WHY HEDGE FUNDS MAKE SENSE

OVERVIEW NOVEMBER 2000

The hedge fund industry has experienced enormous growth in the last decade, growing by some estimates from as few as 300 funds in 1990 to more than 3000 today. They have become highly visible and are thought to command up to $400 billion in capital before leverage. In this article, we analyze the performance and risk characteristics of hedge funds. We evaluate the reasons why hedge funds have produced high levels of risk-adjusted return and alpha, and show how portfolios of hedge funds can enhance strategic asset allocation for both pension funds and endowments. We conclude that hedge funds will increasingly challenge conventional investment management.

- Over the past ten years, **the typical individual hedge fund has produced risk adjusted returns that are quite similar to the typical mutual fund manager.** However, individual hedge funds have realized a much wider range of performance compared with mutual funds.

- **Indexes of hedge funds tend to display risk-adjusted performance superior to traditional active managers and passive benchmarks.**

  - **Volatility of hedge fund indexes is typically much lower than that of mutual fund indexes and equity benchmarks.** This is because of the low correlation among individual hedge funds.

- **The performance of hedge fund indexes can be closely approximated with a portfolio of as few as 20 hedge funds,** suggesting a pooled fund-of-funds approach as a viable alternative investment strategy.

- **Hedge fund portfolios also exhibit a low correlation with traditional asset classes, suggesting that hedge funds should play an important role in strategic asset allocation.**

  - We illustrate the efficacy of hedge funds for typical pension and endowment funds using MSDW's asset-liability modeling framework.

- **Evidence points to continued success for hedge fund managers.**

  - Historical performance of hedge funds appears to be based on the exploitation of market inefficiencies. Due to the expected growth in the supply of these inefficiencies, the advantages of hedge fund investments are not likely to diminish soon. ■

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WHY HEDGE FUNDS MAKE SENSE

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The hedge fund industry has experienced enormous growth in the last decade, growing by some estimates from as few as 300 funds in 1990 to more than 3000 today.[1] They have become highly visible in markets and the press, and are thought to command up to $400 billion in capital before leverage.

Hedge fund portfolios can provide a meaningful improvement in the risk-reward tradeoff for an investor.

Hedge funds, like other established alternative investments including real estate, commodities, venture capital, and private equity, are thought to provide access to returns that are uncorrelated with traditional investments, and superior risk-adjusted returns as well.

There is a trend among fund management companies to introduce hedge fund-like products, and large asset owners have begun to make strategic allocations to hedge funds (more on this later).

In this article we analyze the performance and risk characteristics of hedge funds using a comprehensive database covering the last ten years. We evaluate trends in the capital markets that support a favorable outlook for hedge funds going forward, and show how hedge funds can enhance strategic asset allocation for both pension funds and endowments. Our work shows that when structured as portfolios, hedge funds can provide a meaningful improvement in the risk-reward tradeoff for an investor.

Broadly speaking, hedge funds can be defined as unregulated investment pools, generally with fewer than 100 investors, that may invest in any asset class as well as derivative securities and use long and short positions, as well as leverage. A distinguishing feature of hedge funds is their routine use of long or short positions to offset "market" risks and isolate arbitrage opportunities, although these opportunities are not without their own specific risks. Hedge funds are generally more nimble and dynamic in their trading strategies than tra-

1 A TAXONOMY OF HEDGE FUND STRATEGIES

Strategy	Description	Sub-Strategies	# of Distinct Fund Histories[1]
DIRECTIONAL TRADING	Directional trading strategies are based upon speculation of market direction in multiple asset classes. Both model-based systems and subjective judgment are used to make trading decisions.	Discretionary Trading, Macro Trading, Systems Trading	408
RELATIVE VALUE	Relative value strategies focus on spread relationships between pricing components of financial assets. Market risk is kept to a minimum. Many managers use leverage to enhance returns.	Convergence Arbitrage, Merger Arbitrage, Statistical Arbitrage	348
SPECIALIST CREDIT	Specialist credit strategies are based around lending to credit sensitive issuers. Funds in this strategy conduct a high level of due diligence in order to identify relatively inexpensive securities.	Distressed Securities, Positive Carry, Private Placements	80
STOCK SELECTION	Stock selection strategies combine long and short positions, primarily in equities, in order to exploit under and overvalued securities. Market exposure can vary substantially.	Long Bias, No Bias, Short Bias, Variable Bias	547

1. *Since 1990.*

1. *See Barry Riley, "Hedge Funds Come in From the Cold,"* Financial Times, *June 12, 2000.*

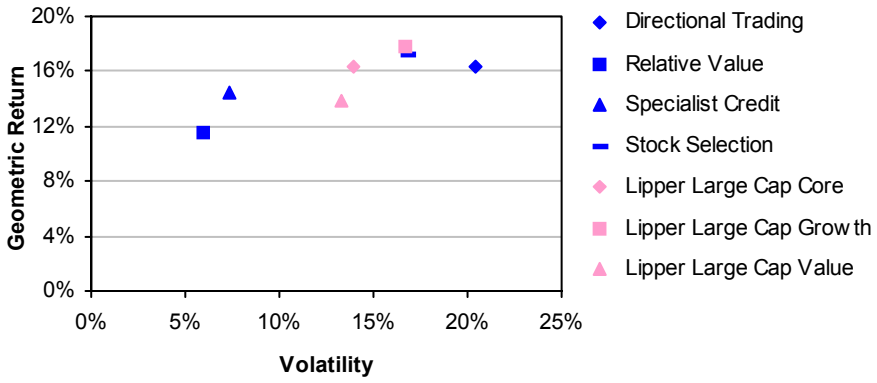
* *We are grateful for the significant contributions of Joan K. Tse and Bradford J. Johmann to this article. We also thank Peter Fanelli for his comments and input.*

ditional active funds.

To establish the historical facts about hedge fund performance and risk, we study a comprehensive database maintained by Financial Risk Management, Limited (FRM). The Appendix describes the contents of the FRM database. Also, since hedge fund performance data is susceptible to biases, we will adjust our figures where appropriate, with details on the methodology given in the Appendix.

Exhibit 1 briefly summarizes the database according to a classification system recently adopted by FRM and MSCI, Inc. Given the wide range and idiosyncratic nature of hedge fund specialties, any classification system will not completely characterize some managers, but we believe this one to be a reasonable description of the universe.

2 MEDIAN INDIVIDUAL HEDGE FUND PERFORMANCE AND RISK CHARACTERISTICS



Note: Performance is annualized from monthly total return data, covering 1990 through June 2000.

THE FACTS ABOUT HEDGE FUNDS

THE PROPERTIES OF INDIVIDUAL HEDGE FUNDS

To begin our analysis of hedge fund performance and risk, we look at the distribution of individual hedge fund total returns, net of fees, and compare it to that of traditional active managers as well as individual stocks. The first key observation is that the return/risk profile of the typical Directional Trading or Stock Selection hedge fund manager is not demonstrably different from that of the typical active manager.

Focusing on the period since 1990, Exhibit 2 plots the annualized geometric return and standard deviation of the median individual hedge fund in each of the four strategy categories, as well as the median in three categories of Lipper large cap U.S. mutual funds.[1] The median number gives an indication of the experience for a typical manager. The median Relative Value and Specialist Credit managers have been less volatile than the median Lipper large cap manager, while the median returns of the four hedge fund strategy managers have been in the same ballpark as the median Lipper managers.

The second key observation about the distribution of hedge fund managers is their much greater performance dispersion relative to the Lipper large cap managers. Exhibit 3 provides details on individual hedge fund manager performance and risk for the four broad strategies and their substrategies, as well as the three Lipper large cap categories, for various subperiods from 1990. Looking at the percentiles of individual manager return and risk, hedge funds in a particular category are much less similar to one another, no matter how narrow the category is. Of course, the benchmark-driven approach of the Lipper managers suggests such an outcome, but the actual difference is striking.

Compare, for example, the Stock Selection hedge fund managers and the Lipper large cap core managers from 1995-2000. Both had similar median performance. Looking at the 25th and 75th percentiles of the performance distribution, the Stock Selection managers were much more disperse: the 25th percentile Stock Selection manager returned 13.2% and had a maximum drawdown of –16.5%, compared with 31.4% and –35.3% at the 75th percentile. For the Lipper core managers, the 25th percentile returned 21.9% with a maximum drawdown of –15.1% versus 24.9% and –17.5% at the 75th percentile. Picking a poor-ranking Stock Selection manager can

The return/risk profile of the typical Stock Selection and Directional Trading hedge fund managers is similar to that of the typical active manager, but the variation in performance across managers is wider for hedge funds.

1. *The universe of Lipper mutual funds is described on www.lipperweb.com. Note that for a given point on the graph, the median return and the median risk do not necessarily refer to the same fund.*

3 INDIVIDUAL HEDGE FUND PERFORMANCE AND RISK CHARACTERISTICS

Annual Performance Percentiles

	1990-June 2000					1990-1994					1995-June 2000					1997-June 2000					July 1999-June 2000				
Strategy	Min.	25%	50%	75%	Max.	Min.	25%	50%	75%	Max.	Min.	25%	50%	75%	Max.	Min.	25%	50%	75%	Max.	Min.	25%	50%	75%	Max.
DIRECTIONAL TRADING																									
Annual Return (%)[1]	1.9	11.1	16.3	20.5	42.3	-2.5	11.0	18.6	24.2	47.2	-11.6	7.4	11.8	20.4	39.6	-31.0	3.8	8.2	16.2	46.0	-69.3	-10.3	0.2	9.6	117.4
Volatility (%)	5.9	16.3	20.4	29.3	54.2	5.0	15.9	22.3	27.9	57.5	2.8	11.5	17.0	26.3	68.8	0.6	9.9	14.9	23.0	62.3	0.5	7.8	11.8	19.1	73.7
Sharpe Ratio[2]	-0.1	0.3	0.4	0.7	2.4	-0.2	0.3	0.5	0.9	3.6	-0.9	0.1	0.4	0.9	5.2	-2.1	-0.1	0.2	0.7	4.8	-15.2	-4.1	-1.9	1.6	25.1
Max Drawdown (%)	-7.1	-18.5	-28.5	-37.3	-62.9	-2.0	-13.9	-21.8	-28.7	-62.2	-1.2	-10.6	-18.6	-33.0	-94.7	0.0	-8.7	-14.9	-27.0	-94.7	0.0	-4.6	-8.8	-17.1	-73.6
Number of Funds	33					48					133					182					236				
RELATIVE VALUE																									
Annual Return (%)[1]	5.5	9.0	11.6	13.6	17.8	4.2	9.0	11.0	12.8	21.1	1.4	9.7	13.8	17.0	29.8	-5.6	7.5	12.8	16.8	56.7	-22.2	8.2	15.5	21.0	94.2
Volatility (%)	1.9	5.2	6.0	8.0	12.9	1.7	4.3	6.8	8.2	12.9	0.6	4.0	5.9	9.1	26.6	0.3	4.2	6.4	10.1	90.5	0.1	3.1	5.0	8.5	171.4
Sharpe Ratio[2]	0.1	0.5	1.1	1.6	2.0	-0.1	0.5	0.9	1.5	2.7	-0.3	0.7	1.7	2.5	7.2	-0.8	0.3	1.2	2.3	10.9	-18.4	1.8	8.3	13.3	107.0
Max Drawdown (%)	-2.4	-7.1	-12.0	-29.8	-27.7	-0.6	-3.5	-7.0	-11.9	-27.7	0.0	-3.2	-7.0	-13.7	-49.0	0.0	-3.1	-6.6	-14.2	-61.3	0.0	0.0	-1.0	-4.3	-46.7
Number of Funds	19					28					98					136					211				
SPECIALIST CREDIT																									
Annual Return (%)[1]	11.5	12.7	14.5	16.9	17.4	12.3	13.6	17.3	21.2	23.8	-5.5	7.4	12.4	15.3	21.8	-18.8	6.8	10.8	16.2	41.0	-59.4	3.8	13.1	23.2	212.8
Volatility (%)	4.1	4.9	7.3	8.9	13.0	3.3	6.1	8.3	11.0	12.1	3.3	5.0	6.0	12.4	20.8	1.5	4.7	6.0	13.5	130.5	0.5	3.6	5.3	13.5	239.7
Sharpe Ratio[2]	0.9	0.9	1.1	1.9	2.9	0.8	1.1	1.7	2.2	3.4	-0.5	0.4	0.9	1.1	4.0	-0.9	0.2	0.7	2.2	6.3	-11.8	-0.7	5.5	10.1	32.4
Max Drawdown (%)	-4.9	-8.7	-11.4	-14.1	-19.4	-2.5	-3.5	-6.2	-9.5	-19.4	-2.1	-7.4	-10.3	-19.8	-65.5	0.0	-2.5	-7.1	-13.9	-65.5	0.0	0.0	-2.4	-6.5	-65.2
Number of Funds	8					8					20					39					54				
STOCK SELECTION																									
Annual Return (%)[1]	-12.1	12.0	17.2	20.9	33.1	-7.0	7.6	13.7	19.4	44.6	-17.2	13.2	22.2	31.4	58.1	-46.1	10.3	22.2	33.3	86.9	-74.1	7.2	27.0	52.5	272.3
Volatility (%)	3.5	13.6	16.8	22.1	38.0	4.2	10.4	16.7	20.6	36.8	2.9	14.4	19.9	25.7	99.9	3.3	15.5	21.7	28.6	118.6	0.8	16.4	23.8	34.6	182.8
Sharpe Ratio[2]	-0.6	0.4	0.7	0.9	2.0	-0.4	0.2	0.6	0.9	2.1	-0.8	0.5	0.9	1.3	2.6	-1.8	0.3	0.9	1.3	4.9	-5.8	0.1	3.5	6.5	22.0
Max Drawdown (%)	-4.7	-19.8	-26.9	-35.5	-84.6	-3.8	-11.6	-19.1	-29.3	-70.4	-2.2	-16.5	-23.0	-35.3	-91.7	-1.1	-14.6	-21.9	-32.1	-89.6	0.0	-5.9	-12.8	-22.2	-78.3
Number of Funds	35					47					143					207					329				
MULTI-MANAGER																									
Annual Return (%)[1]	5.4	9.1	13.4	15.2	17.3	3.8	9.3	11.0	15.3	38.3	-4.1	9.2	11.9	16.5	35.9	-14.0	8.1	11.0	16.2	51.1	-30.3	6.8	13.7	26.5	124.8
Volatility (%)	6.7	9.0	9.8	11.9	15.7	4.2	7.6	9.1	13.6	26.5	2.3	7.2	10.6	15.1	47.2	1.2	7.0	11.8	17.6	53.6	1.4	5.7	10.7	18.4	73.5
Sharpe Ratio[2]	0.0	0.3	0.9	1.0	1.4	-0.2	0.4	0.7	1.1	2.6	-0.4	0.3	0.8	1.3	3.1	-1.1	0.3	0.6	1.1	8.0	-3.7	0.2	1.0	1.8	11.1
Max Drawdown (%)	-5.6	-10.8	-16.9	-22.9	-32.8	-2.8	-7.0	-10.0	-15.1	-33.2	-1.3	-7.7	-13.5	-21.3	-81.9	0.0	-7.2	-13.9	-21.7	-81.9	0.0	-1.5	-5.5	-12.9	-43.3
Number of Funds	17					30					94					134					173				
LIPPER LARGE CAP CORE																									
Annual Return (%)[1]	10.6	14.7	16.3	17.3	21.3	4.8	7.5	8.3	9.7	18.4	11.9	21.9	23.8	24.9	30.7	11.1	19.2	21.5	23.7	34.8	-9.0	6.2	9.2	16.3	51.6
Volatility (%)	5.2	13.5	13.9	14.4	16.8	6.0	12.0	13.0	13.6	16.9	4.5	14.0	14.7	15.2	21.5	5.3	16.4	17.3	17.9	25.3	3.4	15.4	16.2	17.3	32.8
Sharpe Ratio[2]	0.4	0.7	0.8	0.9	1.1	0.0	0.2	0.3	0.4	0.9	0.7	1.2	1.3	1.4	1.6	0.4	0.8	1.0	1.1	1.6	-1.0	0.1	0.3	0.7	2.7
Max Drawdown (%)	-5.3	-15.8	-16.9	-18.7	-24.4	-5.0	-13.3	-15.1	-16.8	-24.4	-5.3	-15.1	-16.2	-17.5	-25.3	-5.3	-15.0	-16.2	-17.4	-25.3	0.0	-5.9	-6.8	-8.3	-18.1
Number of Funds	57					57					127					225					450				
LIPPER LARGE CAP GROWTH																									
Annual Return (%)[1]	3.4	16.0	17.8	19.6	24.5	3.7	7.6	9.0	10.7	19.4	13.7	24.3	26.7	29.2	50.6	4.5	24.4	28.0	31.9	59.0	-3.8	18.3	25.2	32.0	144.5
Volatility (%)	11.6	15.2	16.7	18.0	22.9	7.7	13.6	14.6	16.2	23.4	13.6	16.5	17.8	19.5	28.6	16.1	19.4	20.8	22.8	34.6	13.5	19.0	21.1	26.9	87.5
Sharpe Ratio[2]	-0.1	0.7	0.8	0.9	1.0	-0.1	0.2	0.3	0.3	0.6	0.5	1.1	1.2	1.4	1.6	0.0	0.9	1.1	1.3	2.1	-0.6	0.6	0.9	1.2	2.5
Max Drawdown (%)	-13.0	-17.5	-18.8	-20.8	-39.0	-6.0	-14.8	-17.6	-19.7	-30.2	-12.9	-16.5	-17.7	-19.4	-39.1	-12.9	-16.5	-17.5	-19.3	-39.1	-3.0	-8.7	-10.9	-14.1	-49.2
Number of Funds	65					65					187					270					472				
LIPPER LARGE CAP VALUE																									
Annual Return (%)[1]	10.6	12.9	13.9	15.6	18.6	5.3	7.6	8.3	9.1	15.2	12.3	16.7	19.3	21.9	26.8	3.0	12.5	15.3	18.6	25.7	-24.7	-6.7	0.7	4.4	37.9
Volatility (%)	10.6	12.7	13.3	14.0	17.4	9.3	11.7	12.6	13.4	18.0	11.4	13.5	14.0	14.7	19.2	13.0	15.8	16.4	17.2	66.7	6.1	14.3	15.7	17.0	126.3
Sharpe Ratio[2]	0.4	0.6	0.7	0.8	1.0	0.0	0.2	0.3	0.3	0.7	0.5	0.8	1.0	1.2	1.5	-0.1	0.4	0.6	0.8	1.3	-1.6	-0.8	-0.3	0.0	1.8
Max Drawdown (%)	-11.9	-16.2	-18.4	-19.7	-31.6	-9.8	-14.0	-15.5	-18.0	-24.8	-10.8	-15.3	-17.1	-19.5	-31.6	-10.8	-15.6	-17.1	-19.4	-61.9	-1.9	-6.9	-8.2	-11.4	-61.9
Number of Funds	57					57					149					225					350				

1. *Total return, net of fees. Managers must have reported performance for the entire subperiod to be included in a particular column. Shaded regions referred to in text.*
2. *Assumes 5.0% hurdle rate.*

be much more damaging than picking a poor ranking Lipper large cap core manager. But all hope is not lost.

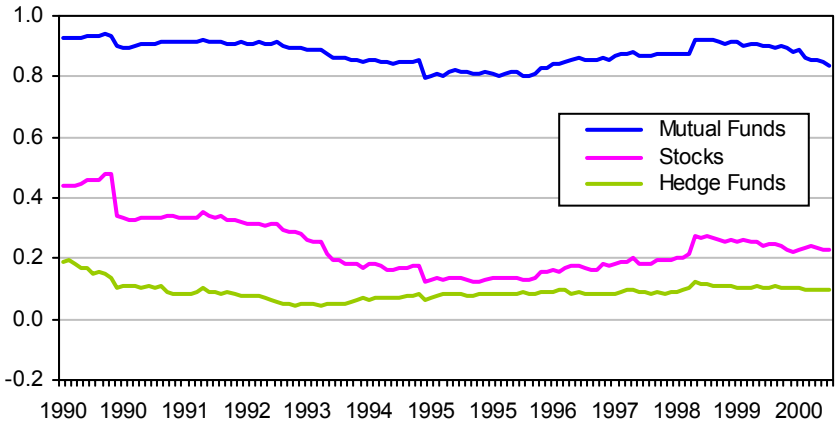
It turns out that the hedge fund managers exhibit much lower correlation with one another than traditional active managers. Exhibit 3 illustrates the average correlation between hedge fund managers, Lipper large cap mutual funds, and stocks within the S&P 500 on a rolling basis since 1990. The average correlation among Lipper managers has been on the order of 90%, while hedge fund managers resemble S&P 500 stocks with an average correlation on the order of 10% (it is about 20% on average for stocks). There appears to be a large, idiosyncratic component to the returns of hedge fund managers, even within a particular strategy, whereas Lipper managers tend to be more correlated with their benchmarks and hence with each other.

The low average correlation among hedge fund managers suggests that pooling funds into portfolios or indexes can significantly reduce their total risk, providing distinct advantages relative to traditional active strategies.

Pooling hedge funds can significantly reduce their total risk.

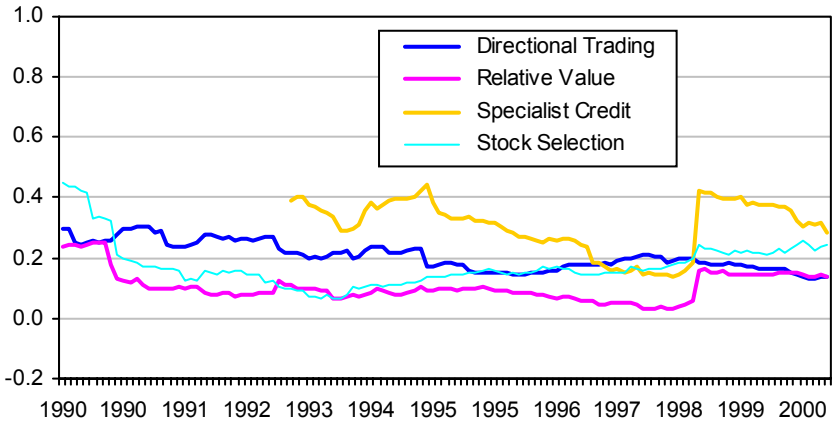
4 CORRELATION BETWEEN INDIVIDUAL HEDGE FUNDS

A HEDGE FUND AVERAGE CORRELATION



Note: Mutual funds encompass the Lipper U.S. large cap universe, stocks are the S&P 500 constituents, and hedge funds encompass the Financial Risk Management universe. Based on 36 trailing months.

B STRATEGY AVERAGE CORRELATIONS



Note: Based on 36 trailing months. Ten funds required per strategy.

HEDGE FUND INDEXES

Indexes of hedge fund performance are useful as summary statistics for the universe of managers, and may provide a benchmark for strategy performance to the extent that they are investable, and to the extent that funds within a given strategy classification are comparable.

We constructed research indexes of hedge fund strategy and substrategy performance using monthly data since 1990, the details of which are given in the Appendix. The indexes encompass all the funds in the FRM database and are equally weighted and rebalanced annually.

The most important observation about indexes of hedge funds is that they exhibit considerably lower risk than traditional active managers and passive benchmarks. Exhibit 5 summarizes our hedge fund indexes. The annualized geometric return of all hedge funds was 18.9% from the beginning of 1990 through June of 2000, with volatility of 5.5% a year and a Sharpe Ratio of 2.5 (assuming a 5% annual hurdle rate), comparing favorably to the Lipper large cap managers and the S&P 500. The low correlation between hedge fund managers is at work here, lowering the volatility of the hedge fund indexes substantially below that of the Lipper managers and the S&P 500. Relative Value managers had the best risk-adjusted excess performance dur-

5 HEDGE FUND INDEX PERFORMANCE AND RISK CHARACTERISTICS

	1990-June 2000				1990-1994				1995-June 2000				1997-2000				July 1999-June 2000			
Strategy	Ann. Return[1]	Ann. Volatility	Sharpe Ratio[2]	Max Drawdown	Ann. Return[1]	Ann. Volatility	Sharpe Ratio[2]	Max Drawdown	Ann. Return[1]	Ann. Volatility	Sharpe Ratio[2]	Max Drawdown	Ann. Return[1]	Ann. Volatility	Sharpe Ratio[2]	Max Drawdown	Ann. Return[1]	Ann. Volatility	Sharpe Ratio[2]	Max Drawdown
ALL HEDGE FUNDS	18.9%	5.5%	2.5	-3.3%	19.0%	4.7%	3.0	-0.8%	18.7%	6.1%	2.2	-3.3%	16.6%	6.7%	1.7	-3.3%	20.5%	9.2%	1.7	-3.1%
DIRECTIONAL TRADING	18.7	10.1	1.4	-5.6	24.2	11.7	1.6	-5.6	14.0	8.3	1.1	-4.6	9.6	6.7	0.7	-3.6	0.1	4.5	-1.1	-2.6
Discretionary Trading	17.9	6.7	1.9	-4.9	22.9	7.4	2.4	-4.9	13.6	5.8	1.5	-2.9	11.1	5.2	1.2	-2.9	6.0	3.9	0.3	-1.4
Macro Trading	22.1	15.5	1.1	-20.1	33.0	17.6	1.6	-17.6	13.0	13.0	0.6	-11.8	5.8	10.7	0.1	-11.8	-7.4	11.7	-1.1	-11.8
Systems Trading	18.2	13.4	1.0	-10.9	22.5	16.1	1.1	-10.9	13.9	10.5	0.8	-5.8	8.7	8.2	0.4	-4.8	-3.1	5.2	-1.5	-3.5
RELATIVE VALUE	13.5	2.8	3.0	-5.3	12.6	2.7	2.8	-1.6	14.3	2.9	3.2	-5.3	12.1	3.3	2.1	-5.3	15.5	1.1	9.4	0.0
Convergence Arbitrage	14.4	3.6	2.6	-8.7	15.0	3.5	2.8	-1.7	13.8	3.7	2.4	-8.7	10.6	4.3	1.3	-8.7	15.1	1.2	8.4	0.0
Merger Arbitrage	14.7	5.1	1.9	-6.9	12.9	6.0	1.3	-6.9	16.3	4.1	2.7	-5.7	16.1	4.9	2.3	-5.7	18.9	2.9	4.9	0.0
Multi-Strategy[3]	19.9	5.3	2.8	-3.5	21.3	7.9	2.1	-2.1	19.1	3.1	4.5	-3.5	19.4	3.8	3.8	-3.5	26.8	3.2	6.8	0.0
Statistical Arbitrage	11.0	3.2	1.9	-3.5	9.3	3.2	1.3	-2.8	12.6	3.1	2.4	-3.5	10.3	3.2	1.6	-3.5	10.4	3.6	1.5	-0.2
SPECIALIST CREDIT	16.9	5.2	2.3	-6.5	18.2	5.3	2.5	-3.6	15.7	5.2	2.1	-6.5	14.0	6.3	1.4	-6.5	23.7	8.3	2.3	-2.9
Distressed Securities	15.1	5.2	1.9	-9.3	18.2	5.3	2.5	-3.6	12.3	5.0	1.5	-9.3	8.8	5.9	0.6	-9.3	6.7	5.1	0.3	-2.3
Positive Carry[3]	9.1	4.5	0.9	-7.0	–	–	–	–	9.1	4.5	0.9	-7.0	9.1	4.5	0.9	-7.0	0.4	4.6	-1.0	-4.0
Private Placements[5]	24.8	12.6	1.6	-9.2	–	–	–	–	24.8	12.6	1.6	-9.2	24.0	13.4	1.4	-9.2	70.7	20.1	3.3	-6.0
STOCK SELECTION	21.0	9.0	1.8	-9.2	16.5	6.2	1.9	-3.2	25.3	10.9	1.9	-9.2	24.9	13.0	1.5	-9.2	38.3	18.6	1.8	-7.9
Long Bias	23.0	12.6	1.4	-14.1	17.1	10.8	1.1	-13.4	28.7	14.0	1.7	-14.1	28.5	16.6	1.4	-14.1	44.7	22.3	1.8	-9.9
No Bias[6]	19.4	5.7	2.5	-5.2	14.8	5.7	1.7	-5.2	22.8	5.6	3.2	-1.6	20.4	5.8	2.6	-1.6	22.8	7.2	2.5	-1.3
Short Bias	1.8	19.5	-0.2	-48.9	10.5	15.6	0.4	-23.6	-5.5	22.5	-0.5	-48.9	-8.8	24.8	-0.6	-48.9	-29.2	28.3	-1.2	-37.8
Variable Bias	17.0	9.8	1.2	-9.4	16.6	8.8	1.3	-9.4	17.4	10.8	1.2	-9.3	15.3	12.8	0.8	-9.3	24.5	18.2	1.1	-8.0
MULTI-MANAGER	13.4	6.2	1.4	-9.2	13.9	5.2	1.7	-5.9	13.0	7.0	1.2	-9.2	12.0	8.0	0.9	-9.2	18.5	10.3	1.3	-5.4
S&P 500	17.2	13.7	0.9	-15.4	8.6	12.5	0.3	-14.8	25.6	14.4	1.4	-15.4	23.1	17.0	1.1	-15.4	7.2	16.0	0.1	-6.8
LIPPER INDICES																				
Large Cap Core	16.0	13.0	0.8	-15.7	8.6	11.7	0.3	-14.2	23.2	13.9	1.3	-15.7	20.5	16.7	0.9	-15.7	10.4	15.4	0.4	-6.5
Large Cap Growth	18.7	15.7	0.9	-17.3	9.6	13.9	0.3	-17.3	27.6	16.9	1.3	-16.4	26.2	20.2	1.0	-16.4	20.7	21.2	0.7	-13.1
Large Cap Value	14.4	12.6	0.7	-15.1	9.1	12.0	0.3	-14.8	19.5	13.1	1.1	-15.1	14.1	15.4	0.6	-15.1	-2.4	14.0	-0.5	-8.6
EAFE	6.6	17.1	0.1	-30.6	1.8	19.8	-0.2	-30.6	11.1	14.2	0.4	-15.0	12.3	16.1	0.5	-15.0	17.4	14.9	0.8	-7.6
EMF	9.6	23.6	0.2	-56.0	20.9	22.1	0.7	-29.2	0.3	24.8	-0.2	-56.0	0.3	29.5	-0.2	-56.0	9.5	20.3	0.2	-13.2
BONDS[7]	9.3	8.1	53.5	-12.1	8.3	8.0	41.7	-12.1	10.3	8.3	63.6	-10.4	8.1	7.7	40.0	-10.4	7.0	6.0	34.2	-2.7

1. *Total return, net of fees.*
2. *Assumes 5.0% hurdle rate.*
3. *Data begin in 1992.*
4. *Data begin in 1996.*
5. *Data begin in 1997.*
6. *Data begin in 1991.*
7. *Ibbotson Long-Term Bond Index.*

ing this period (Sharpe Ratio of 3), while Directional Trading managers had the worst (Sharpe Ratio of 1.4). Performance varies considerably among substrategies, with, for example, a negative Sharpe Ratio for the Short Bias Stock Selection managers.

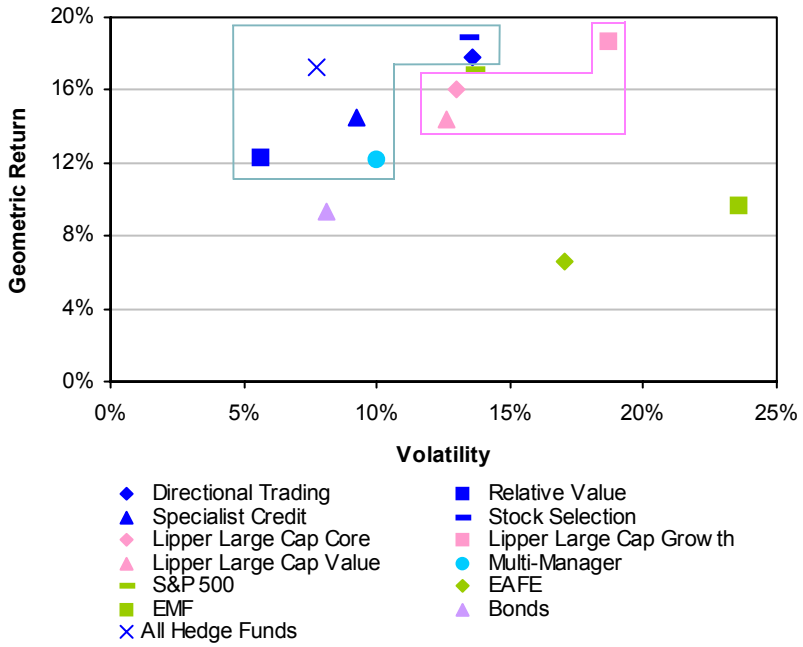
Hedge fund performance has varied through time, with lower figures in the most recent five-and-a-half years. Volatility also appears to have increased in more recent periods. Hedge funds produced higher absolute returns than traditional active managers up to 1994, while the reverse has been true in the strong momentum markets since then. In general, however, the risk-adjusted performance of the universe of hedge funds appears to have been superior to traditional active managers and passive benchmarks over the last ten years.

Even after adjusting for biases in the data, hedge fund strategies tend to exhibit better risk-adjusted returns than traditional active and passive benchmarks.

We estimated the impact on our strat-

egy-level performance results of two significant biases that we believe can be effectively approximated with our data (details in the Appendix): survivorship bias and "stale pricing" bias. The main conclusion in Exhibit 6 is that, even accounting for these biases, hedge fund strategies have exhibited comparable returns to traditional active and passive investments, although with generally less risk as measured by standard deviation.[1]

6 HEDGE FUND INDEX PERFORMANCE AND RISK CHARACTERISTICS — ADJUSTED FOR BIASES



Note: Performance from 1990 through June 2000. Blue box encompasses hedge funds, magenta box encompasses mutual fund managers.

	All Hedge Funds	Directional Trading	Relative Value	Specialist Credit	Stock Selection	Multi-Manager
Annualized Return	17.2%	17.8%	12.3%	14.5%	18.9%	12.2%
Annualized Volatility	7.7%	13.6%	5.7%	9.3%	13.4%	10.0%
Sharpe Ratio[1]	1.6	0.9	1.3	1.0	1.1	0.7

1. Assumes 5% hurdle rate.

HEDGE FUND PORTFOLIOS

A critical concern for hedge fund investors is whether the performance and risk characteristics represented by indexes such as ours can be achieved in portfolios of more modest and realistic size. To better understand this issue, we conducted a simulation experiment that consisted of constructing 1000 randomly selected portfolios of a particular (fixed) number of funds from our database starting in 1990, and calculating the performance and risk characteristics of each one.

The bottom line result from our simulation is that portfolios of as few as 20 hedge funds typically preserve the desirable properties of the indexes that cover the entire universe. Exhibit 7 illustrates the distribution of annual geometric return, volatility, Sharpe Ratio, and maximum drawdown of the random portfolios for a range of portfolio sizes. Median portfolio returns approach a level of 18% with as few as 20 funds, similar to the index of all hedge funds during this period shown in Exhibit 5. Annual volatility and maximum drawdowns decline dramatically as portfolio size increases, with a median volatility level of 7% and drawdown of about –6% with 20 funds. For a portfolio of 20 managers, the median Sharpe Ratio was 1.8, and even at 1.5 for the worst decile was still much better than that for the S&P 500 or Lipper managers during this period.

Of course, these results do not reflect the costs of building a portfolio of hedge funds or fund of funds, but they suggest that favorable Sharpe Ratios can be achieved for the median randomly selected portfolio with a modest number of managers. Manager selection skill would place the investor above the median.

Portfolios of as few as 20 hedge funds preserve the desirable properties of hedge fund indexes.

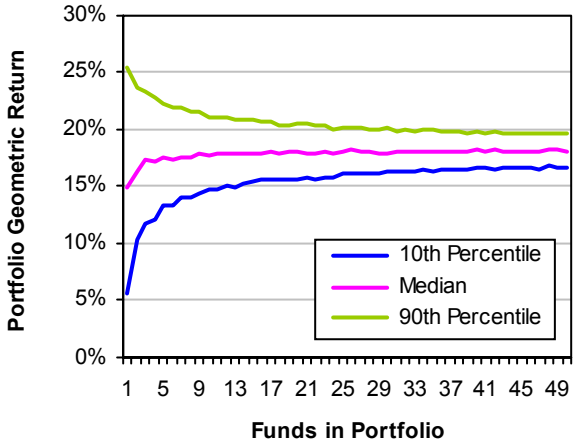
ANOMALIES IN HEDGE FUND PERFORMANCE

When constructing portfolios of hedge funds, practical concerns arise such as whether the investor should limit the search to managers that have performed well in the past, to managers with a significant track

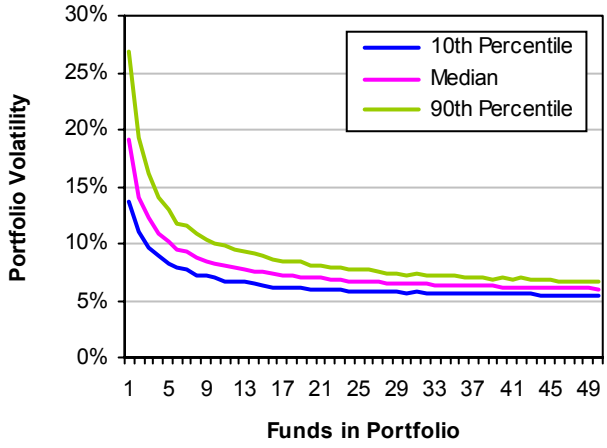
1. *The Lipper indexes are constructed in a way to minimize survivor bias, and the Multi Manager hedge funds represent performance that should be less impacted by biases since they may represent actual investor performance from hedge funds (although they are impacted by an additional fee for portfolio construction, while the other indexes are not).*

7 PROPERTIES OF HEDGE FUND PORTFOLIOS[1]

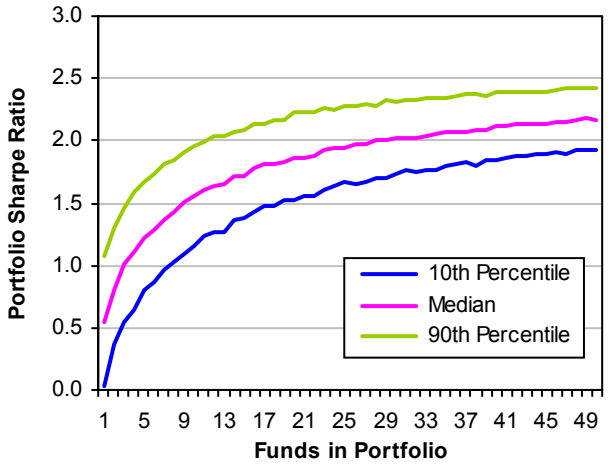
A DISTRIBUTION OF RETURN BY PORTFOLIO SIZE



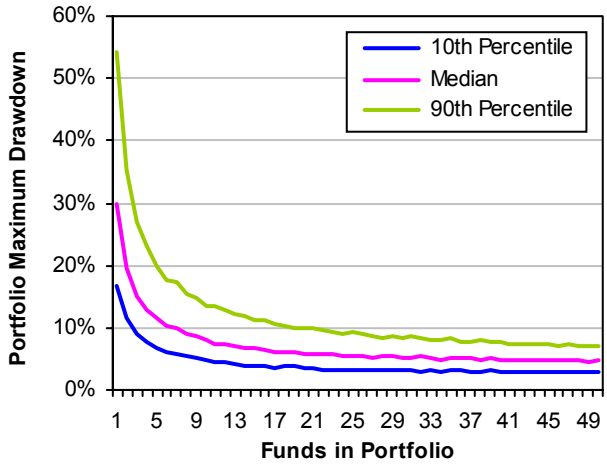
B DISTRIBUTION OF VOLATILITY BY PORTFOLIO SIZE



C DISTRIBUTION OF SHARPE RATIOS BY PORTFOLIO SIZE



D DISTRIBUTION OF MAXIMUM DRAWDOWNS BY PORTFOLIO SIZE



1. *Performance simulated since 1990. Portfolios were equally weighted and rebalanced annually, with one year of performance history required for inclusion and with substitutes for discontinued funds randomly selected and included at the weight of the discontinued funds.*

record, or to those with a large or smaller pool of assets under management. Portfolios could then be tailored to take advantage or guard against significant patterns or anomalies in performance along any of these dimensions.

We tested for persistence in the performance of hedge fund managers and found little convincing evidence that winning funds repeat in a way that can be exploited. Exhibit 8 illustrates the persistence of hedge fund performance by forming five equally weighted portfolios having an equal number of funds, rebalanced monthly or annually, containing the first through fifth quintiles of funds ranked on the previous month's or year's performance. If the winning hedge funds keep winning, for example, we would expect to see the top quintile of performers beating the others. In fact, this appears to be the case for the monthly rebalance but less so for the more realistic annual rebalance.[1] Due to lengthy lockup periods for most funds and the costs of manager selec-

1. *Statistical tests indicate that the returns of the top and bottom quintiles are significantly different for a monthly rebalance, but not for a quarterly rebalance and only marginally for an annual rebalance. Note also that some of the performance persistence of managers for the monthly rebalance could be related to measurement biases, a possibility detailed in the Appendix.*

tion, it is not feasible to rebalance fund portfolios at a monthly frequency. As the results are not convincing for annual rebalancing (although note that the sample of annual returns is quite small), the practical benefits from identifying top performers among hedge funds would appear to be limited.

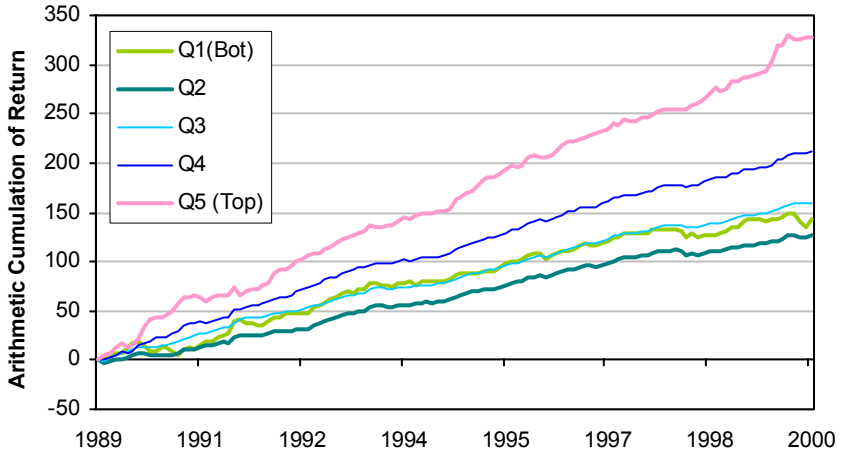
Exhibit 9 analyzes the question of the relative performance of new and older funds. Many institutional investors have active manager guidelines that require a track record of several years. Our results suggest a distinct "hot hands" effect among hedge funds where the funds with the shortest track records have performed the best.

We examined five equally weighted portfolios rebalanced monthly, where portfolio membership is determined by the fund's age. Exhibit 9 illustrates that since 1990, the youngest funds (less than one year track record) have clearly outperformed the older funds in our database on a risk-adjusted basis. This effect suggests that investors may wish to consider less stringent track record requirements for hedge funds that meet other performance guidelines. However, it is worth noting that the newest funds may be most susceptible to reporting biases and investability problems such as small size, leading us to exclude their performance from our research indexes and other portfolio calculations.

While a fund-of-funds may offer some efficiencies, small fund size can be an especially limiting factor for investors since a large investment mandate may be operationally impractical if distributed among too many managers. On the flip side, it may be the case that the smaller funds are more nimble and hence better at extracting alpha with limited market impact, while larger funds are constrained by their requisite trading size and organizational complexity. We find that while the smallest, least investable funds are among the best performers, the

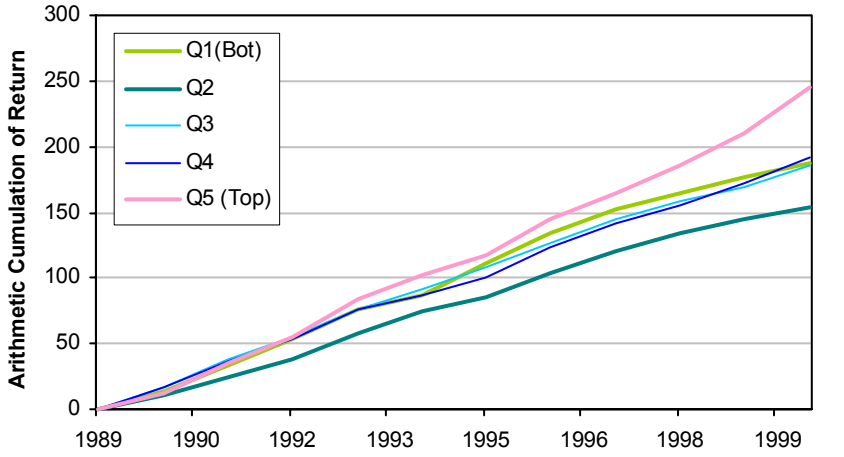
8 PERSISTENCE IN HEDGE FUND PERFORMANCE

A PERFORMANCE PERSISTENCE (MONTHLY)



For Monthly Rebalance	Q1	Q2	Q3	Q4	Q5
Annualized Return	13.9%	12.6%	16.2%	22.0%	35.3%
Sharpe Ratio[1]	0.9	1.7	3.0	3.4	2.7

B PERFORMANCE PERSISTENCE (ANNUAL)



For Annual Rebalance	Q1	Q2	Q3	Q4	Q5
Annualized Return	15.6%	13.0%	15.5%	16.0%	20.0%
Sharpe Ratio[1]	2.4	2.6	4.0	3.5	2.9

1. Assumes 5% hurdle rate.
Note: In keeping with our other analysis, we require one year of reported performance before a fund is included in the quintile portfolios.

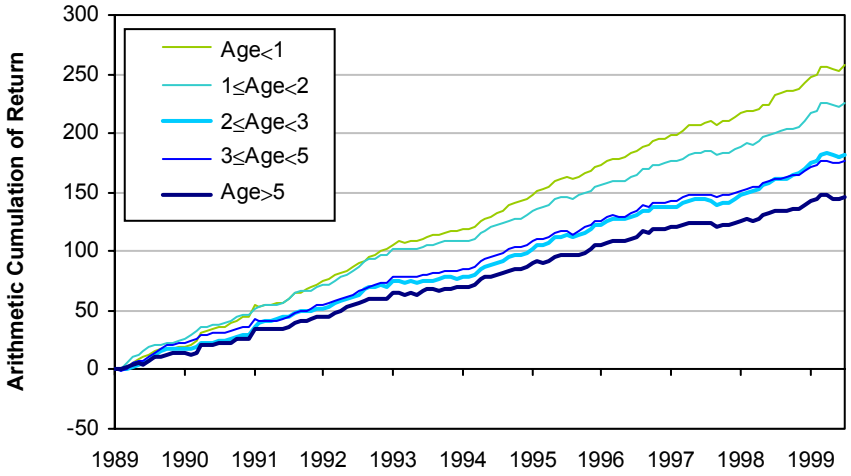
largest funds also perform relatively well.

Exhibit 10 analyzes the impact of size on performance by categorizing funds once per year according to size, then cumulating the returns of equally weighted portfolios of the fund categories. The results indicate that it is the very smallest funds, with net assets of less than $25 million, and the largest funds, with net assets of more than $200 million, which have generally exhibited the best absolute and risk-adjusted performance. Funds with less than $25 million in assets may be considered the least investable funds in the universe. To the extent that the larger funds have existed for a considerable length of time and not returned capital to investors, their size is a signal of success. In general, the evidence suggests that investors need not shy away from larger funds on the grounds of capacity constraints, and that the smallest funds may be worth a look where operationally feasible.[1]

Hedge funds have low correlations with traditional asset classes and therefore provide significant diversification benefits in portfolios.

9 AGE ANOMALIES IN HEDGE FUND PERFORMANCE

A "HOT HANDS": PERFORMANCE OF FUNDS BY AGE (YEARS OF REPORTED PERFORMANCE)



Note: Age-stratified portfolios are equally weighted and rebalanced monthly.

B EFFECTS OF AGE: 1990-JUNE 2000

	Age<1	1≤Age<2	2≤Age<3	3≤Age<5	Age>5
Annualized Return	27.2%	23.5%	18.7%	18.1%	14.7%
Annualized Volatility	6.1%	5.9%	5.5%	5.2%	5.9%
Sharpe Ratio[1]	3.7	3.2	2.5	2.5	1.6

1. Assumes 5% hurdle rate.

SYSTEMATIC RISK AND ALPHA

A desirable property of any active strategy is that it offers returns over and above that which can be achieved by exposure to passive buy-and-hold investments. This additional return is sometimes referred to as alpha.[2]

In addition to helping characterize alpha, exposures to passive investments like equity and bond indexes provide meaningful proxies for systematic market or undiversifiable risk. These exposures represent risk because they measure a correlation between the investment and risky fundamental assets.

We developed a model of hedge fund returns to describe their systematic risk and alpha (details in the Appendix). Since many hedge fund strategies seek to neutralize market risks, one might expect this systematic risk to be low, and the diversifiable or idiosyncratic risk to be high. It is unclear, however, whether alpha should be significant. Our analysis shows that, in fact, hedge fund strategies as a whole have had low systematic risk exposures and high alpha. A key upshot of these results is that hedge funds have low correlations with traditional asset classes and therefore provide meaningful diversification benefits in portfolios.

Exhibit 11 provides results from our risk/alpha analysis for hedge fund strategies and Lipper large-cap managers. Since 1995, the R-squared, or return variation explained by the risk factors, is greater than 40% for all the hedge fund index strategies except Directional Trading, but generally more than 90% for the Lipper large cap managers. The hedge fund strategies therefore exhibit greater unexplained or idiosyn-

1. *The results are similar if the fund portfolios are rebalanced more frequently. It is notable that although we have usable size data for only 56% of the funds in our database, there appears to be no meaningful selection performance bias in the funds which report size information—they are fairly representative of the whole database of funds.*
2. *An alternative usage of the term "alpha," which we do not adopt here, is return in excess of the benchmark.*

cratic risk in this context than the Lipper large-cap managers, and are thus likely to have lower correlations with traditional asset classes.

In both subperiods, the factor sensitivities vary considerably by hedge fund strategy, although the magnitude and significance of the sensitivity to high yield bond returns is pronounced for all of the strategies. As might be expected, the Lipper large cap managers have larger exposures to the equity sectors than the hedge fund managers. The alpha or unexplained return for the hedge funds is positive and a larger proportion of their total excess returns than it is for the Lipper large cap managers. This result suggests that hedge fund managers as a whole have been relatively more skillful with respect to the passive investment risks outlined in Exhibit 12, although perhaps taking on additional, difficult-to-measure systematic risks as well.[1] The Lipper large cap manager returns are effectively "spanned" by these investable risk factors, while the hedge fund returns are not.

Nevertheless, measured against investable proxies for systematic risk, hedge fund portfolios exhibit much less sensitivity than traditional active managers, implying lower correlations with fundamental asset classes. If sustainable, this fact, combined with their favorable risk-adjusted returns, suggests an important role for hedge funds in strategic asset allocation.

THE FUTURE OF HEDGE FUNDS

MANAGER RISK AND ALPHA

We find the performance facts outlined above compelling and unlike those encountered for most other investments. It is therefore valuable to try to identify the market characteristics that explain the historical evidence on hedge fund performance and risk, and the likelihood that these properties can be sustained in the future.

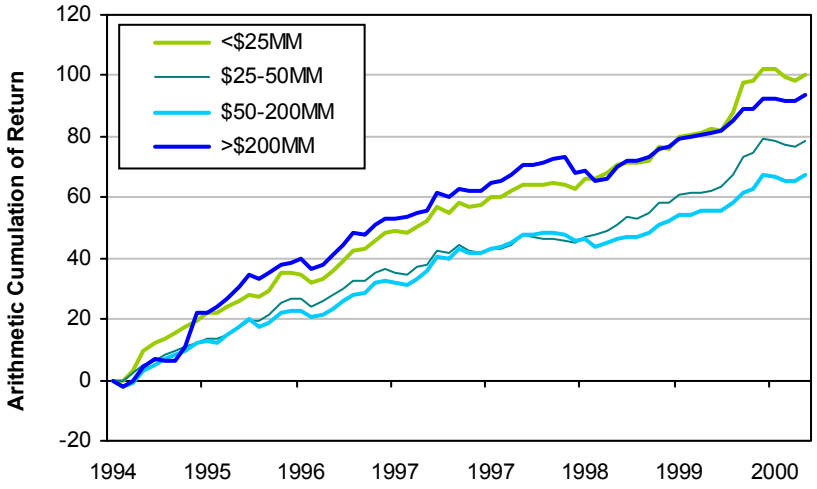
The distribution of realized performance among individual hedge funds is very wide. This is true within strategies as well as between strategies. The main reason is the enormous range of techniques employed by hedge funds to generate returns. At the individual fund level, the investment profile is typically dominated by exposure to a relatively narrow band of "alpha generation" strategies, often resulting from the expertise and ideas of only one or two people.

Growth in the supply of market inefficiencies should allow hedge funds to sustain their favorable risk-adjusted performance.

However, when pooled, the risk of a portfolio of hedge funds tends to fall dramatically, reflecting the extraordinarily low

10 | SIZE ANOMALIES IN HEDGE FUND PERFORMANCE

A EFFECT OF SIZE: 1995-JUNE 2000



B ANNUALIZED PERFORMANCE BY SIZE CATEGORY ($MM)

	<25	25-50	50-200	>200
Annualized Return	19.5%	15.0%	12.7%	18.0%
Annualized Volatility	7.7%	5.8%	5.8%	8.2%
Sharpe Ratio[1]	1.9	1.7	1.3	1.6

1. Assumes 5% hurdle rate.
Note: A one year track record is required for a fund to be included in the analysis.

1. The Appendix that immediately follows this article, outlines the possibility that optionality in the returns of hedge funds with respect to the risk factors may be at work. Our tests, summarized by the "Evidence of Optionality" column in Exhibit 11, suggest that the problem is limited for portfolios of hedge funds.

11 SYSTEMATIC RISK AND ALPHA OF HEDGE FUNDS

			Risk Factor Sensitivity[1]									Annualized Excess Return Decomposition[3]			Evidence of Optionality[4]
		Type	High Yield	EMF	Health Care	Finan.	Tech.	Telecom	Other Sectors	Commod.	R-squared[2]	Total	Explained by Factors	Unexplained ("Alpha")	
1990-1994	HEDGE FUNDS	All Funds	0.05	0.01	0.04	-0.02	**-0.12**	0.05	0.14	0.02	0.22	13.2%	0.2%	13.0%	No
		Directional Trading	-0.16	-0.04	0.14	-0.02	**-0.36**	0.06	0.11	-0.03	**0.26**	18.8%	-2.8%	21.6%	No
		Relative Value	**0.11**	0.01	-0.02	-0.01	0.00	**0.09**	0.02	-0.04	**0.48**	7.0%	0.8%	6.3%	Yes
		Specialist Credit	**0.44**	0.04	**-0.12**	-0.02	0.02	-0.01	0.11	**0.07**	**0.68**	12.5%	2.8%	9.7%	No
		Stock Selection	0.13	0.04	0.01	-0.01	0.04	0.07	0.21	0.05	**0.59**	10.9%	2.3%	8.5%	No
	LARGE CAP MUTUAL FUNDS	Core	0.02	0.00	**0.08**	**0.12**	**0.08**	0.03	**0.58**	0.02	**0.98**	3.9%	4.4%	-0.6%	No
		Growth	0.03	-0.02	**0.15**	**0.16**	**0.13**	0.01	**0.54**	-0.01	**0.94**	5.1%	5.2%	-0.1%	No
		Value	-0.02	0.01	**0.08**	**0.14**	**0.08**	**0.07**	**0.57**	0.01	**0.98**	4.3%	4.2%	0.1%	No
1995-2000	HEDGE FUNDS	All Funds	**0.37**	**0.09**	**-0.11**	-0.05	**0.05**	0.05	0.12	**0.07**	**0.66**	12.2%	1.4%	10.7%	No
		Directional Trading	0.30	0.01	-0.04	-0.12	-0.02	0.06	0.27	0.07	0.14	7.8%	0.7%	7.1%	No
		Relative Value	0.30	**0.03**	-0.01	0.01	-0.01	0.00	0.02	0.02	**0.44**	8.1%	0.7%	7.4%	Yes
		Specialist Credit	**0.37**	**0.12**	**-0.13**	0.04	0.03	0.03	-0.09	0.03	**0.58**	9.4%	-0.9%	10.3%	Yes
		Stock Selection	**0.42**	**0.18**	**-0.19**	-0.05	**0.15**	0.09	0.08	**0.10**	**0.69**	18.6%	3.1%	15.5%	No
	LARGE CAP MUTUAL FUNDS	Core	0.08	**0.05**	**0.07**	**0.12**	**0.20**	**0.09**	**0.38**	0.00	**0.96**	17.7%	19.1%	-1.5%	No
		Growth	0.07	**0.09**	0.06	0.10	**0.37**	**0.13**	0.17	0.01	**0.91**	22.5%	24.3%	-1.9%	No
		Value	**0.10**	**0.03**	**0.03**	**0.16**	**0.08**	**0.05**	**0.53**	0.02	**0.99**	14.0%	15.5%	-1.6%	No

1. *Factor sensitivity refers to the factor's beta (β) from a multivariate regression; an X% monthly excess return on the factor results in an expected βX% excess return for the hedge fund strategy, other things equal. A bold sensitivity indicates that the beta is significantly different from 0 at the five percent level. Factors are defined as follows: Merrill Lynch High Yield Bond Index for high yield bonds, MSCI EMF index for emerging markets, MSCI/S&P sector total returns for the components of the S&P 500, and the Goldman Sachs Commodity Index for commodities.*
2. *A bold R-squared indicates that the regression fit is statistically significant.*
3. *"Explained" is that part of the annual excess return attributable to the systematic risk factors specified. "Unexplained" is that part of the average return not explained by the risk factors and is analogous to Jensen's alpha.*
4. *We constructed a statistical test for optionality in the returns of the hedge fund strategies. "Y" indicates that we cannot reject at the five percent level that there is optionality in the returns; modifying the systematic risk model may therefore be required in these cases.*

correlation between the returns of individual hedge fund strategies. Our risk analysis corroborates this, with a large share of the variation in returns falling into the non-systematic portion of the risk model (Exhibit 11). This is also consistent with the tendency among individual funds to hedge out exposures to market-level risk factors.

The level of excess returns (alpha) produced by hedge fund portfolios reflects the average success of their investment strategies. The key to the success of hedge funds lies in their ability to exploit structural inefficiencies in the markets. Now let's consider why hedge funds might enjoy an edge in transforming market inefficiencies into returns.

Hedge fund managers are focused, and generally avoid risks outside of their area of expertise. The typical performance-based fee structure for a hedge fund attracts the industry's best talent and provides a significant incentive to identify and focus on winning strategies. Moreover, managers often have a portion of their own money invested in the fund.

It is also the case that the typical fund operates in a much less constrained environment than larger institutional funds. For example, greater reliance on strategies involving short-selling is a key enabler of hedge funds' success. In addition, hedge fund decision-making tends to be more streamlined and less committee-oriented, contributing to an overall nimbleness.

In combination, these factors lead us to the conclusion that hedge funds are distinctly positioned to collectively take advantage of inefficiencies in markets.

STRUCTURAL MARKET INEFFICIENCIES

The market inefficiencies hedge funds and other investors seek to exploit arise from several sources. Consider first the mutual fund industry, which simultaneously benefits from and is hindered by a captive client base. For example, these managers have benefited from enormous growth in 401(k) plans. Selection of managers in this arena is often influenced by factors other than performance, e.g. administration, and the costs of switching providers. Furthermore, regulatory and other constraints abound.

Virtually all fund managers are benchmarked to a passive index. The resulting focus on benchmarks and tracking risk limits flexibility. Benchmark tracking in effect ensures a large "deadweight" portion in the asset portfolio. The need to consider the marginal impact on tracking error poten-

tially affects every trading decision. Furthermore, active managers are, in effect, constrained to only shorting stocks up to their weight in the benchmark (i.e., underweighting that stock). The inability to short securities (beyond the benchmark weight) deprives the typical active manager of a significant portion of mispricings in the market. Not only are they unable to take full advantage of overpricings but they often also cannot take full advantage of underpricings because they are unable to create the offsetting short positions necessary to limit risk.

For pension funds and endowments, an allocation to hedge funds can significantly improve the risk/reward profile.

The growth of indexation and passive investing also provides a healthy supply of market inefficiencies. Consider the situation where an index provider has preannounced that a particular stock *X* will leave the index, and another stock, *Y*, will enter the index on a specified date. The strict index fund manager has committed in advance to a trading strategy of buying stock *X* at any price and selling stock *Y* at any price, creating well-documented demand and supply imbalances for securities entering and leaving an index. Hedge funds are particularly well placed to take advantage of these situations.

The growing individual investor base would also appear to contribute to systemic inefficiencies in markets. Evidence suggests these investors often follow momentum strategies naively, guided by poor information sources.

If the historical performance of hedge funds is based on the superior and leveraged exploitation of market inefficiencies, then its continuation requires a stable and growing supply of these market inefficiencies. The supply of inefficiencies will need to grow to accommodate the rapidly expanding hedge fund industry. Is it reasonable to assume that the supply of systemic inefficiencies will grow?

First, the structural inefficiencies we've identified are large, endemic, and should grow in concert with the expansion and liquidity of global markets through equification and other trends. The growing share of assets globally in defined contribution pension funds should increase the demand for active management and index-linked products. Greater participation in markets by individual investors, and expanding commitments to indexation by large asset owners, should also sustain the supply of market inefficiencies.

In addition, several potential future sources of inefficiency can be identified.

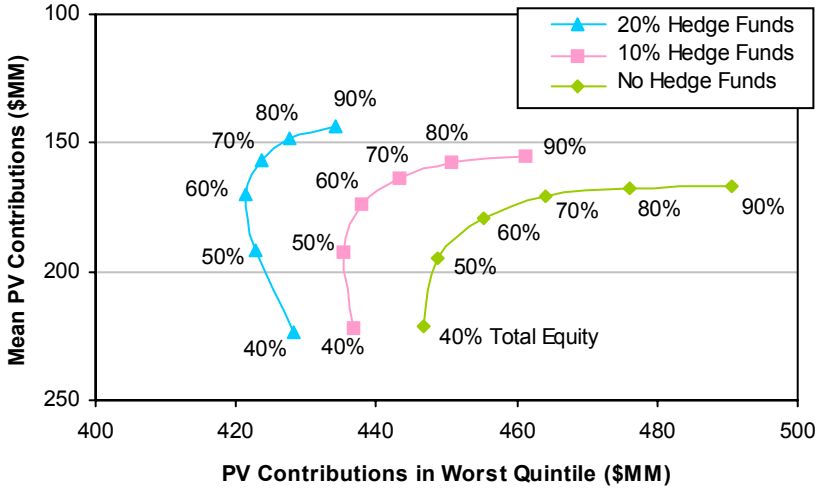
12 IMPROVEMENTS IN RISK-REWARD TRADEOFF FOR A PENSION FUND INVESTING IN HEDGE FUNDS

A MODELING ASSUMPTIONS

ASSET / LIABILITY ASSUMPTIONS	
LIABILITY PROFILE	U.S. defined benefit pension plan
OBJECTIVE	Minimize expected present value of required plan contributions
RISK DEFINITION	Present value of required plan contributions in worst 20% of scenarios

ASSET RETURN ASSUMPTIONS	Equity	Hedge Funds
EXPECTED RETURN	9.4%	8.8%
VOLATILITY	16.0%	8.2%
CORRELATION WITH BONDS	30%	4%
EQUITY/HEDGE FUND CORRELATION	34%	

B IMPACT OF INCLUDING HEDGE FUNDS ON OPTIMAL ASSET ALLOCATION DECISION



Proposed funding with equities of Social Security and other government pension benefits globally may also be expected to increase the supply of market inefficiencies. Consequently, there is reason to believe that the superior, risk-adjusted performance delivered to date by hedge funds in the aggregate is probably sustainable for the foreseeable future.

HEDGE FUNDS IN ASSET ALLOCATION

AN ASSET-LIABILITY FRAMEWORK

Up to this point, we have focused on asset-only attributes of hedge fund investments. In this section, we evaluate the benefits of a strategic investment in hedge funds as experienced by an investor explicitly concerned with liabilities (e.g., pension funds) — this is where the asset-liability framework enters the picture.

In contrast to the typical asset manager, who must decide on a return and risk profile for a portfolio relative to an asset benchmark, strategic investment policy of a fund backing liabilities must be set relative to a liability "bogey." Inclusion of liabilities can change the relative risk/return profiles of different asset classes dramatically. (For example, the minimum risk asset relative to a long-term pension fund liability probably looks more like a long duration bond than cash).

PENSION FUNDS

The measurement of return and risk in our asset liability framework considers the net impact of both sides of the balance sheet. For a defined benefit pension fund, we find a useful metric to be the present value (PV) of future plan contributions — the "true economic liability" of a corporation with respect to the pension plan incorporates both asset and actuarially measured liabilities.

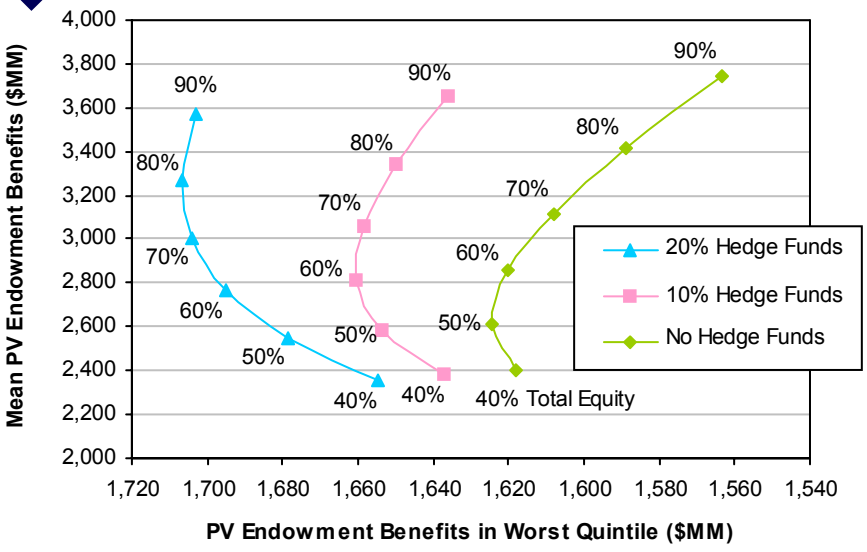
13 | IMPROVEMENTS IN RISK-REWARD TRADEOFF FOR AN ENDOWMENT INVESTING IN HEDGE FUNDS

A MODELING ASSUMPTIONS

ASSET / LIABILITY ASSUMPTIONS	
LIABILITY PROFILE	Endowment fund
FIRST YEAR WITHDRAWAL	5% of initial asset value
SUBSEQUENT YEAR WITHDRAWALS	70% of prior year withdrawal increased by price inflation plus 30% times 5% of prior year end asset value
RETURN DEFINITIONS	Mean real value of withdrawals (including final payment of remainder) Mean geometric real return
RISK DEFINITION	Mean real value of withdrawals in worst 20% of scenarios Mean geometric real return in worst 20% of scenarios Probability of annual geometric real return less than 5%

ASSET RETURN ASSUMPTIONS	Equity	Hedge Funds
EXPECTED RETURN	9.4%	8.8%
VOLATILITY	16.0%	8.2%
CORRELATION WITH BONDS	30%	4%
EQUITY/HEDGE FUND CORRELATION	34%	

B IMPACT OF INCLUDING HEDGE FUNDS ON OPTIMAL ASSET ALLOCATION DECISION



C SCENARIO DETAILS (INITIAL ENDOWMENT VALUE $1 BILLION)

Investment Strategy				Real Benefits ($bn)		Prob. Payout Cut	Prob GRR < 5%[1]	Port TRR[2]	
Equity	Hedge Funds	Bonds	Bond Dur	Mean	Worst 20%			Mean	Worst 20%
50%	0%	50%	5	2.62	1.62	21.9%	52.6%	4.96%	2.88%
54%	6%	40%	5	2.81	1.66	21.1%	45.2%	5.24%	2.99%
56%	14%	30%	5	3.01	1.70	20.1%	39.9%	5.51%	3.12%

1. *Geometric Real Return.*
2. *Total Real Return.*

Our approach analyzes the PV of future contributions over random interest rate and asset performance scenarios generated by a capital markets model. Return is defined as the mean PV of plan contributions across the scenarios. Risk is the same measure, but only considering the worst quintile of scenarios. So, from this risk/return perspective, what happens if hedge funds are added to the traditional asset mix?[1]

Exhibit 12 shows the impact of adding hedge funds on the asset-liability risk/return curves for a typical U.S. defined benefit pension fund (the return assumptions for the respective asset classes shown in Exhibit 12 are deliberately conservative with respect to hedge fund returns).

Consider, for example, the "No Hedge Funds" curve. This line suggests a minimum efficient allocation to equity of 40%. Above this level, increasing equity increases return (lowers plan cost) but increases cost risk.

Now we substitute hedge funds for part of the non-fixed income allocation. This allows for significant expansion of the efficient portfolio set. We observe that as the hedge fund proportion of "Total Equity" is increased, the risk/return tradeoff slope changes — the incremental return/risk ratio is higher. This results in changes to the optimal strategic asset portfolio. For example, the minimum risk equity allocation increases from 40% to 60% if hedge funds comprise 20% of the "Total Equity" portfolio.

ENDOWMENTS

We can also examine the impact of a strategic allocation to hedge fund investments in the context of an endowment fund. Here, the liability is better defined by a target real return and measured by the real value of endowment payouts plus terminal real value of the trust fund (see the first panel of Exhibit 13). The asset class return assumptions are identical to those used in the pension fund example.

Exhibit 13, Panel B shows the expansion in an endowment's risk/return opportunity from adding an allocation to hedge funds. Similar to the case for a pension fund, for each level of total equity allocation, as the hedge fund allocation is increased, return is little changed, but risk (measured by real payouts in the worst 20% of scenarios) is reduced dramatically.

Inclusion of hedge funds justifies an increase in total non-fixed income of the portfolio from 50% to 70%. Panel C shows that changing the asset allocation in this fashion results in higher expected return (measured by either mean realized real return or real value of endowment payouts). Risk is actually lower, measured by worst quintile returns, payouts, or alternatively by the frequency of payout cuts or probability of earning less than 5% real return for the projection period.

CONCLUSION

Our analysis of hedge funds leads to several key conclusions:

- Hedge funds portfolios have produced risk-adjusted returns and alpha that are superior to traditional investments.
- The correlation of hedge funds with fundamental asset classes has been low.
- Investing in portfolios of hedge funds is critical to achieving their economic benefits.
- The structure of the hedge fund industry, and growth in the supply of market inefficiencies, suggest that the advantages of hedge fund investments are not likely to diminish soon.
- Hedge funds will grow in significance in strategic asset allocation.
- Hedge funds should increasingly challenge conventional investment management. ■

1. *For more complete details of the MSDW corporate finance approach to asset liability management, please see, "Asset Liability Modeling in a Corporate Finance Framework,"* Global Equity and Derivative Markets, *January 1998.*

APPENDIX

DATABASE

The FRM database contains 1748 distinct fund histories covering more than 20 years, although we will focus on the last 10 years in our analysis due to data limitations prior to 1990. We believe it to be of high quality and as comprehensive as any of the alternative sources of hedge fund data. In addition to monthly performance, the database includes information on fund strategy and asset size. All performance figures are total returns net of the fees paid by investors in the funds.

INDEX CONSTRUCTION

Our hedge fund research indexes were constructed as follows:

- Equal weighted, annually rebalanced at the start of each calender year;
- One year of performance history required before a fund may be included in the index;
- Each month, new funds that meet the performance history requirement between rebalance dates are included in the index at a weight reflecting the performance of the index prior to that date since the last rebalance, with the existing funds reweighted proportional to their current weights;
- When a fund's performance history stops between rebalance dates, the remaining funds are reweighted proportional to their current weights.

This index construction methodology is a conservative way to represent the universe of hedge funds. It minimizes volatility from fund additions and deletions while maintaining realistic rebalance rules that recognize the lockup periods and track record requirements of most hedge fund investors.

14 | BIASES IN HEDGE FUND PERFORMANCE

A ESTIMATES OF SURVIVOR BIAS USING DATA SINCE 1997[1]

	All Hedge Funds	Directional Trading	Relative Value	Specialist Credit	Stock Selection
Annualized Return	-2.2%	-1.3%	-1.6%	-3.1%	-2.6%
Volatility	-0.4%	-0.7%	0.4%	0.0%	-0.9%
Sharpe Ratio[2]	-0.2	-0.1	-0.9	-0.5	-0.1

1. Negative number indicates amount by which naively measured values may be overstated.
2. Assumes 5.0% hurdle rate.

B RETURNS ADJUSTED FOR SURVIVOR BIAS: 1990–JUNE 2000

	All Hedge Funds	Directional Trading	Relative Value	Specialist Credit	Stock Selection
Annualized Return	17.2%	17.8%	12.3%	14.5%	18.9%

C ESTIMATES OF SERIAL CORRELATION IMPACT ON HEDGE FUND VOLATILITY: 1990-JUNE 2000[1]

	All Hedge Funds	Directional Trading	Relative Value	Specialist Credit	Stock Selection
Volatility from Monthly Returns	5.5	10.1	2.8	5.2	9.1
Volatility Adjusted for Persistence	7.7	13.6	5.7	9.3	13.4

1. Serial correlation (return persistence) can result from spurious influences like stale pricing as well as valid influences like predictable performance.

BIASES IN HEDGE FUND PERFORMANCE

A serious pitfall in performance studies of active managers is the presence of survivorship, selection and other biases in the databases used by researchers. Given the unregulated nature of the hedge fund industry and the resulting lack of complete information, these problems may be especially pronounced for hedge funds.

We focus on the potential impact of selection bias, survivorship bias, and stale pricing on hedge fund performance measurement.

Our database has 1130 distinct funds reporting performance as of June 2000. If estimates that the universe of hedge funds currently numbers more than 3000 are true, our analysis is based on a small subset of the actual industry performance. Nevertheless, we believe the database to be as comprehensive as any other, so that any "selection bias" in our sample should be comparable to that of other studies.

Survivorship bias results when a database includes only funds that are alive today, and has been widely documented for hedge funds. Of course, funds which stop reporting and are excluded from databases may do so because they are closed to new investors but in fact performing well.[1] Nevertheless, estimates of survivorship bias for

1. Our database includes managers that may be technically closed to new investors for some of the reporting period. It is not known what impact this may have on performance measurement.

other databases range from 1.5% to 3% of return per year.[1] In our database, the problem appears to be most severe prior to 1997, and may explain in part the weaker performance of hedge funds after 1997 documented in Exhibit 5.

Exhibit 14, Panel A gives estimates of survivorship bias for the hedge fund strategies in our database. For the universe of hedge funds, the estimated return bias is 2.2% per year since 1997. This implies that, for example, the geometric annual return since 1990 for the universe of hedge funds in Exhibit 5 of 18.9% should be adjusted downward to 17.2% (Panel B). The return bias is of a similar magnitude for the individual hedge fund strategies. There appears to be a less significant impact of survivorship on volatility estimates, rendering them too high by about 40 basis points overall.

A third significant measurement bias that may render hedge fund annual performance estimates different from actual experience is stale pricing. This can occur when a fund holds securities for which up-to-date pricing is hard to come by. Stale pricing leads to serial correlation in returns, which has the effect of biasing downwards our estimates of volatility and correlation. Of course, serial correlation in returns may reflect more legitimate influences such as predictable performance among managers. Our estimates of the downward bias in annual volatility from serial correlation are given in Exhibit 14, Panel C, and are most severe for the Relative Value and Specialist Credit strategies, where the volatility estimates from Exhibit 5 may be as much as 100% too low. As might be expected, the strategies most affected are those likely to transact in exotic securities or private, illiquid markets.

SYSTEMATIC RISK AND ALPHA

A standard approach to describing systematic risk and alpha is a linear regression model, where excess returns (in excess of LIBOR in our case) of the active strategy are described by betas or exposures to investable passive index excess returns thought to represent risk[2]:

$$R^{strat} - R_f = \alpha + \Sigma_i \beta_i \times (R_i^{asset} - R_f) + \varepsilon.$$

If this representation of returns is well specified for the strategy at hand and describes all of the relevant risks, the constant term in the regression can be thought of as a measure of alpha. It may represent security selection skill as well as value-added from dynamic trading, although a precise identification is difficult. The betas represent systematic risk with respect to the investable assets, the product of which is sometimes referred to as investment style.

While useful as an empirical description of risk and alpha, our approach may be unsatisfactory for managing the risk of portfolios of hedge fund strategies since the R-squared values are relatively low in Exhibit 11. One reason may be that the strategy returns are characterized by nonlinear or option-like dependence on the risk factors. Indeed, individual hedge fund returns often exhibit such properties; for example, risk arbitrage funds that profit from successful mergers but suffer substantially larger negative returns when deals fail (returns resembling a short put option).

We developed a statistical test for the presence of option-like returns, the results of which are shown in Exhibit 11 under the heading "Evidence of Optionality." Our results show that, except for the Relative Value strategies, the linear risk framework appears to be adequate for describing diversified portfolios of hedge funds in the context of the proposed investable passive indexes. However, more research is needed to better account for the option-like properties of Relative Value funds, and smaller portfolios of individual funds. In addition, it may be that other hedge fund-specific risk factors are also needed for general hedge fund risk management.

1. *See William Fung and David Hsieh, "Performance Characteristics of Hedge Funds and CTA Funds: Natural versus Spurious Biases," Duke University, September 1999.*
2. *See, for example, William F. Sharpe, "Style Analysis,"* Journal of Portfolio Management, *Winter 1992.*