

# **Hedge Funds: Approaches to Diversification**

**Prepared for:**  
FireVision, LLC  
&  
Professor Robert McDonald

**Prepared by:**  
Amy Ballew  
Meenu Gupta  
Geoffrey Lasry  
Ariel Weinberger

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Kellogg School of Management

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## **Abstract**

This paper has two goals: to determine if hedge funds are a separate asset class and if so, if any of the correlations between hedge fund strategies are low enough to enable fund of fund managers to strategically diversify within the hedge fund arena. Our findings indicate that hedge funds should be considered a separate asset class; they do not have a significant relationship with other asset classes and hedge funds, as a group, react in similar ways to certain external factors. Further, our analysis shows that a fund of funds manager could improve the Sharpe ratio of his or her fund by implementing our systematic approach to fund of funds diversity; the simulation reduced the volatilities (risk) without meaningful effect on the returns.

## Overview

This paper analyzes whether hedge funds can be viewed as a separate asset class and if there is a way for fund of fund managers to increase the benefits of diversification through systematic hedge fund selection.

Both institutional investors and high-net worth individuals use the concept of asset classes in portfolio diversification. The major asset classes that exist today are Equities, Fixed Income, Real Estate, Private Equity, and Venture Capital. It is standard practice to group hedge funds with the asset class they primarily trade, such as considering equity hedge funds as part of Equities and fixed income hedge funds as part of Fixed Income.<sup>1</sup> Despite this practice, hedge fund managers also claim that their returns are uncorrelated with the broader financial markets, e.g. Equities or Fixed Income. If it is true that the hedge fund returns are uncorrelated to broader market returns and as a group they follow some trends together, it would seem reasonable that they should be considered a separate asset class, in contrast to current practice. The first part of this paper explores through regression analysis and factor analysis whether hedge fund returns are uncorrelated to the broader markets.

The second part of this paper focuses on fund of funds diversification. Fund of funds exist to diversify away risk through investing in many different funds.<sup>2</sup> Fund of funds that pursue either a combined strategy or a target return strategy choose hedge funds from a wide range of trading strategies. The fund of fund managers' decisions are based primarily on their funds' previous history and relationships with particular hedge fund managers. While fund of funds managers are conscious not to be over-weighted in a particular strategy, unless they pursue a dedicated strategy, they do not seem to be conscious about being over-weighted in a group of trading strategies that are highly correlated with each other.<sup>3</sup> The fund of funds diversification analysis determines if different trading strategies are correlated with each other. If some

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<sup>1</sup> A hedge fund manager supported this belief by indicating that his investors perceive investments in his convertible arbitrage fund equal to exposure to convertible bonds.

<sup>2</sup> Please see the Background on Fund of Funds section for more information on the role fund of funds play in diversification.

<sup>3</sup> Based on conversations with fund of funds managers.

strategies are significantly correlated with each other and others are not, then a fund of funds manager could add value by creating a mix of strategies that offset risk.

## Background on Hedge Funds

Hedge funds are actively managed investment funds that hold positions in publicly traded securities. Hedge funds were originally created to be “market neutral” funds, to take long positions and then hedge, i.e. offset the risk of the long positions with short positions, creating a position that was not correlated with the market as a whole.<sup>4</sup> For example, a market neutral fund might believe that Ford is underpriced and General Motors is overpriced. Taking a long position in Ford stock and a short position in General Motors stock would hedge away overall market risk and even specific automotive industry risk and focus on the idiosyncratic risk of the two stocks moving relative to each other. The firm profits as the two equities converge to appropriate prices.

The father of hedge funds, A.W. Jones, opened the first hedge fund in 1949 with the mission to separate two sources of risk in stock investments: firm level risk and market level risk. Traditional diversification, buying many assets across the market, can eliminate the idiosyncratic risk from individual security selection. Jones, however, used short selling to isolate the risk from an individual stock selection (see the Ford-GM example above). Hedging in this fashion generally reduces the overall risk, so Jones used leverage to scale both the returns and risk to a level palatable to investors. Thus, Jones created a new investment vehicle, which Fortune magazine named “hedge funds”.<sup>5</sup>

In today’s world, though, there is no common definition of hedge fund.<sup>6</sup> Hedge funds differ from mutual funds in that they have more flexibility and can hold more varied positions in securities, including options, derivatives, and short positions.<sup>7</sup> There are many different trading strategies that require this freedom, some of which do not involve hedging, so the term “hedge fund” now applies to some funds that do not hedge. Funds that use these other strategies and merely use the freedom the SEC gives hedge funds to invest in other ways are still called “hedge

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<sup>4</sup> Goetzman, William N. and Ibbotson, Roger G, “Offshore Hedge Funds: Survival and Performance, 1989-95”, *Journal of Business*, 1999, vol. 72, no. 1, page 93.

<sup>5</sup> Eichengreen, Barry and Mathieson, Donald, “Hedge Funds: What Do We Really Know?”, *International Monetary Fund Economic Issues*, Number 19, September 1999, ISBN 1-55775-849-2.

<sup>6</sup> Hedge funds are defined by their freedom from the regulatory controls imposed by the Investment Company Act of 1940.

<sup>7</sup> Goetzman and Ibbotson, page 91.



funds” due to their regulatory status. An example of a hedge fund that does not hedge is a fund that is a short seller, who only shorts stocks and does not take offsetting long positions.

Hedge funds enjoy their freedom because they are exempt from the Investment Company Act of 1940.<sup>8</sup> The act required companies that engage primarily in investing and trading in securities to disclose information about the company and its investing objectives, as well as about the company’s structure and operations.<sup>9</sup> Because hedge funds are not subject to this act, they enjoy more freedom in investing activities, e.g. can use leverage and do not have to report their activities. To avoid being included under the act, hedge funds are structured as partnerships. The membership in these partnerships is limited to a maximum of 499 investors and only “accredited investors” (as defined by the SEC)<sup>10</sup> can invest in hedge funds; because of the limit on the number of investors, most hedge funds have significant minimum investments (ranging from \$250,000 to several million).

Due to the freedom from regulation that hedge funds enjoy, they can be challenging for investors to evaluate. Hedge funds have fewer disclosure requirements than mutual funds, making it difficult for investors to understand what is happening to their money. Hedge funds also place more restrictions on investors, generally locking up assets for certain time periods (lock up periods vary from three months to five years). Historically, high net worth individuals were the only investors who would tolerate these disadvantages; institutional investors required more transparency.

In the last few years, however, an increased interest in alternative investments has brought institutional investors to the field.<sup>11</sup> Over the last thirteen years unlevered assets under hedge fund management have grown from \$100 billion to \$6.8 trillion.<sup>12</sup> This growth was fueled

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<sup>8</sup> Section 3(c)(1) of the Investment Company Act of 1940 exempts hedge funds from certain registration and clients’ requirements of the Investment Company Act of 1940 as long as the number of investors remains below the limit, which was originally 100 and is now raised to 500.

<sup>9</sup> SEC website, <http://www.sec.gov/about/laws.shtml>

<sup>10</sup> The SEC defines an accredited investor as someone whose individual net worth, or joint net worth with a spouse, exceeds \$1million or whose individual income was in excess of \$200K, or joint income was in excess of \$300K, in each of the two preceding years and who reasonably expects to reach the same level of income in the current year.

<sup>11</sup> “The Benefits of Alternative Investment Strategies In the Institutional Portfolio”, Lars Jaeger, Swiss Alternative Investment Strategies Group AG, November 19, 2001, page 2.

<sup>12</sup> Merrill Lynch/Cap Gemini Ernst & Young, World Wealth Report 2001.

by a regulatory change in 1996 that expanded the number of investors a hedge fund could have from 99 to 499.<sup>13</sup>

The last few years have seen numerous stories in the press regarding hedge fund successes and failures; famous/infamous hedge fund managers and funds include George Soros and his Quantum Fund, Julian Robertson and his Tiger Management, and John Meriwether's LTCM. The hedge fund craze rose to such heights in 1998 that Business Week referred to it as "The Great Brain Drain of Wall Street". The growth in asset size and popularity of hedge funds have brought about a change in investor base, giving rise to the concept of fund of funds, a hedge fund that invests in other hedge funds.<sup>14</sup>

### ***Organization***

Hedge funds are typically organized as private partnerships. They are often incorporated offshore for tax reasons. Because they are private partnerships, they have less oversight from regulatory bodies; offshore funds are even less regulated. However, as mentioned previously, the private partnership structure limits the number of investors to under 500. Table 1 below outlines the organizational differences between hedge funds and mutual funds.

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<sup>13</sup> Goetzman and Ibbotson, page 94.

<sup>14</sup> The term "Fund of Funds" can apply to any fund that invests in other funds. For the purpose of this paper, we are using the term to specifically refer to funds that invest exclusively in hedge funds.

TABLE 1: MUTUAL FUNDS VS. HEDGE FUNDS

MUTUAL FUNDS	HEDGE FUNDS
A portfolio made up of numerous stocks and/or bonds	A private pool of investment capital organized into a limited partnership to invest in a portfolio made up of a variety of securities
Managed by a Fund Manager, whose fees are not dependent on whether the investors profit	Managed by a General Partner, whose fees are dependent on whether the investors profit
The Fund Manager's assets unlikely to be a significant percentage of the fund	The General Partner's assets are probably a large percentage of the fund
Available to the general public	Available to accredited investors whose individual net worth, or joint net worth with a spouse, exceeds \$1M <i>or</i> Whose individual income was in excess of \$200K, or joint income was in excess of \$300K in each of the two preceding years and who reasonably expects to reach the same level of income in the current year <i>or</i> For institutions, employee benefit plans, partnerships or foundations who meet the Accredited Investor criteria of Rule 501(a) Regulation D
Are not limited in the number of investors who can invest in the fund	Are limited by the SEC to 499 investors ("limited partners") who can invest in any one fund
Are limited by the SEC in the securities or strategies used to be profitable	Are not limited in the securities or strategies used to be profitable

**Strategies**

Mutual funds are often grouped according to their securities holdings. However, hedge fund managers have a wider range of investment vehicles and trading strategies available to them. Because of this diversity, hedge funds are grouped by investment strategy, rather than merely by the type of securities they hold. Strategies are a combination of security type, position type (long or short), and trading style.

TABLE 2: HEDGE FUND STRATEGIES

STRATEGY	DESCRIPTION
Convertible Arbitrage	Fund managers focus on pricing discrepancies between convertible bonds and the equity of the issuing firm. The value of the option portion of the bond is hedged by either a short position in the stock or the use of options.
Dedicated Short Sellers	Dedicated short sellers hold only short positions (with no offsetting long positions) in publicly traded equities.
Distressed Securities <sup>15</sup>	Fund managers invest in (long and short) securities of companies that have been or will

<sup>15</sup> Our database, the TASS database, includes Distressed Securities as part of Event Driven.

STRATEGY	DESCRIPTION
	be affected by a distressed situation. Distressed is defined as reorganization, bankruptcies, distressed sales, and corporate restructuring. Securities include bank debt, corporate debt, trade claims, common stock, preferred stock, and warrants. Positions are hedged with S&P put options.
Emerging Markets	Emerging Market funds invest in sovereign or corporate debt and/or equity in countries considered to be emerging -- most markets other than North America, Western Europe, Japan, New Zealand, and Australia.
Equity Long/Short	Fund managers' investments consist of a portfolio of long equities hedged at all times with short sales of stocks and index options. This strategy is the largest category of hedge funds in terms of numbers and assets managed.
Event Driven	Event Driven opportunities include LBO, mergers, and hostile takeovers. Fund managers are generally long companies being acquired and short the stock of acquiring companies. The fund's exposure is hedged through S&P put options or put option spreads. Event Driven also include "corporate life cycling" investing. Managers invest in opportunities created by spin-offs, M&A, bankruptcy reorganization, recapitalizations, and share buybacks. Securities include common stock, preferred stock, debt securities, and options. Positions are hedged with S&P put options.
Fixed Income Arbitrage	Fund managers profit by exploiting pricing discrepancies between fixed income securities and their derivatives. Managers remain market neutral by hedging their exposure to interest rates. Most fixed income trades include yield-curve arbitrage, corporate vs. Treasury yield spread, municipal vs. Treasury yield spreads, cash vs. futures, and on the run vs. off the run.
Fund of Funds	Fund managers invest in a series of other hedge funds. Fund managers promise investors diversification because with less invested capital an investor can participate in many individual hedge funds. Without fund of funds, investors would need to put up the minimum investment in each of the individual hedge funds, often reducing the ability of the individual investor to diversify.

### *Leverage*

As mentioned previously, hedge funds have fewer regulatory restrictions than mutual funds. These relaxed restrictions allow the funds to take short positions in securities, to take on substantial leverage and to make less detailed financial reports.

To leverage their capital, hedge funds buy securities on margin and borrow funds from banks. While most funds do not achieve the levels of leverage of Long Term Capital Management, which at times was levered at 30 to 1, most hedge funds do use leverage to enhance their returns.<sup>16</sup> Given the minimal reporting requirements, this leverage is difficult for investors to monitor. Therefore, it is difficult for investors to correctly account for the risk they are incurring.<sup>17</sup>

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<sup>16</sup> Eichengreen and Mathieson, September 1999.

<sup>17</sup> Funds state their target leverage in their prospectus, but do not generally notify their investors about changes in leverage.

### ***Fees and Incentive Structures***

Hedge funds typically receive compensation in two ways: an annual management fee based on a percentage of total assets and an incentive fee based on a percent of the gains. The incentive fee is sometimes limited with a high water mark; a high water mark states that the manager only receives gains relative to the highest level the fund has reached. Thus, if a fund was at \$100M in year 1, then dropped to \$90M in year 2, then rose to \$120M in year 3, the gains over year 3 would be calculated relative to \$100M, not \$90M.

A.W. Jones' original hedge fund set the current benchmark of 1% management fee and 20% incentive fee. Today, the management fees range from 0.5% to 2% and the incentive fees range from 10% to 30% of the profits.

## **Background on Fund of Funds**

Fund of funds serve as asset allocation vehicles and are considered hedge funds from a legal and regulatory perspective. A fund of funds manager raises money from investors and then invests the money in various hedge funds. As mentioned previously, hedge funds are structured as partnerships and are limited to less than 500 investors. This restriction on hedge funds has given rise to very high minimum investments (up to \$5M). These limitations make it difficult for an investor to diversify in the hedge fund arena. For instance, if an investor had \$10M in assets to invest in alternative investments such as hedge funds, he or she might not be able to diversify adequately; it would be difficult for the investor to invest in more than about ten hedge funds with solid track records. However, a fund of funds is an effective tool for diversification because it can pool together many investors' money to meet the minimums.

Each fund of funds has an investment approach that is determined by the strategies of the underlying hedge funds to which it allocates its capital. There are four basic options available to the fund of funds managers:<sup>18</sup>

1. Target Return – The fund of funds manager allocates capital to hedge funds in an attempt to generate a target return in the 10-15% range with a promise of low volatility.
2. Maximal Return Approach – Under this option, fund of funds managers select those hedge funds whose investment strategies they believe will generate the highest return under current market conditions and are willing to accept the greater volatility associated with higher returns.
3. Dedicated Strategy – Fund of funds managers select funds that invest in a particular asset class, such as long/short equity, or in event driven strategies such as merger arbitrage.
4. Combined Strategy – Fund of funds managers mix lower risk strategies with more aggressive ones to create a fund with a more balanced risk profile.

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<sup>18</sup> “Fund of Funds” by Martin Gross, *Hedge Funds: Investment and Portfolio Strategies For the Institutional Investor*, Jess Lederman and Robert Klein, Editors McGraw-Hill, Inc. 1995.

## ***Advantages***

Fund of funds offer a variety of advantages to investors: diversity, lower minimums, and access to otherwise closed managers. Diversity is considered the strongest advantage of a fund of funds. Through investing in numerous funds, a fund of funds manager hopes to diversify away some of the risk and volatility associated with the returns of individual hedge funds. The advantage of diversity manifests itself differently depending on the fund of funds strategy. A combined strategy fund of funds offers portfolio construction-related diversity through combining different hedge fund strategies. Dedicated strategy fund of funds offers diversity among managers within a specific strategy.

A second advantage of fund of funds is that they offer access to a diversified hedge fund investment without meeting the minimums of many individual hedge funds. In addition, fund of funds can offer access to hedge funds that are closed to new investors. Managers who do not believe they can gain good returns on more assets than they have under management and do not want to dilute the returns they currently have will at times close themselves to new investors. When a hedge fund closes to new investors, however, an investor could still invest in the fund by investing in a fund of funds that has money in that particular hedge fund. This is particularly valuable because the stable and successful hedge funds are the most likely funds to close to investors.

Fund of funds also offer advantages to individual hedge funds. Hedge funds are limited to 499 investors, but a fund of funds that invests in an individual hedge fund is considered only one investor. Thus, when a hedge fund accepts money from a fund of funds, it only uses up one of the 499 investor slots but gains access to 499 more investors.

## ***Disadvantages***

The primary disadvantages of fund of funds are: double fees, no direct access to underlying hedge fund managers, and fund of fund managers must be skilled at both hedge fund manager selection and asset allocation.

## The Data

### *Source*

We obtained our data from the TASS database, maintained by HedgeWorld, [www.hedgeworld.com](http://www.hedgeworld.com). The TASS database is one of the leading databases of hedge fund data in the world. TASS includes a wide variety of information, including historical returns, inception date, primary strategy, net assets under management, location, manager, minimum investment, management fee, incentive fee, prime broker and legal structure. For our analysis, we primarily used the historical returns and the net assets under management.

### *Fund Selection*

We used two main criteria for selecting funds: age and size. If a fund is young and has few months of returns, analyzing it is difficult for two reasons. First, with very few data points it is meaningless to compare it to other funds because idiosyncratic movements are likely to overshadow any underlying patterns. Second, very young funds often have not had enough time to prove they are a viable fund. We chose to require three years of history for the funds that we included in our analysis.

In addition to youth, small size can also create problems when analyzing returns. Small funds are not viable for institutional investing and tend to be more focused on a small number of high net worth investors. Therefore, we chose to include only those funds that currently have \$50M or more in net assets under management (capital investment).

An exception to this size requirement was the fund of funds strategy. Since fund of funds are, on average, smaller funds, we lowered this minimum to \$25M for our Fund of Funds screen. The lower minimum investment amounts lead to lower total net assets under management than in individual hedge funds.

### *Strategy Selection*

We had limited access to the TASS database, therefore we targeted seven strategies during our data collection: Long Short Equity, Convertible Arbitrage, Event Driven Arbitrage, Fixed Income Arbitrage, Dedicated Short Sellers, Emerging Markets, and Fund of Funds. The



strategies that are in the TASS database but are not included in our data set are Global Macro, Equity Market Neutral, Managed Futures, and Other. We eliminated Managed Futures and Other because they were small and unfocused, respectively. Global Macro and Equity Market Neutral were not included due to time constraints, not due to any specific aspects of the strategy.

Using the screens above, we extracted the data from the TASS database. Our resulting data set is broken down by strategy in the table below.

TABLE 3: NUMBER OF FUNDS IN DATA SET FROM EACH STRATEGY

STRATEGY	NUMBER OF FUNDS
Convertible Arbitrage	39
Dedicated Short	4
Emerging Markets	71
Equity Long/Short	177
Event Driven	91
Fixed Income Arbitrage	31
Fund of Funds	91
<i>Total</i>	<i>504</i>

### ***Data Limitations***

#### *Survivorship Bias*

Because hedge funds are not required to report their returns, return data is only collected from funds that volunteer the information. There has historically been little incentive for the collectors of data to search out information on funds that are no longer in existence. This gives rise to survivorship bias, or an overemphasis on the funds that have been successful and are still in business.

#### *Size Bias*

The above holds true for fund size too. Our data selection process limited on size, however, fund managers prefer to invest in funds of larger size and are unlikely to invest in funds of under \$50M in net assets under management. This does not mean that there is no bias, but does indicate that the bias of our data set is consistent with the bias of most experienced hedge fund investors.

## The Method

The question we have posed has two parts. Part one asks if hedge funds are a separate asset class. Part two is dependent on part one and asks, if hedge funds are a separate asset class, how can fund of funds managers better diversify themselves by selecting funds in uncorrelated strategies. This section focuses on part one of our analysis.

### *Regression*

Hedge funds should be considered a separate asset class if returns are uncorrelated with benchmarks of other traditional asset classes and if hedge funds as a group follow some trends together. The benchmarks that we selected for the data analysis were: returns on the S&P 500, returns on the NASDAQ 100, returns on the Ten-year treasury, LIBOR and VIX<sup>19</sup>. The S&P 500 and NASDAQ 100 benchmarks were used to compare hedge fund returns to the equity market. The Ten-year Treasury and LIBOR benchmarks were used for the fixed income market. The volatility index, VIX, was used to compare hedge fund returns to option returns; increased volatility generally increases option returns. To identify whether any of the strategies were correlated with the benchmarks in the market, we used both regression analysis and factor analysis.

For the regression portion of our analysis, we adjusted the fund returns using the Sharpe ratios to reduce the distortion caused by leverage. The Sharpe ratio for a fund is given by:

$$SR = \frac{r_{fund} - r_{risk-free}}{\sigma}$$

The Sharpe ratio is a way to look at the risk-return balance of a fund. This is particularly key for hedge funds, which are able to use both risky securities such as derivatives and also use leverage to increase returns. However, using leverage to increase returns increases the variance of those returns proportionately. By using the Sharpe ratio rather than the straight returns of the fund, we reduced the effect of leverage on the returns.

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<sup>19</sup> VIX, introduced by CBOE in 1993, measures the volatility of the U.S. equity market. This index is calculated by taking a weighted average of the implied volatilities of eight OEX calls and puts. The chosen options have an average time to maturity of 30 days. Consequently, the VIX is intended to indicate the implied volatility of 30-day index options. It is used by some traders as a general indication of index option implied volatility. [www.cboe.com](http://www.cboe.com)

We began with the historical monthly returns for each hedge fund. From those returns, we calculated the volatility of the returns as defined by the standard deviation of the returns over the life of the fund. We then calculated the Sharpe ratio of the returns with the formula above, using the standard deviation of the returns over the life of the fund as sigma and one-month return on the three-month treasury as the risk-free rate. We followed a parallel approach for finding the Sharpe ratios of the S&P 500, the NASDAQ 100, and the Ten-year Treasury (we did not use the Sharpe ratio for LIBOR and VIX because they reflect a rate or volatility, not a price).

Once we had calculated the Sharpe ratios, we regressed the Sharpe ratio of each hedge fund's monthly returns against each of the benchmarks.

$$SR_{a,i} = \beta_a x_i + \varepsilon_i$$

In the formula above, SR represents the Sharpe ratio,  $a$  indicates the fund,  $x$  indicates the benchmark (either SR of the return or the rate itself),  $\beta$  represents the coefficient of the independent variable, and  $\varepsilon$  represents the error of the fit for the given month  $i$ . This analysis yields a coefficient for each fit and as well as regression statistics, e.g. t-statistics, correlation statistics, and  $R^2$ s.<sup>20</sup>

We ran the regressions above over two time periods: 1999-2001 and 1995-2001. All 504 funds in our data set were included in the 1999-2001 run and the funds that existed in 1995 were included in the 1995-2001 run.

### ***Factor Analysis***

Most money managers gauge their performance according to a pre-selected benchmark. The excess returns, or the returns in excess of the return of the benchmark, typically determine fees. Investors need to understand the benchmark the fund uses and how the returns are allocated across the elements of the benchmark in order to understand how the manager is judged. For instance, a fund that advertises as a large cap value fund should have the Russell 1000 Value Index in its benchmark.

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<sup>20</sup> T-statistic is calculated by dividing the regression coefficient by its standard error. A large t-statistic (>|3|) indicates that the variable is a significant determinant of the dependent variable.  $R^2$  represents the proportion of the variance explained by the independent variable(s).

### Theory Behind Style Analysis

Style analysis is a specific case of factor analysis that allocates the returns of a fund to the returns on various indexes and other benchmark funds. Style analysis is represented by:

$$\tilde{R}_{p,t} = [\delta_{1,p}x_{1,t} + \delta_{2,p}x_{2,t} + \dots + \delta_{n,p}x_{n,t}] + \tilde{\varepsilon}_{t,p} \quad t = 1, 2, 3, \dots, T$$

Where  $\tilde{R}_{p,t}$  represents the managed portfolio return at time  $t$  and  $x_1, x_2 \dots x_n$  are the returns on style benchmark index portfolios. The slope coefficients  $\delta_1, \delta_2 \dots \delta_n$  represent the managed portfolio average allocation among the different style benchmark index portfolios – or asset classes – during the relevant time period. The sum of the terms in the square brackets is that part of the managed portfolio return that can be explained by its exposure to the different style benchmarks and is termed the *style* of the manager. The residual component of the portfolio return,  $\tilde{\varepsilon}_{t,p}$ , reflects the manager's decision to depart from the benchmark composition within each style benchmark class. This is the part of return attributable to the manager's stock picking ability and is termed *selection*.<sup>21</sup>

In style analysis, the factor weights,  $\alpha$ , should sum to one. They can, however, be less than zero if the fund can take a short position in securities represented by one of the indices. This is particularly important to consider when finding factor weights for hedge funds, because of their ability to take short positions. In the style analysis on our data set, we allowed factor weights to be negative, but retained one as a constraint of the sum of the factor weights.

The objective of style analysis is to select a set of factor weights,  $\alpha$ , that minimizes the unexplained variation in returns (tracking error).<sup>22</sup>  $R^2$  represents the proportion of the variance explained by the selected style benchmark asset classes and is a useful metric for differentiating between active managers and passive managers. The definition of  $R^2$  is:

$$R^2 = 1 - \frac{Var(\tilde{\varepsilon}_p)}{Var(\tilde{R}_p)}$$

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<sup>21</sup> Jagannathan, Ravi and Ben Dor, Arik, "Understanding Mutual Fund And Hedge Fund Styles Using Return Based Style Analysis", Northwestern University And National Bureau Of Economic Research, May 2002

<sup>22</sup> Jagannathan and Ben Dor, May 2002

The right side of the equation equates to one minus the proportion of unexplained variance. The left side then indicates the proportion of the variance of  $R_p$  explained by the asset classes.

### *Implementing Style Analysis*

Using StyleAdvisor software by Zephyr Associates Inc., we performed a return-based style analysis. We used seventeen benchmark indices, each representing an asset class we deemed necessary to perform the analysis. We selected benchmarks to represent each of the publicly traded asset classes and subgroups within those asset classes, including t-bills, long-term U.S. government bonds, foreign bonds, corporate bonds, U.S. equities, foreign equities, emerging market equities, and options. See Table 4 for a list and descriptions.

TABLE 4: THE ASSET CLASSES AND INDEXES USED AS BENCHMARKS

ASSET CLASS	INDEX	DESCRIPTION <sup>23</sup>
Bills	Salomon Brothers' 90-day Treasury Bill index	Cash equivalence with less than 3-months to maturity
Government Bonds	Salomon Brothers' 1-10 Year Treasury Salomon Brothers' 10+Year Treasury	Intermediate Government bonds have maturity between 1 and 10 years. Long Term Bonds have maturity over 10 years.
Corporate Bonds	Salomon Corporate Bond Index	Corporate bonds with ratings of at least BB
U.S. Equity	Russell 1000 – Value Russell 1000 – Growth Russell 2000 – Value Russell 2000 – Growth	The Russell 1000 Index measures the performance of the 1,000 largest companies domiciled in the U.S. and represents approximately 91% of the investable U.S. equity market. The next 2,000 largest stocks constitute the Russell 2000 Index, which represents approximately 7% of the investable U.S. equity market. The two indexes are reconstituted annually to reflect changes in the marketplace. The returns of their constituents are market cap-weighted and include dividends. Stocks in each base index (the Russell 1000 and Russell 2000), are ranked by their price-to-book ratio (PBR) and their I/B/E/S forecast long-term growth mean (IBESLT).
Developed Equities	MSCI EAFE	Composite country index of all Developed countries except the U.S. The securities in each country are organized by industry group, and stocks are selected, targeting 60% coverage of market capitalization. Selection criteria include: size, long- and short-term volume, cross-ownership and float.
Emerging Markets	MSCI EMF Asia	The index covers 27 emerging market country indices.

<sup>23</sup> Jagannathan and Ben Dor, May 2002

ASSET CLASS	INDEX	DESCRIPTION <sup>23</sup>
	MSCI EMF Latin America MSCI EMF Europe/Middle East	Designation as an emerging market is determined by a number of factors such as GDP per capita, local government regulations, perceived investment risk; foreign ownership limits and capital controls. The index reflects only investable opportunities for global investors by taking into account local market restrictions on share ownership by foreigners.
Non-U.S. Bonds	Lehman Global Ex US Bond Index	Bonds outside the U.S. and Canada.
Options	S&P Call – In the money S&P Call – Out of the money S&P Put – In the money S&P Put – Out of the money	Once-a-month in short-maturity highly liquid European put and call options on the S&P 500 index. On the first trading day in every month, an at-the-money call or option on the S&P 500 with one month to maturity is purchased. On the first trading day of the following month, the option is sold and another at-the-money call or put option on the S&P 500 index that expires a month later is bought. This trading pattern is repeated every month. The returns from this trading strategy are calculated for two options: an at-the-money and out-of-the-money options <sup>24</sup> .

### *Option like features in hedge fund returns*

Glosten and Jagannathan (1994) suggested augmenting the return on style benchmark indices with returns on selected options on the style benchmark indices in order to capture the investment style of portfolio managers who employ dynamic trading strategies<sup>25</sup>. Fung and Hsieh (1998)<sup>26</sup>, Fung and Hsieh (2001)<sup>27</sup>, and Mitchell and Pulvino (2001)<sup>28</sup> have empirically demonstrated that returns generated by hedge fund strategies exhibit significant non-linear option like patterns. Agarwal and Naik (2001) showed how the systematic risk of hedge funds can be

<sup>24</sup> From the different strike price contracts available, Agarwal and Naik select the option where the strike price is closest to the current index value and define this to be at-the-money option. For calls (puts), they select the option with next higher (lower) strike price to be the out-of-the-money option.

<sup>25</sup> Glosten, Lawrence and Ravi Jagannathan, 1994, “A Contingent Claim Approach to Performance Evaluation,” *Journal of Empirical Finance*, 1, 133-160.

<sup>26</sup> Fung, William and David A. Hsieh, 1998, “Performance Attribution and Style Analysis: From Mutual Funds to Hedge Funds,” Duke University working paper.

<sup>27</sup> Fung, William and David A. Hsieh, 2001a, “The Risks in Hedge Fund Strategies: Theory and Evidence From Trend Followers,” *Review of Financial Studies*, 14, 313-341.

<sup>28</sup> Mitchell, Mark, and Todd Pulvino, 2001, “Characteristics of Risk in Risk Arbitrage,” *Journal of Finance*, forthcoming.

expressed through a combination of naïve option-based strategies on the S&P 500 Index and standard asset classes like equities and bonds<sup>29</sup>. Agarwal and Naik found that the inclusion of options trading strategies increased the explanatory power of the regression dramatically and accounted for the non-linear component of returns.<sup>30</sup> We have included these option indices in our benchmark.

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<sup>29</sup> Agarwal, Vikas, and Narayan Naik, 2001, "Characterizing Systematic Risk of Hedge Funds with Buy-and-Hold and Option-Based Strategies," Working Paper, London Business School.

<sup>30</sup> Jagannathan and Ben Dor, May 2002

## The Results

### *Regression Results*

To evaluate the results of the regressions, we calculated the t-statistics and p-values for each of the fund regressions. Tables 5 and 6 summarize the information; they provide a count of the number of funds in each strategy that had a two-tailed p-value of less than 5% (and a corresponding t-statistic with magnitude >1.96) and the percentage of the funds in that strategy the count represents.

TABLE 5: NUMBER OF FUNDS WITH P-VALUES  $\leq 5\%$ , 1999-2001

STRATEGY	# OF FUNDS	S&P		NASDAQ		10-YEAR		LIBOR		VIX	
		#	%	#	%	#	%	#	%	#	%
CONVERTIBLE	39	0	0%	1	3%	4	10%	11	28%	2	5%
DEDICATED SHORT	4	1	25%	0	0%	0	0%	0	0%	2	50%
EMERGING MARKETS	71	2	3%	1	1%	7	10%	8	11%	3	4%
EQUITY LONG SHORT	177	0	0%	11	6%	11	6%	4	2%	0	0%
EVENT DRIVEN	91	0	0%	0	0%	5	5%	33	36%	4	4%
FIXED INCOME	31	0	0%	0	0%	2	6%	19	61%	0	0%
FUND OF FUNDS	91	1	1%	1	1%	3	3%	11	12%	6	7%
TOTAL	504	4	1%	14	3%	32	6%	86	17%	17	3%

TABLE 6: NUMBER OF FUNDS WITH P-VALUES  $\leq 5\%$ , 1995-2001

STRATEGY	# OF FUNDS	S&P		NASDAQ		10-YEAR		LIBOR		VIX	
		#	%	#	%	#	%	#	%	#	%
CONVERTIBLE	17	0	0%	0	0%	2	12%	5	29%	2	12%
DEDICATED SHORT	4	1	25%	0	0%	0	0%	0	0%	2	50%
EMERGING MARKETS	18	2	11%	0	0%	6	33%	5	28%	2	11%
EQUITY LONG SHORT	77	3	4%	0	0%	6	8%	2	3%	7	9%
EVENT DRIVEN	49	4	8%	6	12%	18	37%	15	31%	10	20%
FIXED INCOME	11	0	0%	0	0%	1	9%	7	64%	4	36%
FUND OF FUNDS	50	1	2%	1	2%	9	18%	7	14%	3	6%
TOTAL	226	11	5%	7	3%	42	19%	41	18%	30	13%



As you can see from the charts above, only 1%, 3%, 6% and 3% of the funds had meaningful p-values with respect to the S&P, NASDAQ, Ten-year Treasury and VIX for the 1999-2001 period. Those percentages were slightly higher for the 1995-2001 period but still only reflected 5%, 3%, 18% and 13% of the funds. It is not surprising that there are some funds that are influenced by LIBOR because of the relationship between LIBOR and the return on cash; we will discuss why the return on cash is relevant to hedge funds in more detail in style analysis results section.

These results indicate that no trading strategy is strongly correlated with any of the indices used. This set of regressions indicates that hedge funds meet the first criteria to be treated as a separate asset class. Exhibits 1 and 2 provide additional details of the regression results, including averages of the regression statistics and correlation coefficients.

### ***Factor Analysis Results***

Our factor analysis supported the findings from the regressions; hedge fund returns do not show a meaningful relationship to other asset classes. Using  $R^2$  as a measure of how much of the fund returns are attributable to the style benchmark, we first look at the average  $R^2$  found during our Style Analysis. The results show that the 17 factors only account for ~60% of the mean variance in the portfolios (See Table 7). Good results would expect more of the variance to be accounted for; if a mutual fund manager only met his or her style benchmark with a 60%  $R^2$ , that would be considered a problem.

TABLE 7: MEAN  $R^2$  AND STANDARD DEVIATION FOR EACH STRATEGY

STRATEGY	MEAN $R^2$	STANDARD DEVIATION OF $R^2$
Convertibles	56.14	12.58
Event Driven	56.52	15.88
Emerging Markets	61.01	17.72
Fixed Income	54.48	11.93
Fund of Funds	67.74	14.40
Long Short	67.74	13.76
Short Seller	29.73	28.57

In addition, the  $R^2$  are not consistent within a strategy. The  $R^2$  show substantial variation around the mean. The standard deviation for the  $R^2$  across a strategy is also shown in Table 7 above. Most of the strategies showed a standard deviation of around 15%, or a quarter of the mean. This shows that the benchmark was not consistently reflecting the performance of funds in the strategy.

The next question to address is if hedge funds are not correlated to other asset classes, should they be considered an asset class on their own? One way to look at asset classes is to say that to be a distinct asset class, a group of securities should meet two criteria: it should not be correlated to any other asset class, showing it to be distinct, and the securities within the group should follow similar behavior, showing it to be a cohesive class. This does not mean that the behavior needs to be tightly mandated, but some trends should be evident.

To evaluate this, we reviewed the weights assigned to each of the factors, by strategy. Exhibits 9 through 15 show the mean factor weights and standard deviation of the factor weights for each strategy. If hedge funds are a candidate as an asset class of their own, there should be a similar mix of factors across funds and across strategies.

To show whether hedge funds behave consistently with respect to the factors, we looked at the consistency of the factor relationship (positive or negative) and the significance of the weight on that factor. To screen the factors, we set up two criteria. If at least 6 of the 7 strategies had the same sign on the factor weight (positive or negative), then the strategy behaved consistently with respect to that factor. If the average weight on the factor had a magnitude greater than 0.15 and the standard deviation was less than the magnitude of the mean factor weight, we considered the factor to be meaningful. Table 8 summarizes the results of this screen.

TABLE 8: CONSISTENCY OF FACTOR WEIGHT, SIGN AND MAGNITUDE

	STRATEGY COUNT (OF 7)		MEAN FACTOR WEIGHT	STANDARD DEVIATION OF FACTOR WEIGHT
	POSITIVE WEIGHT	NEGATIVE WEIGHT		
<b><i>Salomon 3-month T-bill</i></b>	<b>7</b>	<b>0</b>	<b>0.71</b>	<b>0.40</b>
Salomon 1-10 Yr. Governments	3	4	-0.01	0.29
Salomon 10+ Yr. Governments	5	2	0.05	0.11
Salomon Corporate Bond Index	4	3	0.08	0.47
Russell 1000 Growth	1	6	-0.09	0.09

	STRATEGY COUNT (OF 7)		MEAN FACTOR WEIGHT	STANDARD DEVIATION OF FACTOR WEIGHT
	POSITIVE WEIGHT	NEGATIVE WEIGHT		
Russell 1000 Value	3	4	-0.02	0.09
Russell 2000 Growth	6	1	0.05	0.15
Russell 2000 Value	2	5	0.02	0.10
MSCI EAFE Index	5	2	0.06	0.11
MSCI EMF Asia	5	2	0.03	0.05
MSCI EMF Latin America	4	3	0.03	0.05
MSCI EM Europe/Middle East	6	1	0.05	0.05
Lehman Global Ex US Bond Index	1	6	-0.12	0.14
Call - in the money	5	2	0.39	0.43
Call - out of the money	2	5	-0.14	0.16
<b>Put - in the money</b>	<b>1</b>	<b>6</b>	<b>-0.19</b>	<b>0.15</b>
Put - out of the money	6	1	0.10	0.11

By those criteria, two factors were meaningful for our set of hedge funds. The cash equivalent, in this case the Salomon 3-month T-bill, was positive for all seven strategies and had a mean factor weight of 0.71. There are two probable sources for this relationship.

First, the return on cash can be considered the risk-free rate of return and is a common benchmark in investment management. Thus, a fund with assets to invest must always consider the return on an investment relative to that rate. The nature of arbitrage is to capitalize on a discontinuity in the market; with many hedge funds competing for these arbitrage opportunities, the returns on a given trade are competed down to a return that reflects the return on cash plus a risk premium. If the cash rate changes, it is likely that funds will adjust the returns they demand on a given trade.

Second, hedge funds are allowed to short securities. When a fund holds a short position, if the underlying security drops, the fund receives a rebate on the short. This rebate is calculated based on the risk-free rate. Thus, the return a fund expects through the life of a trade is related to the cash position if the trade includes a short position.

The other factor that was meaningful was a written, in the money put. As mentioned in The Method section, this relationship reflects empirically demonstrated option-like behavior of hedge funds.<sup>31</sup>

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<sup>31</sup> Mitchell and Pulvino, 2001

These two factors show that there is some consistency across the hedge funds we are using. While not conclusive, these results suggest that hedge funds behave similarly and meet the second criteria for an asset class.

## **Fund of Funds – A Systematic Approach to Diversity**

### ***Purpose and Method***

Fund of fund managers seek to create a diverse portfolio of hedge funds. With the exception of Dedicated Strategy fund of funds, managers achieve diversification through investing in different strategies. Managers are conscious to not become over-weighted in a single trading strategy. However, based on conversations with fund of fund managers, it does not appear that managers concern themselves with becoming over-weighted in trading strategies that are highly correlated with each other. The purpose of the analysis discussed below is 1) to determine if any trading strategies are correlated with each other 2) If there are trading strategies that are correlated with each other, then determine if there is a systematic approach to diversification.

Consistent with the methods and criteria discussed above, we ran a series of regressions regressing the Sharpe ratios of the different trading strategies against each other. The trading strategies considered in the regression were Convertible Arbitrage, Dedicated Short, Emerging Market, Equity Long Short, Event Driven, and Fixed Income. In each regression the weighted average Sharpe ratio of a specific trading strategy was individually regressed against the Sharpe ratios of the funds in the remaining trading strategies.

We ran the regressions above over two time periods: 1999-2001 and 1995-2001. All 413 funds in six strategies (excluding the Fund of Funds strategy) in our data set were included in the 1999-2001 run and the funds that existed in 1995 were included in the 1995-2001 run.

### ***Data Analysis***

While no strategy yielded a high t-statistic when regressed against other strategies, there were interesting  $R^2$ 's implying some correlations among Equity Long Short funds, Emerging Market funds, and Event Driven funds. While  $R^2$  is not as strong an indicator as the t-statistic, given its high level between these three trading strategies, we believed it worth pursuing. Exhibits 3 and 4 detail the  $R^2$ 's calculated.

### ***Simulation to Test Systematic Approach to Diversity***

The concept of a systematic approach to diversity is best explored with a simulation. We created a simulation to compare the volatility of fund of funds that invest equally among all trading strategies versus the volatility of fund of funds that invest equally among baskets of correlated trading strategies.

The simulation created two series of 10,000 fund of funds each. The first series mimicked fund of funds that invest equally across all strategies. The second series mimicked fund of funds that group strategies that are correlated together into a “basket”, reducing the correlation of the funds it holds. To effectively represent a fund of funds manager selecting hedge funds at the beginning of 1999, we only included hedge funds with positive returns in 1998 in the simulation.

The first simulation compared the average three-year returns and average standard deviations (1999 to 2001) of a fund of funds that invested in a total of twelve funds split equally amongst the six trading strategies (standard diversification) with the three-year average returns and average standard deviation of a fund of funds that invested in a total of twelve funds split equally amongst four baskets of strategies (basket approach). See Table 9 to see the strategies in each basket.

TABLE 9: SIMULATION BASKETS

BASKETS	FUNDS
Basket 1	Convertible
Basket 2	Dedicated Shorts
Basket 3	Emerging Market, Equity Long Short, Event Driven
Basket 4	Fixed Income

Given that the Dedicated Short basket only offered four funds to choose from, a second simulation was run excluding this category. This simulation compared the average three year returns and average standard deviations of a fund of funds that invests in a total of fifteen funds split equally amongst five trading strategies with the average three year returns and standard deviations of a fund of funds that invests in a total of fifteen funds split equally amongst 3

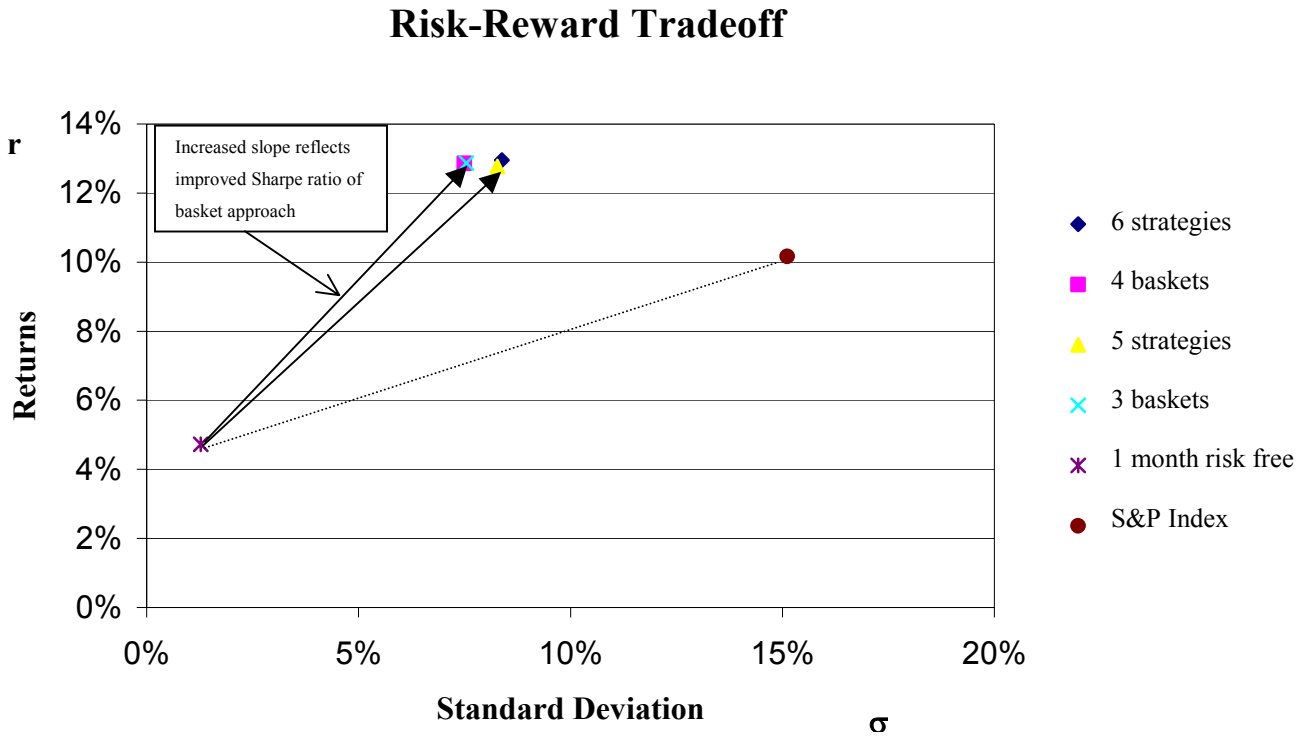
baskets of hedge funds. Table 10 shows a summary of the simulation results. Please refer to Exhibits 5 through 8 for more detailed result of the simulation.

TABLE 10: SIMULATION RESULTS

SIMULATION 1	3-YR AVERAGE RETURN	3-YR STDEV
6 Strategies	12.96%	8.38%
4 Baskets	12.86%	7.50%
SIMULATION 2		
5 Strategies	12.77%	8.28%
3 Baskets	12.87%	7.55%

In the first simulation the basket approach offers a *slightly lower* return than the six-strategy approach for *significantly lower* volatility. In the second simulation the basket approach provides a *slightly higher* return than the five-strategy approach for *significantly lower* volatility. Both simulations support the conclusion that the basket approach provides a better form of diversification. The chart below highlights the magnitude of the risk-return tradeoff.

CHART 1: RISK-RETURN TRADEOFF OF BASKET STRATEGY



As is evident from the chart above, a manager using this approach would be able to achieve a higher Sharpe ratio, demonstrated by the higher slope of the basket approach.<sup>32</sup>

<sup>32</sup> The returns depicted in the chart are net of the fees from the individual hedge funds but are gross of fees from the fund of funds. An individual investor diversifying with the basket approach could achieve these returns; a fund of funds investor would have to pay an additional 10% incentive fee.



## **Conclusion**

Our analysis indicates that hedge funds should be seriously considered a new major asset class. Further, our analysis shows that there is significant potential for the managers of fund of funds to use the correlations inherent within the various hedge fund strategies to create a more systematic approach to diversification. This approach can both reduce the volatility in fund of funds and result in improved risk-reward performance.

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## Exhibits

**Exhibit 1. Summary Statistics**  
**Regression Analysis - Correlation to Indices**  
**January 1995 - March 2002**

<b>Strategy</b>	Convertible				
Total #	17				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	1.6465	1.8640	2.5958	4.6501	5.7030
Mean	0.7435	0.8565	0.8712	1.8800	1.3353
Standard Deviation	0.4833	0.4897	0.8380	1.6884	1.3309
<i>Correlation</i>					
Max	0.0196	0.0397	0.1617	0.0751	0.1571
Mean	(0.0738)	(0.0873)	(0.0644)	(0.1803)	(0.1011)
Standard Deviation	0.0582	0.0604	0.1119	0.1750	0.1541

<b>Strategy</b>	Dedicated Strategy				
Total #	4				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	2.3570	1.6387	1.4142	1.0503	3.4239
Mean	1.1725	1.0344	0.9567	0.6792	2.1512
Standard Deviation	0.9526	0.6971	0.3150	0.4101	1.1055
<i>Correlation</i>					
Max	0.2477	0.1750	0.1516	(0.0110)	0.3481
Mean	0.1013	0.1058	0.0655	(0.0733)	0.1576
Standard Deviation	0.1302	0.0836	0.0978	0.0442	0.2139

<b>Strategy</b>	Emerging Market				
Total #	18				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	2.0396	1.6893	2.9139	2.6985	3.2914
Mean	1.0008	0.7704	1.6090	1.2435	1.0275
Standard Deviation	0.6178	0.5000	0.8486	0.8210	0.9013
<i>Correlation</i>					
Max	0.1005	0.1271	0.1979	0.1930	0.1521
Mean	(0.0879)	(0.0597)	(0.1412)	(0.1074)	(0.0222)
Standard Deviation	0.0910	0.0797	0.1311	0.1169	0.1436

<b>Strategy</b>	Equity Long Short				
Total #	77				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	2.3570	1.9007	2.6575	8.5948	3.4239
Mean	0.7944	0.7598	0.9106	0.8610	0.8076
Standard Deviation	0.5477	0.5147	0.6136	1.2711	0.7184
<i>Correlation</i>					
Max	0.2477	0.2019	0.2179	0.1964	0.3481
Mean	0.0092	0.0203	(0.0594)	(0.0192)	(0.0077)
Standard Deviation	0.1047	0.0968	0.1034	0.1366	0.1122

<b>Strategy</b>	Event Driven				
Total #	49				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	3.1552	2.3208	3.3896	4.7090	4.0317
Mean	0.8492	0.7592	1.4830	1.4206	1.1477
Standard Deviation	0.7054	0.7155	0.9970	1.1592	0.8701
<i>Correlation</i>					
Max	0.0762	0.0312	0.1330	0.1244	0.4007
Mean	(0.0752)	(0.0768)	(0.1445)	(0.1264)	(0.0708)
Standard Deviation	0.0899	0.0820	0.1160	0.1408	0.1375

<b>Strategy</b>	Fixed Income				
Total #	11				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	1.4480	0.8882	2.7147	4.2323	4.4614
Mean	0.8574	0.4504	0.9971	2.5129	1.8860
Standard Deviation	0.5053	0.3457	0.6767	1.1746	1.7541
<i>Correlation</i>					
Max	0.1388	0.0959	0.1455	(0.0742)	0.3597
Mean	0.0182	0.0025	(0.0543)	(0.4144)	(0.0679)
Standard Deviation	0.1093	0.0632	0.1191	0.2654	0.2534

<b>Strategy</b>	Fund of Funds				
Total #	50				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	2.2280	2.1176	4.4399	3.0361	3.8792
Mean	0.8235	0.6453	1.1891	0.8984	0.8328
Standard Deviation	0.5337	0.4913	0.9446	0.7898	0.7099
<i>Correlation</i>					
Max	0.1016	0.2239	0.4339	0.2398	0.1734
Mean	(0.0689)	(0.0142)	(0.0582)	(0.0636)	(0.0578)
Standard Deviation	0.0757	0.0865	0.1477	0.1096	0.0997

**Exhibit 2. Summary  
Statistics  
Regression Analysis - Correlation to Indices  
January 1999 - March 2002**

<b>Strategy</b>	Convertible				
Total #	39				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	1.7342	2.2265	3.2726	5.7356	2.1647
Mean	0.4940	0.6408	1.0220	1.3764	0.8774
Standard Deviation	0.4175	0.5067	0.7056	1.5169	0.5843
<i>Correlation</i>					
Max	0.2742	0.3437	0.3222	0.2776	0.3353
Mean	0.0066	(0.0467)	(0.0235)	(0.1679)	0.1048
Standard Deviation	0.1049	0.1233	0.1943	0.2273	0.1321

<b>Strategy</b>	Dedicated Strategy				
Total #	4				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
Max	2.0494	1.9074	0.7746	0.9185	2.7823
Mean	1.1836	1.2933	0.4179	0.4603	1.7989
Standard Deviation	0.9545	0.6646	0.3583	0.4117	1.1285
<i>Correlation</i>					
Max	0.3193	0.2992	0.1263	(0.0069)	0.4160
Mean	0.1681	0.2054	(0.0051)	(0.0751)	0.1360
Standard Deviation	0.1741	0.1019	0.0980	0.0669	0.3209

<b>Strategy</b>	Emerging Market				
Total #	71				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	2.5390	2.1716	3.2726	17.9422	3.1761
Mean	0.6784	0.6150	0.9866	1.2823	0.9038
Standard Deviation	0.5226	0.4825	0.7133	2.1716	0.6314
<i>Correlation</i>					
Max	0.3852	0.3210	0.1646	0.2229	0.2963
Mean	(0.0058)	0.0045	(0.1348)	(0.1674)	0.0485
Standard Deviation	0.1537	0.1295	0.1468	0.1921	0.1707

<b>Strategy</b>	Equity Long Short				
Total #	177				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	1.4091	2.1500	2.3310	6.5234	1.7141
Mean	0.6146	0.7055	0.9608	0.8307	0.7462
Standard Deviation	0.4111	0.5542	0.5683	1.4250	0.5020
<i>Correlation</i>					
Max	0.2239	0.3333	0.1718	0.1749	0.2025
Mean	0.0230	0.0664	(0.1079)	(0.0079)	(0.0216)
Standard Deviation	0.1196	0.1288	0.1435	0.1036	0.1549

<b>Strategy</b>	Event Driven				
Total #	91				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	1.9164	1.8624	3.0912	5.9021	2.6814
Mean	0.6328	0.6223	0.8575	1.6773	0.8346
Standard Deviation	0.4667	0.4760	0.6827	1.3781	0.5803
<i>Correlation</i>					
Max	0.2556	0.2632	0.2704	0.1889	0.4034
Mean	(0.0031)	(0.0438)	(0.0984)	(0.2190)	0.0231
Standard Deviation	0.1255	0.1187	0.1423	0.2253	0.1621

<b>Strategy</b>	Fixed Income				
Total #	31				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	1.4739	1.6093	2.6734	6.1697	1.9039
Mean	0.7079	0.5823	0.9507	2.5247	0.5933
Standard Deviation	0.4024	0.3967	0.6105	1.6763	0.5514
<i>Correlation</i>					
Max	0.2355	0.2558	0.4024	(0.0049)	0.2987
Mean	0.1010	0.0506	0.0104	(0.4499)	0.0697
Standard Deviation	0.0851	0.1008	0.1804	0.2627	0.1123

<b>Strategy</b>	Fund of Funds				
Total #	91				
<b>Indices</b>	S&P	NASDAQ	10-year	LIBOR	VIX
<i>T-Statistic - Absolute Value</i>					
Max	2.2403	2.6942	4.5191	7.4079	2.7864
Mean	0.6178	0.6569	0.8051	0.8967	0.8049
Standard Deviation	0.4657	0.5293	0.6426	1.0501	0.6050
<i>Correlation</i>					
Max	0.3230	0.4050	0.2912	0.3079	0.3404
Mean	0.0757	0.0889	(0.0211)	(0.1110)	0.0247
Standard Deviation	0.0965	0.1079	0.1386	0.1688	0.1504



**Exhibit 3. Summary Statistics**  
**Regression Analysis - Correlation Amongst Trading Strategies**  
**January 1995 - March 2002**

<b>Dependent Variable</b>	Convertible
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Dedicated Short	6%
Emerging Market	77%
Equity Long Short	77%
Event Driven	79%
Fixed Income	64%

<b>Dependent Variable</b>	Dedicated Short
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	67%
Emerging Market	67%
Equity Long Short	74%
Event Driven	62%
Fixed Income	35%

<b>Dependent Variable</b>	Emerging Market
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	73%
Dedicated Short	18%
<b>Equity Long Short</b>	<b>89%</b>
<b>Event Driven</b>	<b>81%</b>
Fixed Income	76%

<b>Dependent Variable</b>	Equity Long Short
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	79%
Dedicated Short	0%
<b>Emerging Market</b>	<b>91%</b>
<b>Event Driven</b>	<b>87%</b>
Fixed Income	54%

<b>Dependent Variable</b>	Event Driven
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	78%
Dedicated Short	39%
<b>Emerging Market</b>	<b>87%</b>
<b>Equity Long Short</b>	<b>93%</b>
Fixed Income	52%

<b>Dependent Variable</b>	Fixed Income
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	70%
Dedicated Short	18%
Emerging Market	84%
Equity Long Short	83%
Event Driven	69%

The Strategies highlighted in *red* are those strategies that yielded significant correlation with each other consistently across the regressions analyzed.

**Exhibit 4. Summary Statistics**  
**Regression Analysis - Correlation Amongst Trading Strategies**  
**January 1999 - March 2002**

<b>Dependent Variable</b>	Convertible
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Dedicated Short	14%
Emerging Market	81%
Equity Long Short	79%
Event Driven	80%
Fixed Income	55%

<b>Dependent Variable</b>	Dedicated Short
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	66%
Emerging Market	21%
Equity Long Short	76%
Event Driven	62%
Fixed Income	41%

<b>Dependent Variable</b>	Emerging Market
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	77%
Dedicated Short	48%
<b>Equity Long Short</b>	<b>92%</b>
<b>Event Driven</b>	<b>84%</b>
Fixed Income	76%

<b>Dependent Variable</b>	Equity Long Short
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	82%
Dedicated Short	60%
<b>Emerging Market</b>	<b>94%</b>
<b>Event Driven</b>	<b>89%</b>
Fixed Income	63%

<b>Dependent Variable</b>	Event Driven
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	81%
Dedicated Short	73%
<b>Emerging Market</b>	<b>92%</b>
<b>Equity Long Short</b>	<b>92%</b>
Fixed Income	67%

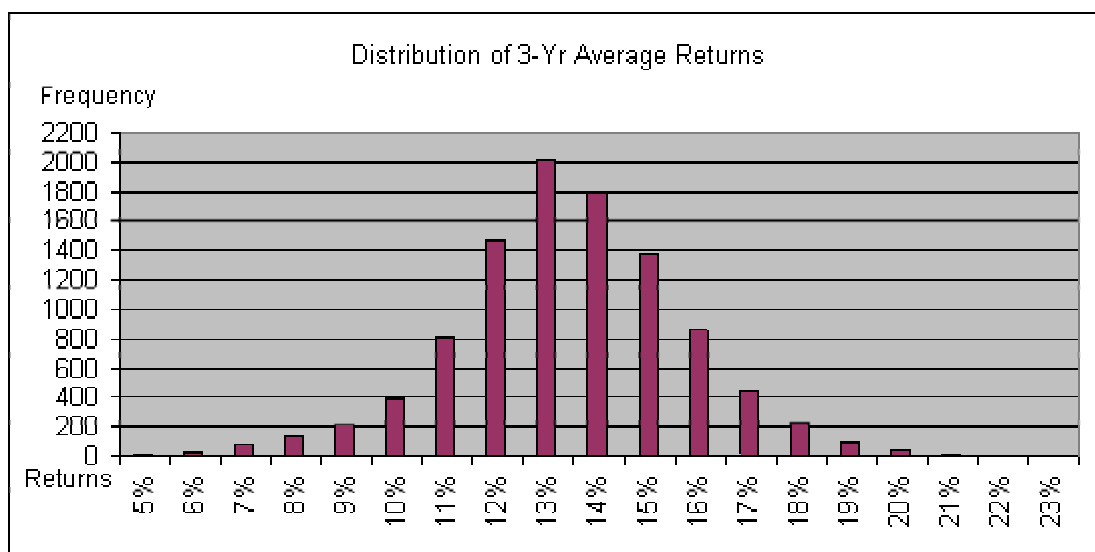
<b>Dependent Variable</b>	Fixed Income
<i>Independent Variable</i>	<u>R<sup>2</sup></u>
Convertible	74%
Dedicated Short	28%
Emerging Market	86%
Equity Long Short	86%
Event Driven	75%

The Strategies highlighted in *red* are those strategies that yielded significant correlation with each other consistently across the regressions analyzed.

**Exhibit 5. Summary Statistics**  
**Approach A - 6 Strategies**

Strategies	# Funds
Convertible	26
Dedicated Short	3
Equity Long Short	124
Event Driven	60
Emerging Market	7
Fixed Income	15

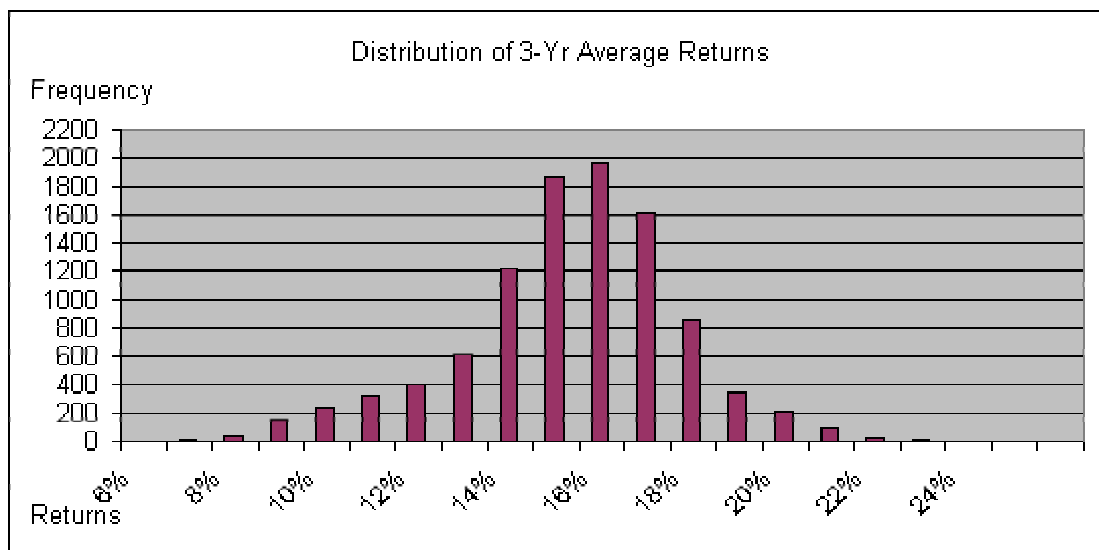
	Simulation Statistics			
	Annual 99	Annual 00	Annual 01	3-Yr Average
Average	22.11%	9.39%	7.37%	12.96%
Standard Deviation				8.38%
Frequency				
0%	0	132	333	0
10%	6	5,489	7,640	846
20%	3,217	4,290	2,027	9,138
30%	6,363	89	0	16
40%	411	0	0	0
50%	3	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
100%	0	0	0	0



**Exhibit 6. Summary Statistics**  
**Approach B - 4 Baskets**

Strategies	# Funds
Basket 1	26
Basket 2	3
Basket 3	191
Basket 4	15

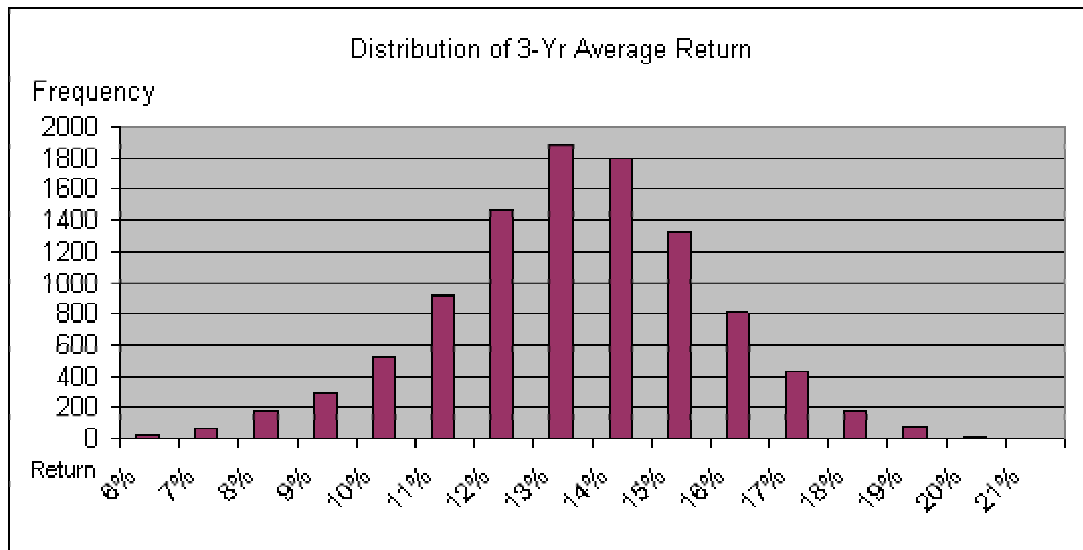
	Simulation Statistics			
	Annual 99	Annual 00	Annual 01	3-Yr Average
Average	20.76%	11.06%	6.76%	12.86%
Standard Deviation				7.50%
Frequency				
0%	0	63	613	0
10%	0	3,616	7,895	1,174
20%	4,275	6,159	1,492	8,808
30%	5,601	162	0	18
40%	124	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
100%	0	0	0	0



**Exhibit 7. Summary Statistics**  
**Approach A - 5 Strategies**

Strategies	# Funds
Convertible	26
Equity Long Short	124
Event Driven	60
Emerging Market	7
Fixed Income	15

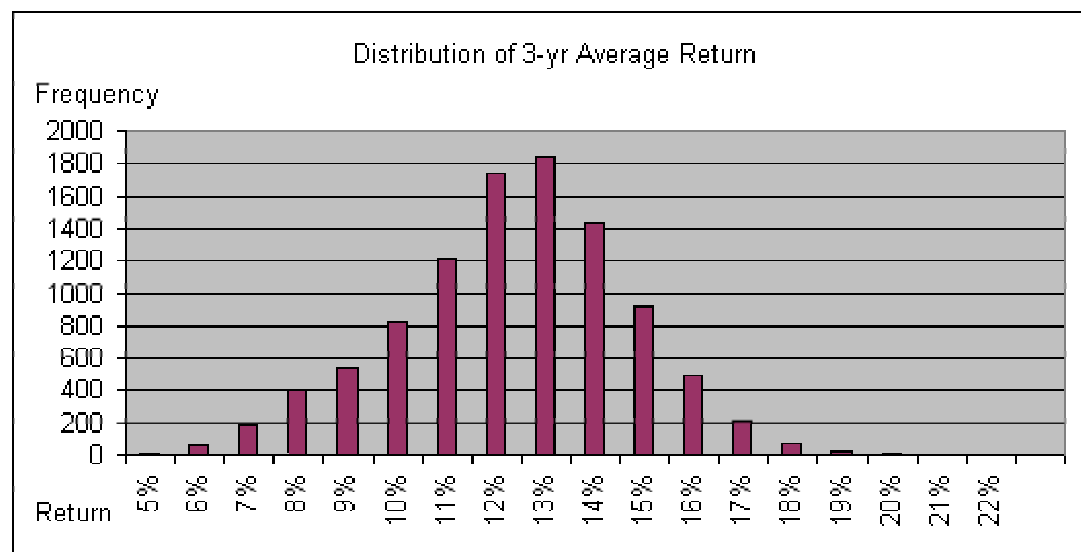
	Simulation Statistics			
	Annual 99	Annual 00	Annual 01	3-Yr Average
Average	21.88%	9.28%	7.15%	12.77%
Standard Deviation				8.28%
Frequency				
0%	0	90	288	0
10%	3	5,741	7,881	1,070
20%	3,225	4,115	1,831	8,924
30%	6,537	54	0	6
40%	235	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
100%	0	0	0	0



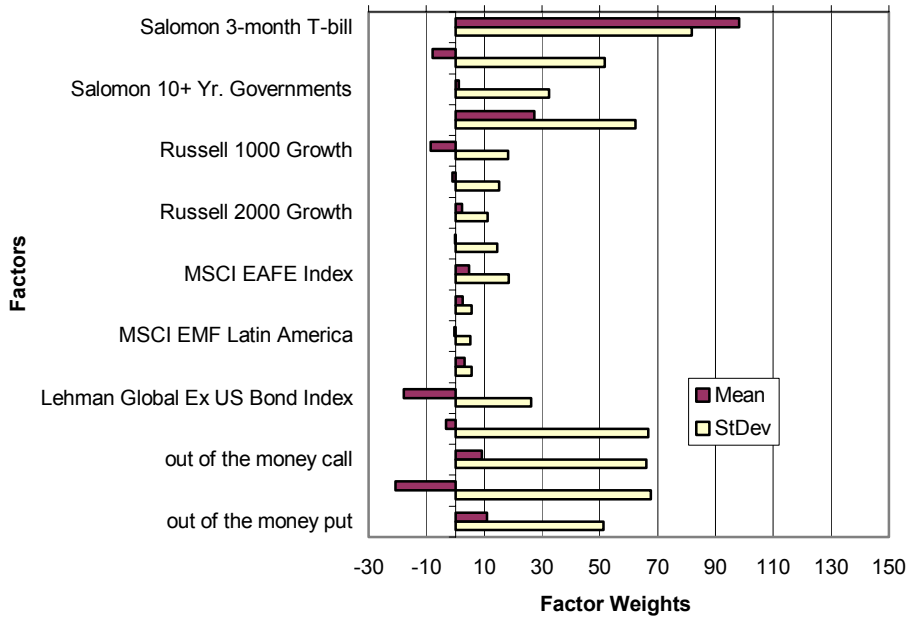
**Exhibit 8. Summary Statistics**  
**Approach B - 3 Baskets**

Strategies	# Funds
Basket 1	26
Basket 2	191
Basket 3	15

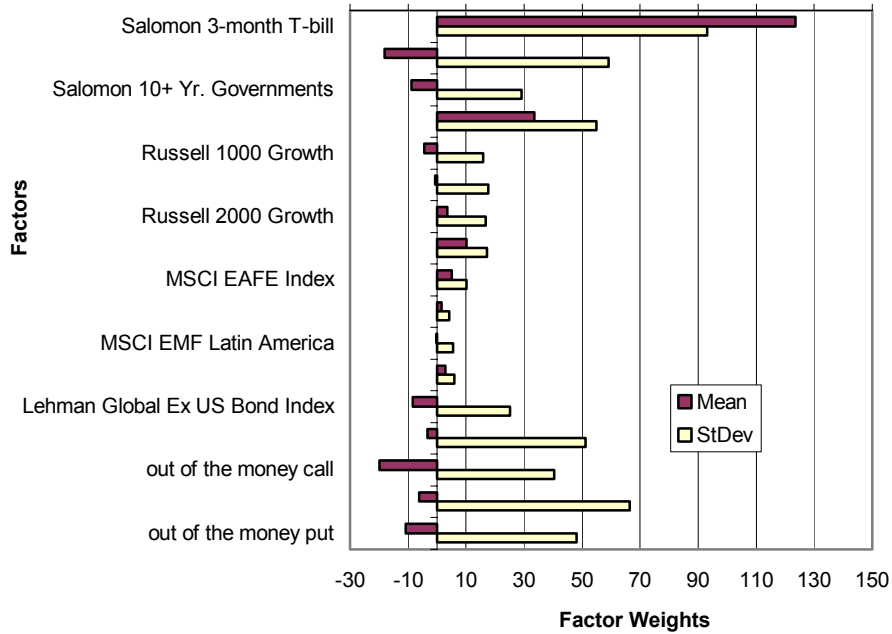
	Simulation Statistics			
	Annual 99	Annual 00	Annual 01	3-Yr Average
Average	20.65%	11.44%	6.52%	12.87%
Standard Deviation				7.55%
Frequency				
0%	0	35	477	0
10%	3	3,509	8,060	1,207
20%	4,564	6,256	1,463	8,783
30%	5,317	200	0	10
40%	116	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
100%	0	0	0	0



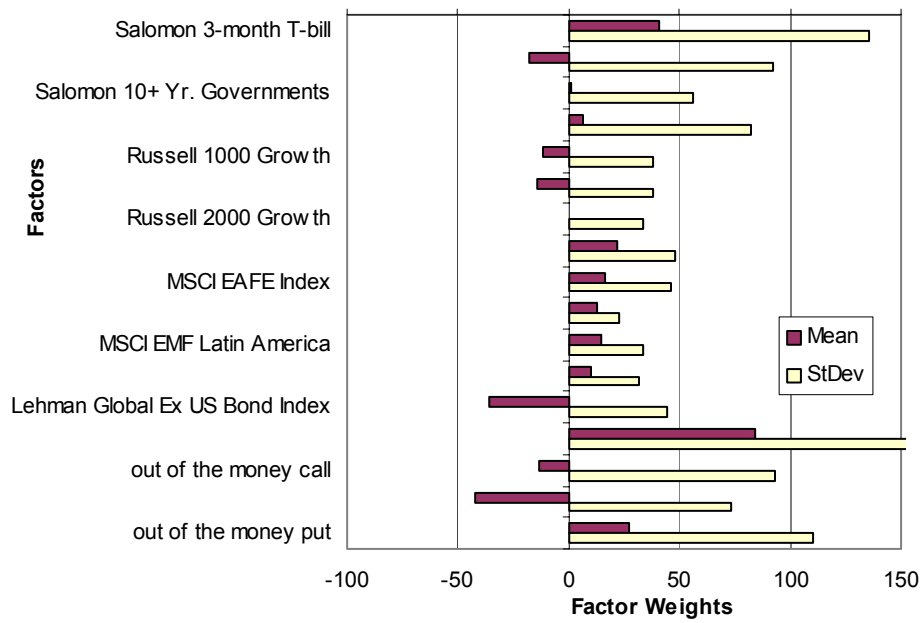
**Exhibit 9: Factor Weights for Convertible Arbitrage**



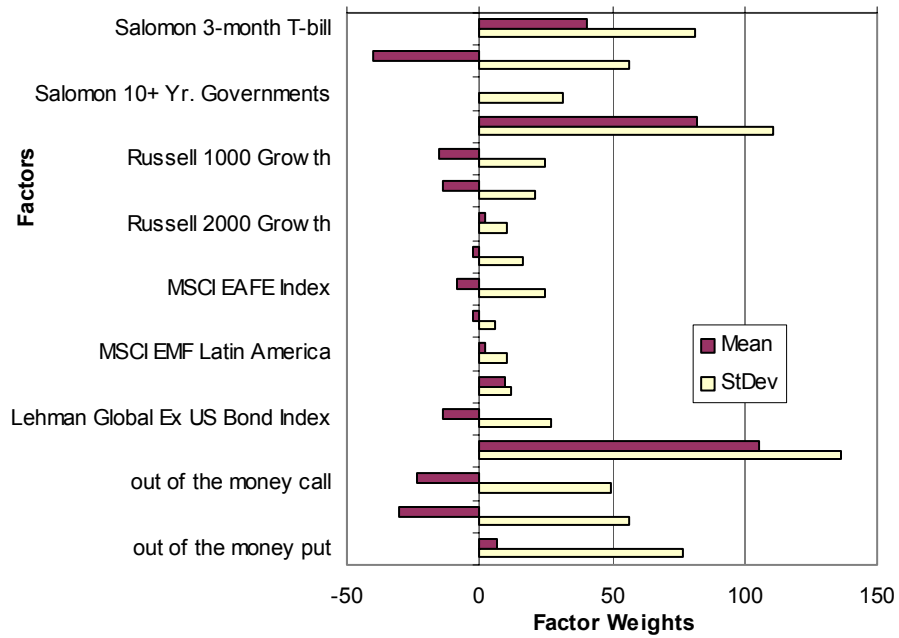
**Exhibit 10: Factor Weights for Event Driven**



**Exhibit 11: Factor Weights for Emerging Markets**

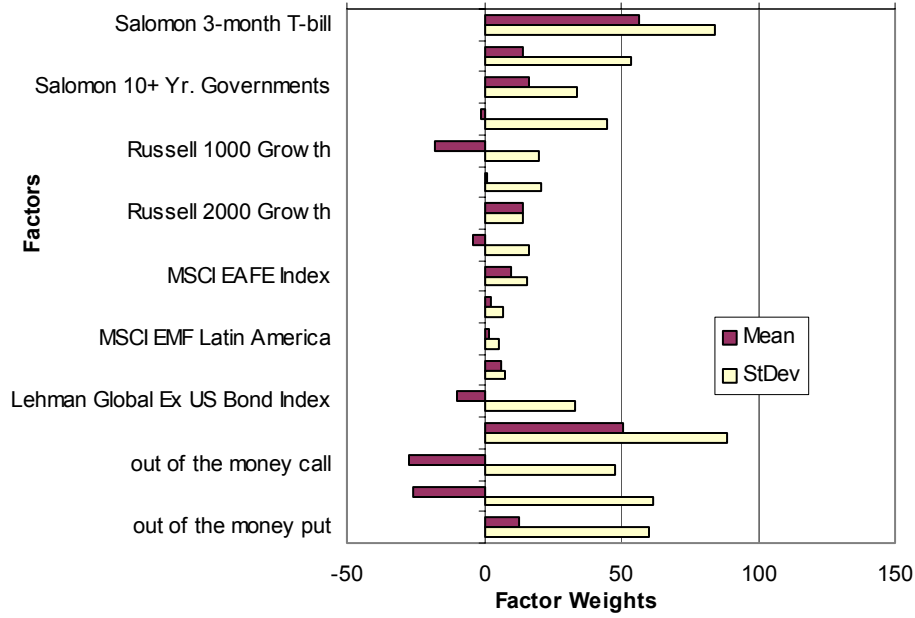


**Exhibit 12: Factor Weights for Fixed Income**

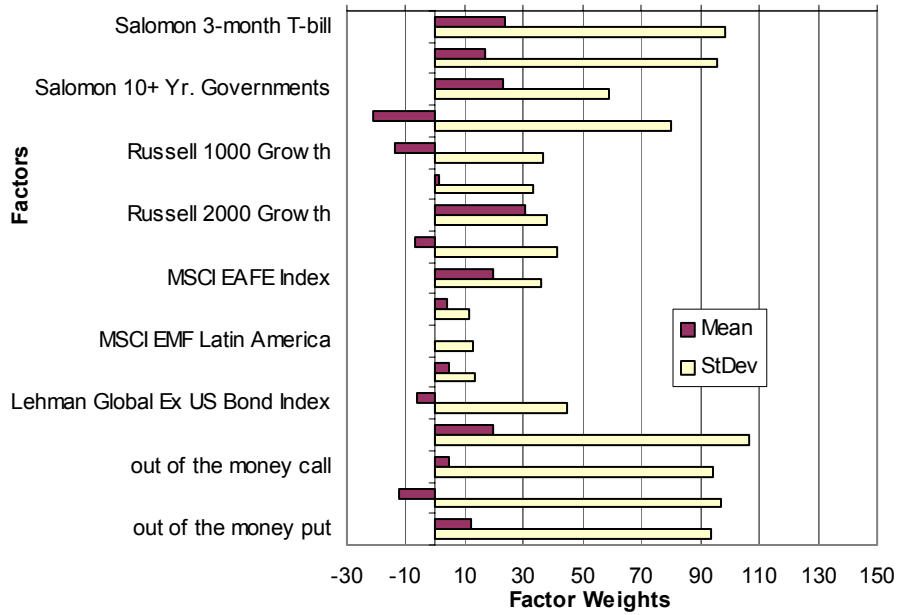




**Exhibit 13: Factor Weights for Fund of Funds**



**Exhibit 14: Factor Weights for Long Short Equity**



**Exhibit 15: Factor Weights for Short Sellers**

