

# Portfolios of Alternative Assets: Why Not 100% Hedge Funds?

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Interest in “alternative assets” is increasing tremendously, driven by a constant search for superior risk-adjusted returns. Investors have moved beyond holding plain-vanilla stock and bond portfolios to include hedge funds and structured products in their portfolio mix. Hedge “funds of funds” and principal-protected versions of hedge funds are particularly attractive to high net worth individuals and institutions with more liberal investment mandates. Nonetheless important questions remain about the appropriateness of including these products in portfolios and the allocations that they should receive.<sup>1</sup>

I argue that adding such investments to conventional portfolios significantly improves portfolio performance in a risk and reward context. This occurs under a variety of circumstances via diversification and low correlations with other asset classes. Indeed, when risk-adjusted returns are considered, portfolios of hedge funds dominate investments in traditional bond and equity portfolios.

Furthermore, I show that portfolios of hedge funds are in reality a conservative investment and can substitute for bonds and cash as a defensive vehicle when equity prices decline. This is especially true when hedge fund investments are leveraged. These conclusions are subject to several major caveats, however.

## BACKGROUND

### Funds of Hedge Funds

As the hedge fund industry has evolved over the last two decades, institutions and individuals who initially invested in one or several hedge funds began to spread their exposure over a number of hedge fund managers. This produces diversification benefits by providing more stable returns at lower risk.

A natural offspring of such diversification efforts is the creation of *funds of hedge funds*, in which diversification is provided in a convenient package by one sponsor. This saves investors significant time and expense by efficiently providing due diligence, performance evaluation, and manager monitoring. It also creates an effective instrument for investing in hedge funds as an asset class and reduces the dollar size of the investment necessary to achieve effective diversification.

### Quasi-Hedge Fund Products

Simultaneously with the evolution of hedge funds as an asset class, “enhanced-yield cash substitutes” have evolved as a viable addition to portfolios. These products typically have as an objective outperforming Treasury returns by a target percentage. They often employ principal protection embedded in a deposit or note format. Upon the maturity

of an instrument, the investor receives a return of principal, plus additional return conditioned on the manager's performance.

Enhanced-yield products with principal guarantee can be decomposed into two components: 1) the known cash return portion that repays principal, and 2) the incremental return component attributable to manager skill. The latter is generated in a number of ways, using leveraged instruments such as options. This makes enhanced-yield cash products simply quasi-hedge funds that blend cash with hedge fund exposure to produce a conservative return with low volatility.

From an asset allocation perspective, when hedge funds and cash are included separately in the asset universe, enhanced-yield products are replicated simply through an allocation to hedge funds and cash. Because they are a combination of two primary asset classes, we do not discuss enhanced-yield products here.

## HEDGE FUND RETURNS

Our data on hedge funds come from Evaluation Associates, Inc. (EAI), and show that returns averaged 16.5% in the 1990s with an annualized volatility of 3.5%.<sup>2</sup> This is obviously excellent compared to other

assets as well as superior to equities and bonds on a risk-adjusted basis. This return and risk profile is confirmed using alternative data available from TASS and presented in a study by Brown, Goetzmann, and Park [1998]. Of major importance, both data sources are virtually perfectly correlated, and show that 1994 was essentially a zero-return year, constituting the only such poor performance year reported (Exhibit 1).<sup>3</sup>

## Hedge Funds Offer Superior Returns

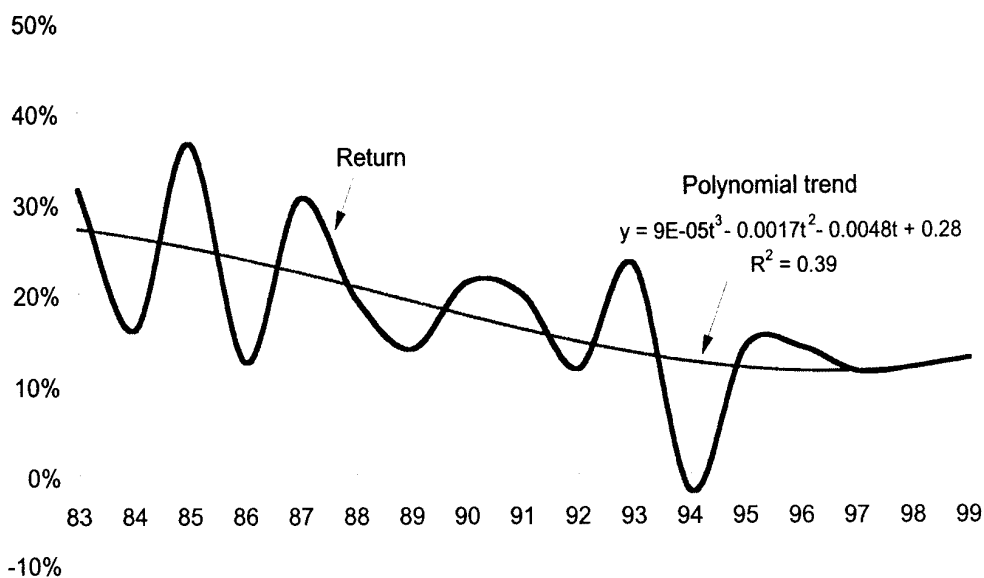
Why might hedge funds offer superior risk-adjusted returns? There are four reasons, all related to market inefficiency arguments.

First, there is a lack of transparency in hedge fund markets. Performance data and information are much less readily available than for other assets such as equities and bonds. Many investors may thus avoid hedge funds as a consequence of poor information. This is evidenced by the fact that investors often enlist the assistance of consultants to perform due diligence before investing in hedge funds.

Second, the hedge fund industry cannot absorb the large amounts of funds that institutional investors need to invest in order to meet even small allocations. Consequently, a large pool of investable funds are effectively

## EXHIBIT 1

### Modest Decline in Hedge Fund Returns 1983-1999



Source: Brown, Goetzmann, and Park [1998] data.

barred from moving into the industry. This may leave a high-return niche by default.

Third, because hedge funds are typically organized as partnerships, the number of investors is limited. Consequently, hedge funds usually establish large minimum investments that effectively exclude the bulk of retail investors. This may also constrain fund inflows and keep returns relatively high.

Finally, hedge funds are not as liquid as other financial products. An investor often has to wait at least one quarter to liquidate a hedge fund investment. This limits flexibility in hedge fund investing and most likely restricts the size of the asset class.

### **Are Reported Hedge Fund Returns Real?**

Two related questions are 1) whether reported hedge fund industry returns are realistic, and 2) whether they will persist in the future. With respect to whether reported hedge fund returns are accurate, the answer is yes, in that recorded information represents what is collected. Unfortunately, such return data are likely biased upward because individual hedge funds are added to data bases only when they have a demonstrated record of success. Hedge funds that fail are largely excluded from reported returns by data vendors. Furthermore, firms that fail are often dropped from existing data bases, creating even more potential for upward bias. Available historical returns thus may be subject to significant "survivor bias." This implies that reported aggregate returns for hedge funds may substantially overestimate the actual performance an investor would realize.<sup>4</sup>

A related concern is that as assets increasingly flow into hedge funds, managers may not continue to deliver the high returns attained to date.<sup>5</sup> There is some evidence to indicate that this is the case. Brown, Goetzmann, and Park [1998] find that hedge fund returns averaged more than 20% in the 1980s, but declined to the mid-teens in the 1990s. In our own tests, we find there is a statistically significant negative trend in hedge fund returns from the 1980s onward according to TASS data. The rate of decline has diminished in the last few years, however.

### **THE HEDGE FUND EFFICIENT FRONTIER**

Hedge fund strategies come in a variety of flavors and formats. Many data vendors and consultants use ten or more descriptive strategies to segment the industry. Of course, diverse hedge fund strategies, if consis-

tently followed, produce varying risk and return profiles. For example, hedge funds that primarily sell short demonstrate statistically different risk, reward, and correlation profiles from those that make global macro bets. The same is true for other hedge fund strategies.

### **Hedge Fund Strategies**

The relative abundance of performance data on different strategies allows the construction of efficient hedge fund frontiers using standard mean-variance analysis. This produces efficient combinations of strategies that represent optimal hedge fund portfolios. One can thus design hedge funds of funds that have superior risk and reward characteristics. Such an analysis also produces information on the way in which diverse hedge fund strategies may be added to stock and bond portfolios.

We use five basic hedge fund strategies to construct the hedge fund efficient frontier: 1) relative value; 2) event-driven; 3) equity hedge; 4) global asset allocation; and 5) short-selling. These are the basic broad categories provided by EAI.

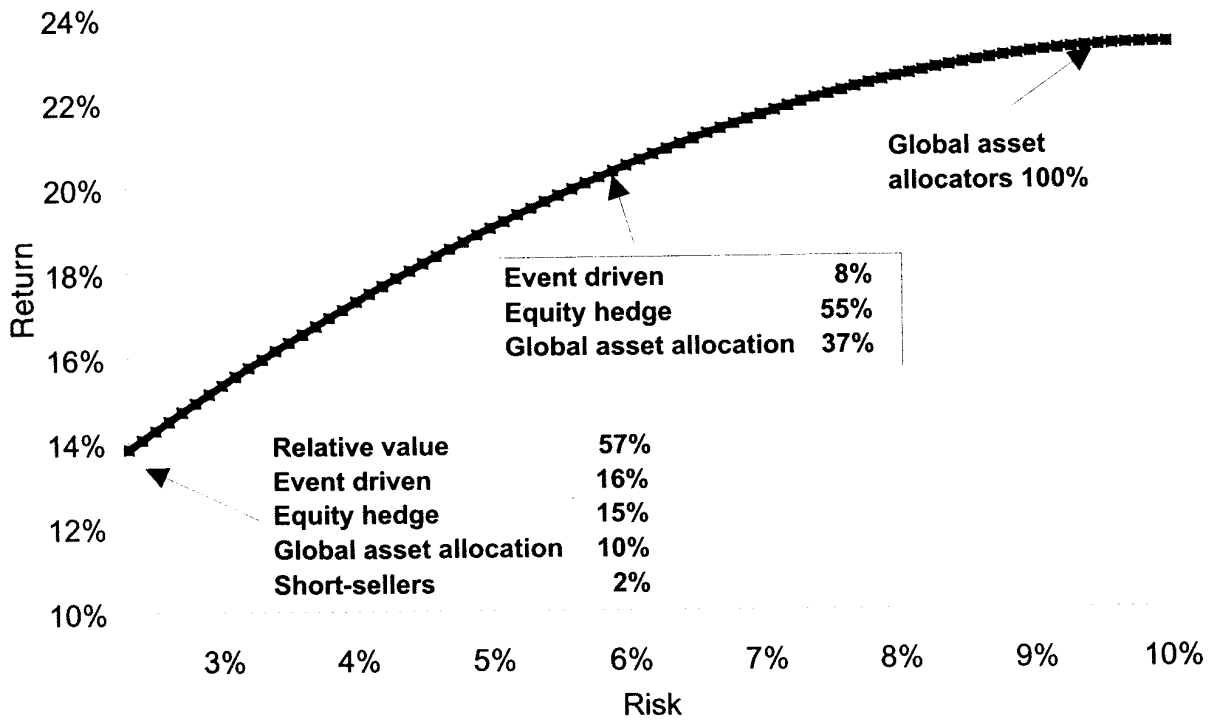
"Relative value" managers primarily execute market-neutral strategies that combine long positions offset in whole or part by short positions. These could be in equities, convertibles versus common equity, yield-curve arbitrage, or even in commodities. "Event-driven" managers primarily employ merger and acquisition or bankruptcy arbitrage. "Equity hedge" managers engage in classic hedge fund activity where long positions are offset by short positions, except that there is typically a long bias. "Global asset allocators" take leveraged long or short positions in virtually any financial product in any market. Finally short-sellers do exactly what is implied: Sell short equities that are expected to decline in price.<sup>6</sup>

### **Results**

The results of generating the efficient frontier for hedge fund strategies indicate that the most aggressive optimal portfolios assign high weightings to global asset allocators and equity hedge managers (Exhibits 2 and 3). This is what one would expect, since these strategies generate the highest returns (Exhibit 4). Aggressive, risk-preferring investors should thus skew their hedge fund portfolios to global asset allocators and equity hedge managers.

Relative value and event-driven managers produce more conservative risk-adjusted returns. Consequently, conservative investors should assign large weights to rel-

**EXHIBIT 2**  
Hedge Fund Efficient Frontier



**EXHIBIT 3**  
Selected Portfolios on Hedge Fund Efficient Frontier (%)

Portfolio Return	Portfolio Risk	Relative Value	Event-Driven	Equity Hedge	Global Asset Allocators	Short-Sellers
				<i>Allocation</i>		
23.1	10.9	—	—	—	100.0	—
22.4	8.5	—	—	24.1	75.9	—
21.7	6.9	—	—	46.3	53.7	—
21.3	6.4	—	—	59.7	40.3	—
20.8	6.0	—	7.8	54.7	37.5	—
20.1	5.6	0.2	17.9	47.2	34.6	—
19.2	5.0	11.5	17.2	40.8	30.5	—
18.4	4.5	20.2	16.7	35.8	27.3	—
17.9	4.2	27.2	16.2	31.8	24.7	—
17.4	3.9	32.9	15.9	28.6	22.6	—
16.6	3.5	40.1	15.7	24.6	19.2	0.5
15.8	3.0	46.6	15.7	21.0	15.6	1.2
15.1	2.7	52.3	15.6	17.8	12.4	1.9
14.6	2.4	56.8	15.6	15.3	9.9	2.4

## EXHIBIT 4

### Returns, Volatility, and Correlations for Various Hedge Fund Strategies (%)

	Total	Relative Value	Event-Driven	Equity Hedge	Global Asset Allocators	Short-Sellers
Weight EACM 100 index	100.0	30.0	15.0	30.0	20.0	5.0
Return	16.5	12.4	14.6	20.7	23.1	-5.0
Risk (standard deviation)	3.4	2.1	4.7	7.5	10.9	22.7
Ratio	4.8	5.9	3.1	2.7	2.1	-0.2
<i>Correlation</i>						
Total EACM 100 Index	1.00	0.49	0.37	0.60	0.75	-0.15
Relative Value		1.00	0.26	0.28	0.14	-0.09
Event-Driven			1.00	0.55	-0.09	-0.56
Equity Hedge				1.00	0.04	-0.73
Global Asset Allocators					1.00	0.20
Short-Sellers						1.00

Source: EAI. Monthly series begins January 1991 through 1997.

ative value managers and commit smaller percentages of funds to other hedge fund strategies.

Finally, we note that short-sellers have produced very poor returns through the 1990s "Goldilocks" economy and the unprecedented equity bull market. Any allocation to this strategy should be small unless an investor strongly believes that a bear market is imminent. Even then, an investor who wants protection against equity market declines can achieve it using other hedge fund strategies that generally have low correlation with equity markets.<sup>7</sup>

## CONVENTIONAL PORTFOLIOS

### Methodology

Having established the basic behavioral characteristics of hedge fund portfolios, we determine the optimum asset allocation for portfolios of conventional assets and compare them to hedge fund portfolios. Our overall approach proceeds as follows. First, we ask how portfolios of alternative assets alone compare with conventional portfolios. Second, we inquire to what extent hedge fund assets should be blended with traditional assets to produce optimum portfolios. In this second step, we address the issue of potential overstatement of hedge fund returns due to survivor bias and the possibility of declining future returns.

As usual with asset allocation, the assumptions underlying the analysis are critical to any conclusions

reached. We include U.S. and EAFE equities, U.S. bonds, international bonds, and cash as the appropriate asset classes. This is a simple, well-diversified global portfolio that includes the key asset classes employed by most investment managers.

To simplify the process and remove subjectivity from the analysis, we reengineer expected returns given current market capitalizations combined with historical volatilities and correlations. Studies have shown that return assumptions are the most critical component in asset allocation, so this is our primary motivation.<sup>8</sup>

### Influence of Current Market Conditions

The result of reengineering returns produces a somewhat unusual situation reflecting the current market environment where the U.S. yield curve is relatively flat and the risk-free rate relatively high (Exhibit 5). In this context, U.S. bonds are less attractive than would normally be the case. Furthermore, indications are that expected returns are higher for EAFE equities than for U.S. equities. Again, this is no doubt a function of recent equity market performance in that the U.S. market has out-performed and mean reversion to historical patterns favors EAFE equities.

The resulting efficient frontier for conventional assets thus weights international equities and cash heavily (Exhibit 6). Equity allocations tilt to EAFE for more risky portfolios. And bond allocations are rel-

atively low compared with typical allocations suggested by asset allocation models in recent years. As we have noted, this is attributable to high relative cash returns reflected in the flat U.S. yield curve. Undoubtedly cash returns will diminish at some time compared to long-term bond returns. Nonetheless, at least for the present, these allocations provide an unbiased point of departure.

## DO HEDGE FUNDS DOMINATE CONVENTIONAL PORTFOLIOS?

When we compare the hedge fund efficient frontier with the efficient frontier for conventional assets, it is obvious that investments in hedge funds dominate conventional portfolios at all risk levels. That is, all efficient hedge fund portfolios have Sharpe ratios significantly

### EXHIBIT 5

#### Asset Class Returns, Risks, and Correlation Assumptions (%)

	U.S. Equities	EAFE	U.S. Bonds	International Bonds	Hedge Funds	Cash
Implicit return	11.0	12.80	6.2	7.40	16.50	5
Excess return	6.0	7.80	1.2	2.40	11.50	0
Risk	12.0	14.00	4.0	8.70	3.50	0
Sharpe ratio	0.5	0.56	0.3	0.28	3.29	-
<i>Correlations</i>						
U.S. equities	1.00	0.45	0.50	0.10	0.25	0.00
EAFE		1.00	0.25	0.45	0.15	0.00
U.S. bonds			1.00	0.40	0.30	0.00
International bonds				1.00	0.05	0.00
Hedge funds					1.00	0.00
Cash						1.00

Returns for U.S. equities, EAFE, U.S. bonds, and international bonds are reengineered from current market capitalizations given historical risks (monthly trailing standard deviation) and correlations. Hedge fund returns, risks, and correlations are historical based on EAI monthly data from 1991 through April 1998. Correlations are rounded to nearest 0.05.

### EXHIBIT 6

#### Efficient Frontier for Traditional Assets (%)

Portfolio Return	Portfolio Risk	U.S. Equities	EAFE	U.S. Bonds	International Bonds	Cash
<i>Portfolio Allocation</i>						
12.8	14.0	-	100	-	-	-
12.5	12.7	16	84	-	-	-
12.2	11.8	32	68	-	-	-
11.7	10.7	44	50	-	6	-
11.0	9.6	40	42	8	11	-
10.6	9.0	36	39	10	10	4
10.2	8.4	34	37	10	9	10
9.6	7.4	30	32	9	8	21
8.9	6.3	26	27	7	7	33
8.1	5.0	20	22	6	6	46
7.5	3.9	16	17	5	4	58
5.4	0.6	3	3	1	1	93

exceeding those of conventional portfolios. Consequently, if one presumes reported historical returns for hedge funds will be realized and compares these to conventional portfolios, one would hold only hedge funds for any risk profile. Hedge fund portfolios “dominate” conventional portfolios.

The problem with this dominance proposition is that hedge fund returns are “fuzzy” because of survivor bias and the fact that future returns may decline due to potential heavy inflows of investor funds. The truth is we do not know exactly the magnitude of survivor bias, nor can we derive implicit expected returns for hedge funds because there is no accurate information on hedge fund market capitalization. For this reason, it is not strictly valid to compare the hedge fund efficient frontier with conventional portfolios.

It would be presumptuous at this point to suggest that portfolios of hedge funds universally dominate conventional portfolios as an investment. Even so, we can conclude that as long as hedge fund survivor bias and future expected returns subtract no more than 5 or 6 percentage points from historical returns, hedge funds are superior to any combination of conventional portfolios on a risk-adjusted basis.

## COMBINING HEDGE FUNDS WITH TRADITIONAL ASSETS

### Procedure

One solution to the issue of hedge fund survivor bias and potentially declining future returns is simply to admit ignorance and iterate over a range of plausible hedge fund returns. We follow this route and produce efficient portfolios combining hedge funds with conventional assets under various hedge fund return assumptions. We vary the return assumption for hedge funds over the range from 5.5% to 12.5% (equivalent to excess returns of 0.5 to 7.5 percentage points), while holding volatility and correlation constant.

The resulting efficient frontiers for hedge funds combined with conventional assets are revealing (Exhibit 7). Hedge funds enter efficient frontiers across virtually all risk levels, even when relatively low returns are assumed. This occurs because of the superior risk-adjusted characteristics of portfolios of hedge funds — Sharpe ratios are so high for hedge funds that the asset class enters virtually all portfolios.

It should be noted that hedge funds enter efficient portfolios largely at the expense of bonds. In this regard,

hedge funds are primarily a substitute for bonds and a complement to equities.

### Findings

If one presumes prospective hedge fund returns are 11.5%, a risk-preferring investor desiring 12.5% risk optimally would weight a portfolio 87% in EAFE equities and 14% in a portfolio of hedge funds. For the same hedge fund return assumption, but at 4.5% portfolio risk, the investor should allocate 24% of funds to EAFE and 76% to hedge funds. The implications obviously are that, to reduce risk, investors should invest more in the hedge fund asset class.

The same pattern persists for lower levels of prospective hedge fund returns, except that equity weightings become larger and hedge fund allocations progressively smaller. For example, with presumed hedge fund returns of 6.5% (equivalent to an excess return of only 1.5 percentage point and a full 10 percentage points below the 1990s history), hedge funds represent a quarter to half of funds allocated in a medium-risk portfolio. And only when prospective returns on hedge funds fall to 5.5% are they driven out of efficient portfolios altogether.

### Conclusions

If one believes that hedge funds offer at least several percentage points of excess return above Treasury rates, we can easily conclude that they should play an important role in portfolios. Hedge funds constitute a conservative investment on a risk and return basis. They primarily displace investments in bonds and cash in efficient portfolios. Finally, blends of equities and hedge funds offer superior returns on a risk-adjusted basis for virtually all levels of risk.

These findings contradict the prevailing wisdom that hedge funds are a risky investment and more a substitute for equities. Our analysis suggests just the opposite. A risk-preferring investor might hold a portfolio consisting entirely of hedge funds if survivor bias is small and future returns on par with history. But more prudently, such an investor would be better advised to blend hedge fund portfolios with equities. Similarly, conservative investors would be best advised to increase their holdings of hedge funds to reduce risk.

We note that these conclusions are anecdotally consistent with investor behavior we have observed. Allocations to hedge funds by some aggressive small institutions

## EXHIBIT 7

### Efficient Portfolios Under Alternative Hedge Fund Returns (%)

Portfolio Return	Portfolio Risk	U.S. Equities	EAFE Equities	U.S. Bonds	International Bonds	Hedge Funds	Cash
<i>Asset Allocation</i>							
12.5%							
12.7	12.5	–	80	–	–	20	–
12.6	8.5	–	41	–	–	59	–
12.6	6.5	–	30	–	–	70	–
12.6	4.5	–	22	–	–	78	–
11.5%							
12.6	12.5	–	87	–	–	14	–
12.2	8.5	–	58	–	–	42	–
12.0	6.5	–	40	–	–	60	–
11.8	4.5	–	24	–	–	76	–
10.5%							
12.6	12.5	–	91	–	–	9	–
11.9	8.5	–	62	–	–	38	–
11.5	6.5	–	42	–	–	57	–
11.0	4.5	–	22	–	–	78	–
9.5%							
12.5	12.5	14	83	–	–	3	–
11.5	8.5	9	56	–	–	35	–
11.0	6.5	7	43	–	–	50	–
10.3	4.5	3	23	–	–	74	–
8.5%							
12.5	12.5	16	84	–	–	–	–
11.2	8.5	21	50	–	–	28	–
10.3	6.5	14	34	–	–	51	–
9.5	4.5	7	19	–	–	73	–
7.5%							
12.5	12.5	16	84	–	–	–	–
11.0	8.5	29	46	–	–	25	–
9.9	6.5	19	32	–	–	49	–
9.5	4.5	16	27	–	–	57	–
6.5%							
12.5	12.5	16	84	–	–	–	–
10.5	8.5	31	41	–	–	28	–
9.4	6.5	23	30	–	–	46	–
8.1	4.5	14	17	5	–	57	8
5.5%							
12.5	12.5	16	84	–	–	–	–
10.2	8.5	34	37	10	8	–	–
9.1	6.5	27	29	8	7	–	29
7.8	4.5	18	20	5	5	–	52

Source: Results of optimization analysis. Hedge fund returns appear in italics.



and high net worth individuals we know are as high as 40%, with the balance of exposure in equities. For these investors, hedge funds offer diversification benefits without sacrificing absolute returns the way bond holdings would. In contrast, our experience with more conservative investors indicates that few hold hedge funds in their portfolios. Thus, risk-averse investors appear significantly underexposed to hedge funds.

## PROSPECTIVE HEDGE FUND RETURNS

Although it is not critical to the analysis presented here, we will venture an opinion on minimum prospective returns for hedge funds. We focus specifically on a scenario that in our view is the “worst case.”

First, recall that a simple trend model projects a future return for hedge funds of approximately 11%. This estimate is significantly lower than historical returns and embodies investment inflows at rates prevailing in the past. Unfortunately, it excludes the effect of survivor bias that must be incorporated.

### Previous Studies

The issue of survivor bias is complex and not unique to hedge funds. Grinblatt and Titman [1992] find that survivorship biases up mutual fund returns by 0.5% annually. Blitzler [1995] reports that removing survivor bias from the S&P reduces returns by approximately 0.7% to more than 1%, depending on time period and the replication technique used. Because entry and exit are much higher in hedge funds, survivor bias is thus likely to significantly exceed the 1% reported for the S&P.

As an aside, we expect over time that survivor bias will diminish, as data compilers are now attuned to the problem and typically will carry returns for defunct funds at zero return levels. This should reduce the magnitude of the problem. Nonetheless, the issue remains that with an arbitrary start date in the past, hedge fund data remain “contaminated.”

### Example

To illustrate the potential magnitude of survivor bias, consider the effects of exit on an equal-weighted index consisting of one hundred hedge funds. Assume that, upon exit, any fund will show a negative 100% return for the month and zero return thereafter.<sup>9</sup> For example, if one of our hedge funds were to exit in the first month of our

return series, its impact on index return would be minus 1% since the fund represents 1% of the portfolio. Thereafter, at a zero return, it would dampen total index returns by one-hundredth of the average return for each period.

For example, if the index monthly return is 100 basis points, replacing one hedge fund earning average returns with a hedge fund returning -100% would reduce index returns to approximately zero *for that month*. Annually, the effect would be to reduce returns from 12.7% to 11.4%, assuming failure occurs in the first month of the year.<sup>10</sup> In the following year, however, returns rebound to 12.5% since ninety-nine funds yield 100 basis points monthly.

Combining this logic with the fact that there are only a few established managers that exit each year from funds of hedge funds leads to the conclusion that survivor bias is not likely to be so huge as to discredit hedge funds as an asset class. Nonetheless, in our sample of one hundred hedge fund returns, if the average exit rate were to reach three per year, we would expect average returns to be dampened by approximately 3.9% annually over a five-year period.<sup>11</sup> This assumes replacement with new average performers at year-end. Thus, the worse case expected return for hedge funds would be a trend of 11% minus 3.9%, or 7.1%. Even at this overstated exit level, hedge funds enter most optimum portfolios.<sup>12</sup>

## LEVERAGING HEDGE FUNDS

The high risk-adjusted returns attainable via hedge fund investments make them an ideal product for leveraging. Rarely do hedge fund portfolios report negative returns. Even in the worse year on record — 1994 — returns were essentially flat. For this reason, and because hedge fund returns are higher than bond returns and less risky, leveraging hedge funds represents an unadulterated profit opportunity. The only requirement is that hedge fund returns exceed LIBOR borrowing costs, which has been the case historically and appears likely to continue.

On the surface, leveraging hedge funds may appear paradoxical — borrowing to purchase more exposure on an already highly levered investment might seem extraordinarily risky. But the risk and return profile of hedge funds, as already described, is more attractive than that of other assets (which very often produce successive negative return months and quarters). And of course there is the occasional bear market with a 25% decline that can destroy a highly leveraged equity position. Hedge funds, with a fundamentally different investment style and low correlation with bonds and equities, avoid this deficiency.

## CONCLUSIONS

Portfolios of hedge funds represent an important alternative asset class that has gained prominence in recent years. Unlike other asset classes, however, returns are fuzzy and the asset class lacks transparency. The fact that the magnitude of survivor bias is unknown complicates the estimation of historical returns for hedge funds, much less the forecasting of prospective returns. That said, even under severe return assumptions, we show that hedge funds offer superior portfolio-enhancing characteristics and should be an integral part of an investor's investment spectrum.

This is true for both aggressive (risk-preferring) and conservative (risk-averse) investors. For aggressive investors, a blend of equities with hedge funds is appropriate, or even 100% exposure to hedge funds. For more conservative investors, hedge funds should be used in lieu of bonds as a diversification instrument.

## ENDNOTES

<sup>1</sup>We focus on hedge funds primarily because of the market size — estimated at as much as \$400 billion in assets under management (see “Hedge Fund Demand ...” [1998]). Other alternative assets recently gaining attention include private equity, catastrophe bonds, inflation-protected securities, CBOs, and CLOs. See Lamm [1998, 1999b] for a review of the benefits of including catastrophe bonds, and inflation-protected securities in portfolios. In addition, note that throughout, when we discuss hedge funds as an asset class, we mean a diversified portfolio of hedge funds such as is typically in most funds of hedge funds.

<sup>2</sup>For our measure of hedge fund returns and volatility, we use the EACM 100 — a monthly index of returns on 100 hedge funds compiled by Evaluation Associates, Inc. The index is constructed to represent a hedge fund universe of companies with a minimum of \$20 million under management and begins in January 1991 with data backfilled from a universe of member funds specified for 1996. The index consists of five broad hedge fund strategies with weighting as follows: 30% relative value; 15% event-driven; 30% equity hedge funds; 20% global asset allocators; and 5% short-sellers. Within each category, funds are equal-weighted. Managers must be representative of a particular investment strategy and have at least a one-year audited record (the average is three). Assets of funds under management average \$270 million per fund.

<sup>3</sup>Since the original completion of this study, hedge fund returns fell in the aftermath of problems at Long Term Capital Management in 1998. This has little impact on the con-

clusions I present here, however. For an update on more recent experience, see Lamm [1999a].

<sup>4</sup>The survivor bias issue is discussed at length in Brown, Goetzmann, and Park [1998] and Brown, Goetzmann, and Ibbotson [1999].

<sup>5</sup>This view is raised often and explained in detail by Ibbotson [1998].

<sup>6</sup>See William Crerend [1998] for more detail on the hedge fund strategies and categorizations discussed here. See Fung and Hsieh [1997] for an analysis of whether qualitative categorizations of hedge fund strategies are quantitatively distinct.

<sup>7</sup>We do not discuss the correlation between hedge fund strategies and returns in other asset classes. Note in general, though, that although the correlation between returns on a weighted basket of strategies versus bonds and equities is low, such correlation increases as one moves up the efficient frontier and declines as one moves toward more conservative portfolios.

<sup>8</sup>See, for example, Chopra and Ziemba [1993].

<sup>9</sup>It should be noted that many hedge funds do not exit immediately upon one poor quarter's performance. It may take significant time for customers to withdraw their investments and the hedge fund to fade away. Or, a fund may recover and live to excel another day.

<sup>10</sup>On an annual basis, the impact would be to reduce returns from  $(1.01)^{12} - 1 = 12.7\%$  to  $0.9999(1.0099)^{11} - 1 = 11.4\%$ . This is an extreme assumption in that usually some capital is returned when hedge funds exit.

<sup>11</sup>According to our experience, one exit per year is probably the norm for one hundred hedge funds selected via professional due diligence screens. The number of exits from funds of hedge funds in particular should be low where managers are often reviewed quarterly. In addition, we note that exit risk is typically much less in funds of funds where start-up managers are excluded.

<sup>12</sup>In contrast to returns, the impact of exiting on hedge fund portfolio risk is minimal. There is a major impact during the month of exit — total portfolio risk rises 1% assuming one fund in a sample of one hundred loses all its capital. But thereafter the effects are to reduce index volatility (since 1% of the index has a volatility of 0%). Thus, at exit points, volatility increases slightly and then decreases.

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