow Jones Euro Stoxx 50).

Equity Market Neutral has the best Sortino ratio for MAR levels spanning from 0 to 9%. Multi-Strategy is in second position, until a MAR level of 2%. Stock market indexes have much lower Sortino ratios than the hedge funds. Dedicated Short Bias exhibits the worst Sortino ratio for all levels of MAR.

Table 4: The Downside Risks and Sortino Ratios for Hedge Funds and Stock Indexes for MAR Level Spanning from 0 to 10%												
	MAR	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
HF Strategies												
CSFB Global Index	DR* Sortino ratio	5.27% 2.06	5.14% 1.92	5.33% 1.66	5.70% 1.38	6.15% 1.12	6.25% 0.94	6.60% 0.74	7.23% 0.53	7.23% 0.40	7.50% 0.25	7.50% 0.12
Convertible Arbitrage	DR* Sortino ratio	4.10% 2.12	4.20% 1.82	4.24% 1.57	4.41% 1.28	4.59% 1.02	4.59% 0.80	4.59% 0.58	4.59% 0.36	4.59% 0.14	4.59% -0.07	4.59% -0.29
Dedicated Short Bias	DR* Sortino ratio	8.49% -0.17	9.19% -0.26	9.87% -0.35	10.70% -0.41	11.31% -0.48	11.93% -0.54	12.58% -0.59	13.34% -0.63	13.76% -0.68	14.40% -0.72	14.84% -0.77
Emerging Markets	DR* Sortino ratio	12.46% 0.78	12.52% 0.70	12.65% 0.61	12.65% 0.53	12.80% 0.45	13.06% 0.36	13.39% 0.28	13.65% 0.20	14.03% 0.12	14.03% 0.05	14.34% -0.02
Equity Market Neutral	DR* Sortino ratio	1.24% 8.03	1.72% 5.21	2.30% 3.46	2.61% 2.66	2.81% 2.11	2.81% 1.76	2.81% 1.40	2.81% 1.05	2.81% 0.69	2.81% 0.34	2.81% -0.02
Event Driven	DR* Sortino ratio	7.52% 1.54	5.61% 1.89	5.20% 1.84	5.41% 1.59	5.57% 1.36	5.57% 1.18	5.57% 1.00	5.57% 0.82	5.57% 0.65	5.57% 0.47	5.57% 0.29
Fixed Income Arbitrage	DR* Sortino ratio	4.58% 1.37	3.63% 1.44	3.60% 1.18	3.63% 0.89	3.63% 0.62	3.63% 0.34	3.63% 0.07	3.63% -0.21	3.63% -0.48	3.63% -0.76	3.63% -1.03
Global Macro	DR* Sortino ratio	8.13% 1.73	7.81% 1.67	7.51% 1.61	7.68% 1.44	7.92% 1.27	8.25% 1.10	8.63% 0.94	8.63% 0.82	8.63% 0.70	9.02% 0.56	9.28% 0.44

(Contd...)

Table 4: The Downside Risks and Sortino Ratios for Hedge Funds and Stock Indexes for MAR Level Spanning from 0 to 10% (...contd)												
	MAR	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
HF Strategies												
Long/Short Equity	DR* Sortino ratio	6.56% 1.80	6.59% 1.64	6.82% 1.44	7.22% 1.22	7.67% 1.02	8.02% 0.85	8.41% 0.69	8.63% 0.56	8.77% 0.43	8.97% 0.31	8.97% 0.20
Managed Futures	DR* Sortino ratio	7.05% 0.95	7.53% 0.76	7.92% 0.60	8.58% 0.43	9.18% 0.30	9.94% 0.17	10.56% 0.07	11.16% -0.02	11.30% -0.11	11.48% -0.20	11.92% -0.27
Multi-Strategy	DR* Sortino ratio	4.03% 2.37	3.62% 2.37	3.93% 1.93	4.23% 1.55	4.36% 1.28	4.36% 1.05	4.36% 0.82	4.36% 0.59	4.36% 0.36	4.36% 0.13	4.36% -0.10
Stock Market Indexes												
S&P 500	DR* Sortino ratio	10.08% 0.85	10.42% 0.73	10.84% 0.61	11.16% 0.50	11.76% 0.39	12.10% 0.29	12.60% 0.20	13.06% 0.12	13.27% 0.04	13.78% -0.03	13.95% -0.10
Dow Jones	DR* Sortino ratio	12.51% 0.58	12.98% 0.48	13.60% 0.39	13.89% 0.31	14.29% 0.23	14.93% 0.15	15.45% 0.08	15.77% 0.02	16.42% -0.05	17.17% -0.10	17.29% -0.16
Nasdaq	DR* Sortino ratio	18.55% 0.44	18.47% 0.38	18.62% 0.33	18.94% 0.27	19.30% 0.21	19.60% 0.16	19.87% 0.10	20.39% 0.05	20.80% 0	21.27% -0.04	21.49% -0.09
Russel 2000	DR* Sortino ratio	9.76% 0.79	10.39% 0.65	10.88% 0.53	11.12% 0.43	11.77% 0.32	12.05% 0.23	12.79% 0.14	13.04% 0.06	13.54% -0.02	13.88% -0.09	14.05% -0.16
Dow Jones Euro Stoxx 50	DR* Sortino ratio	13.21% 0.88	13.42% 0.79	13.65% 0.71	13.92% 0.62	14.38% 0.53	14.82% 0.45	15.18% 0.37	15.67% 0.30	16.07% 0.23	16.27% 0.16	16.64% 0.10
Note: * Annualized Downside Risk.												

Conclusion

The empirical analysis demonstrates that hedge funds dethrone stocks and bonds. Their returns and their volatility are very attractive. According to mean-variance approach, it is better to invest in hedge funds. But, when one goes further by taking into account the skewness and kurtosis, one can notice the presence of risks of asymmetry and extreme losses in hedge fund returns. Event Driven and Fixed Income Arbitrage are the riskiest strategies because their skewness are highly negative, and their kurtosis are highly in excess. Consequently, volatility cannot be used anymore as a measure of hedge fund risks, as it does not give any information about those risks that investors need to know the most. Similarly, the Sharpe ratio is also not a reliable risk-adjusted performance measure for hedge funds, as it overestimates their performance. Thus, more relevant indicators must be used.

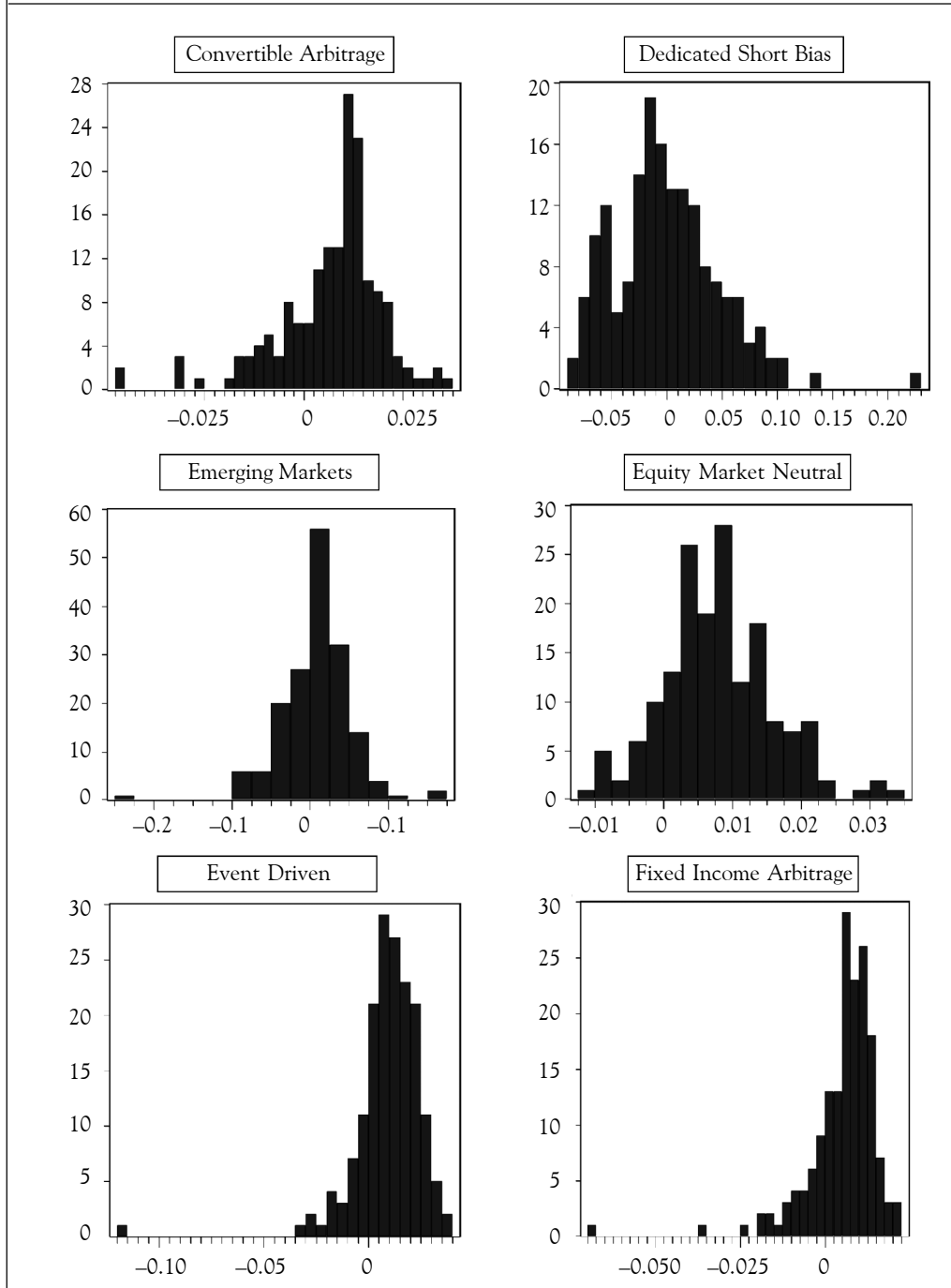
Further research can be done to test new relevant indicators that take into account the higher moments such as Conditional Value-at-Risk (CVAR), Cornish-Fisher ratio, or the Omega ratio. ♦

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Appendix A

Histograms of Monthly Returns of Hedge Fund Indexes from January 1994 to January 2008

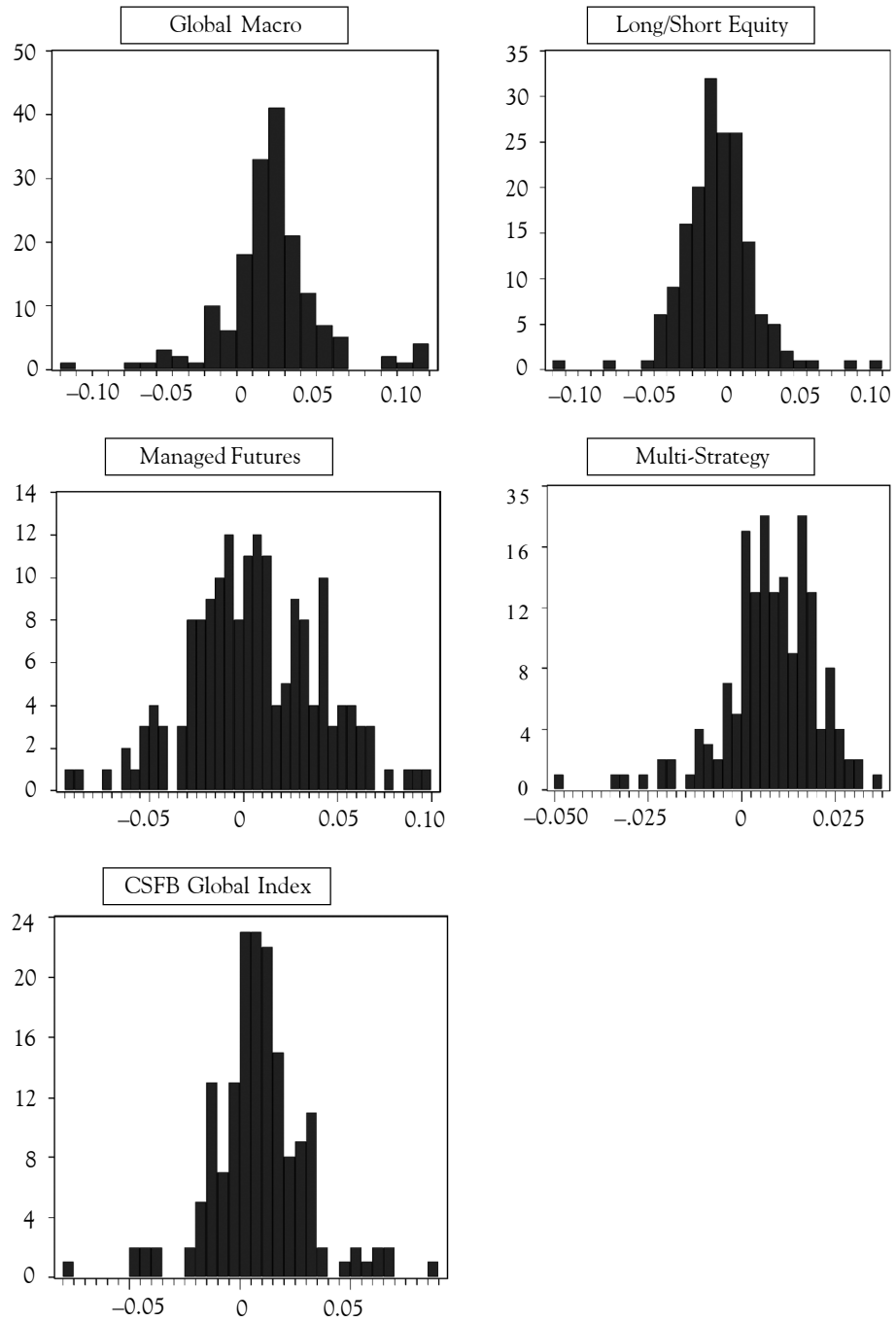


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Appendix A

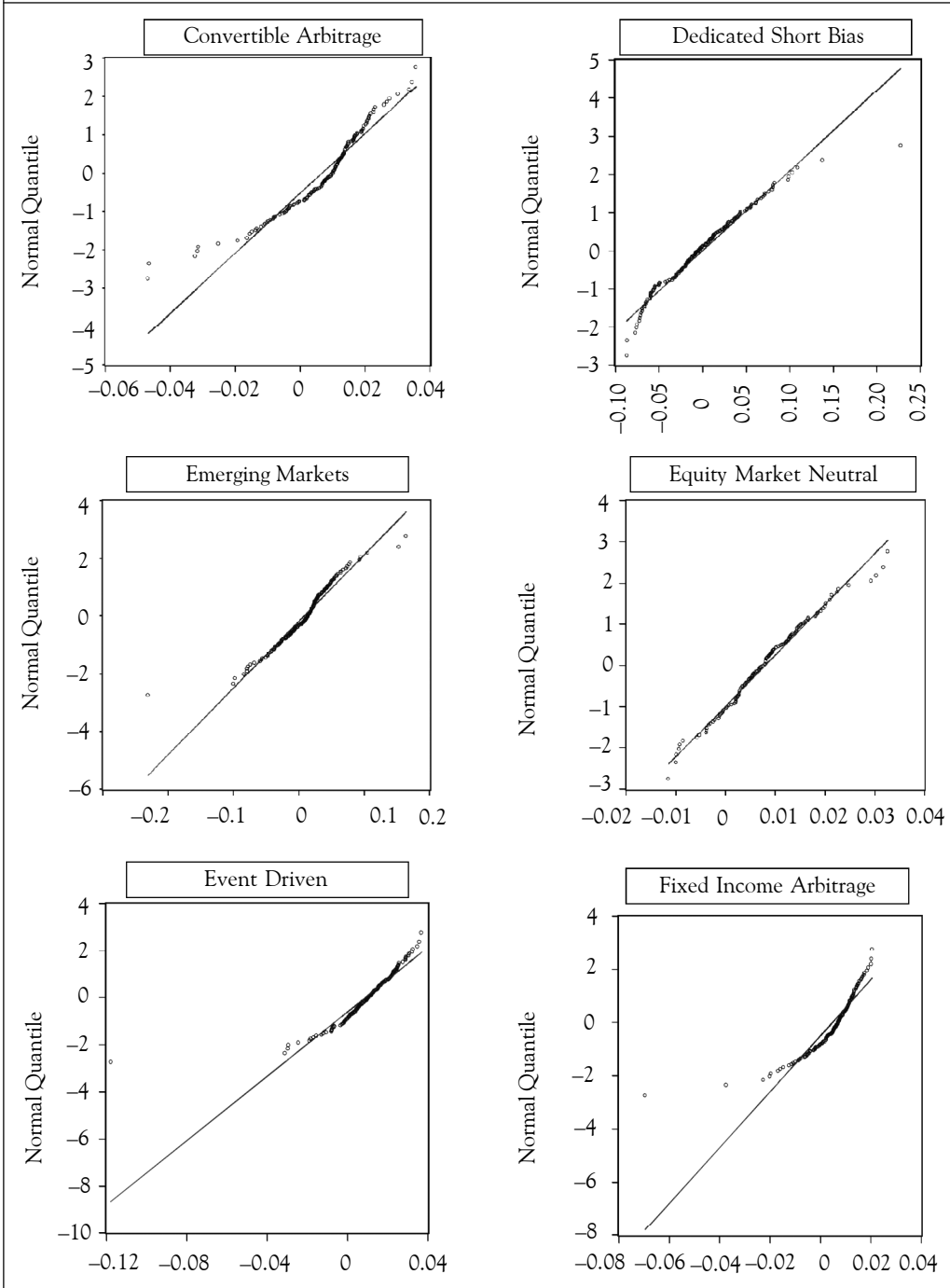
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Histograms of Monthly Returns of Hedge Fund Indexes from January 1994 to January 2008



Appendix B

Quantile-Quantile Plots of Monthly Returns of Hedge Fund Indexes from January 1994 to January 2008

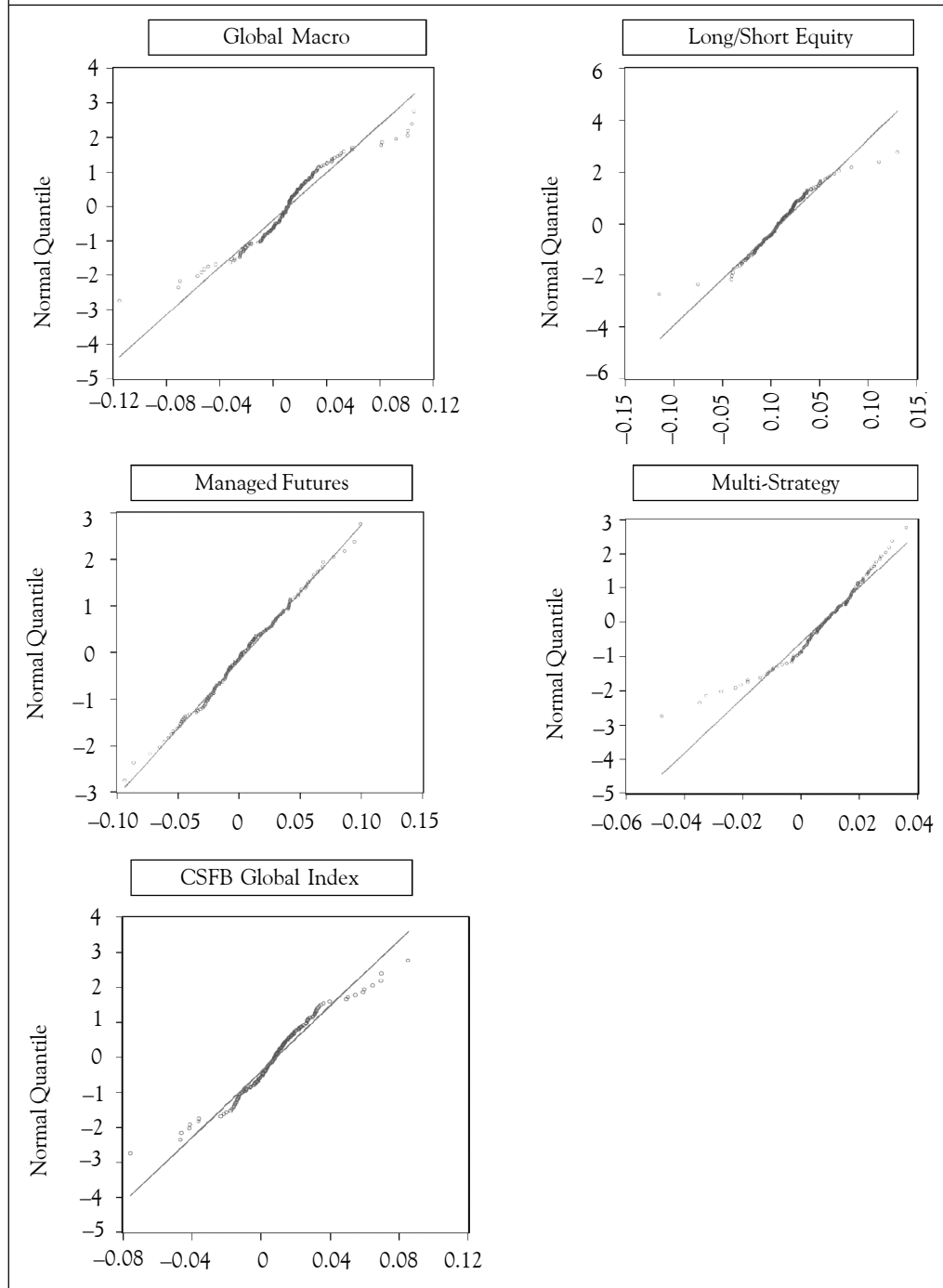


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Appendix B

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Quantile-Quantile Plots of Monthly Returns of Hedge Fund Indexes from January 1994 to January 2008



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