Active Risk Budgeting In Action: Understanding Hedge Fund Performance

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- As investors begin to adopt Active Alpha Investing, their demand for hedge funds is likely to increase.
- To fully embrace this style of investing, investors need a framework to analyze hedge fund risk and return. This paper proposes such a framework.
- Our framework identifies the following key issues in assessing and projecting hedge fund performance:
  - The impact of market returns versus active returns
  - The differences in active returns across hedge fund strategies
  - The relative confidence that investors place in alternative strategies
- Hedge funds will continue to play an important role in investors portfolios. Our framework is designed to help investors isolate the key decisions that they must make.
Introduction

The world of institutional investing is changing. Increasingly, investors are designing their investment policy in terms of two broad types of risk exposures: market risk (e.g., passive exposure to global capital market return) and active risk (attained through skill-based strategies to deviate from global capital market allocations).

In this new world, two trends are emerging:

• Investors are demanding more active risk. As this trend develops, it is likely that a larger fraction of total portfolio risk will be allocated to active strategies. An implication of this trend is that investor demand for hedge funds should increase, as hedge funds provide a potential source of active returns.

• Investors want to make more efficient use of their active risk budgets. That is, in addition to increasing the total level of active risk, investors want to ensure that it is allocated to those active strategies where conviction about active performance is the highest.

This second trend, in turn, places an analytic burden on investors: if they are to properly allocate active risk between hedge funds and other active strategies on an ex ante basis, they must also understand the sources of hedge fund risk and performance. In other words, they must be able to clearly distinguish between the active and market risk inherent in hedge fund performance.

Understanding this distinction, and forming views on the components, is important for both the development of an ex ante active risk budget and the ongoing monitoring of an investment program.

In this paper, we begin by developing a simple framework for understanding portfolio risk and performance. After discussing data issues that are relevant for applying this framework to hedge funds, we apply the framework to hedge fund index returns. We then discuss how some of the data related issues could influence our interpretations of some of the important risk and return characteristics. Finally, we show how the framework could be modified to allow the development of an ongoing risk-monitoring program.
I. A Simple Framework for All Asset Classes

Any portfolio’s return and risk can be decomposed into two parts. The first part derives from the asset class in which the portfolio is invested, and the second part draws from the manager’s views.

Asset class risk and return can usually be obtained from passive investments, or indexing of the asset class. The asset class is typically defined by some benchmark index like the MSCI-World equity index or the Lehman Aggregate Bond Index. These indices offer a few very attractive characteristics.

They are known in advance, are investible, and are widely accepted as being representative of their asset class, for example large capitalization global equities in the case of the MSCI-World index. The indices provide a neutral set of positions, so an active manager can easily set portfolio weights with reference to the neutral index weights. There is typically a well-defined process for coming up with the index constituents and their weights.

The active component of risk and return is what we seek when allowing managers to deviate from their assigned benchmark. Hedge funds are an extreme case in which the manager is completely free of a passive asset class benchmark portfolio – there is no neutral set of positions for a hedge fund manager. Nevertheless, recognizing that any portfolio combines passive and active risks, hedge funds are really not very different from other components of our investment portfolios. As implementation vehicles for managers’ views, and ideally as vehicles for pure active risk (i.e., active risk that is uncorrelated with market risk), hedge funds represent something familiar in our portfolios – active risk – but with little or no passive asset class risk attached.

The framework for thinking about active and passive risk is, at this point, quite well accepted and well defined. The following formula captures the main ideas:

\[ R_p = R_f + \beta (R_m - R_f) + \alpha \]

We start with the idea of portfolio return, \( R_p \), deriving from the risk-free rate of return, \( R_f \), and compensation for bearing risk. The latter term can itself be divided into two pieces: the first of these is passive, or asset class, return and is given by \( \beta (R_m - R_f) \) (beta measures market risk, and \( R_m \) is the return on the market index). The second compensation for bearing risk is alpha. Alpha is a measure of the return derived from skill-based deviations from market (or asset class) returns.

There are a few important observations from this formula:

- First, we are interested in accounting for market risk when evaluating an active portfolio manager since we expect to be paid for taking this risk. We can evaluate our decision to allocate to the asset class by comparing the passive asset class return \( R_m \) to reasonable foregone alternative opportunities, such as the risk-free rate.

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1 Following AIMR’s performance and presentation standards, a performance benchmark needs to be:

1. Representative of the asset class or mandate
2. Investible (e.g., a viable investment alternative)
3. Constructed in a disciplined and objective manner
4. Formulated from publicly available information
5. Acceptable by the manager as the neutral position
6. Consistent with underlying investor status (e.g., regarding tax, time horizon etc.)


2 Some practitioners have used alpha synonymously with active return. This usage works when beta is 1.0. Active returns are better defined as \( R_p - R_m \). After substitution, we get active return = alpha + (beta -1)(R_m - R_f). In this definition, what is important about alpha is that it is uncorrelated with market risk: the definition says nothing about the source of alpha. For example, it is possible that a manager could achieve their alpha through the timing decision. In this case, we would expect that the manager would vary their beta depending on their expectation for future market performance: when they expected positive market returns their beta would be greater than one, and vice versa. Conditional on the manager’s market expectations, their beta would be different from one. However, in order for alpha to be uncorrelated with market returns, their unconditional beta (i.e., the beta represented by the average of several market cycles) should equal one. An alpha derived from the timing decision stands in contrast with a long-term beta position that differs from one. In the former case, there is the potential for an active return that is unconditionally uncorrelated with market returns, which can be called alpha with some justification. In the latter case, however, the active return will be correlated with the market return.
• Second, each portfolio may have a different level of mandated market risk (e.g., a different level of beta), and therefore a different expected risk premium. In fact, depending upon the investment mandate, the amount of both alpha and market risk may be choices the manager makes. If this is the case, then the framework allows us to measure the effect of deviating from the mandated market risk as well.

• Finally, alpha measures the average return to non-benchmark risk taken. We can evaluate our decision to allocate to the manager by analyzing alpha.

Alpha is the return to skill-based strategies. Some examples of skill-based strategies include security selection (e.g., long and short positions in specific securities) and sector rotation (e.g., long and short positions in particular sectors). Interestingly, the timing decision can also be viewed as an application of a skill-based strategy. In this case, the manager’s skill lies in choosing when to deviate from a long-term beta: when positive returns are expected, then the manager should increase their beta relative to the long-term beta and vice versa. From the perspective of portfolio construction, the key consideration for alpha is that it is uncorrelated with market performance. This property becomes important as we begin to assess how to estimate hedge fund returns.

In any period, alpha is the difference between portfolio return and return attributable to the market.

\[ \text{Alpha} = R_p - [R_f + \text{Beta} \times (R_m - R_f)] \]

We can evaluate the value proposition of investing in an active manager by assessing the amount of active return received per unit of active risk. This is typically summarized by the Information Ratio (IR), calculated as the ratio of average alpha to residual risk.\(^3\) Residual risk is measured as the standard deviation of alpha over time.

We can therefore restate that alpha = IR x residual risk, to reflect the economic reality that alpha derives from the manager’s investment skill as measured by IR, and the amount of active risk the manager assumes. This allows us to more clearly decompose returns as:

\[ R_p = R_f + \text{Beta} \times (R_m - R_f) + \text{IR} \times \text{Residual Risk} \]

With hedge funds, there is no externally imposed guideline or restriction dictating the amount of market risk taken. Consequently, we typically combine expected market returns and active returns in the risk premium to create an expected return for the manager. That is:

\[ R_p = R_f + \text{risk premium} \]

Importantly, if we expect the manager to take some steady state amount of market risk, we will reflect that in the expected risk premium. The framework also allows us the ability to debate the relative merits of our expected risk premium based on a few well-defined inputs.

It would be unreasonable to expect an active manager to deliver exactly the expected alpha in every period. Therefore, in addition to a single estimate of expected return for the manager, we can use our measures of residual risk to develop a reasonable range of alphas to be expected from the manager. Residual risk simply captures the dispersion of alpha over time, as measured by the standard deviation of alpha. Consequently, we can use residual volatility to determine whether realized alphas are within expectations.

Assuming that alphas (and residual returns) are normally distributed, we would expect a manager to deliver alpha that is within one residual volatility above or below expected alpha in two out of every three years. Moreover, in one out of twenty years, we would expect to see alpha less than expected alpha minus two standard deviations or greater than expected alpha plus two standard deviations.

\(^3\) A manager’s active risk, or tracking error, is simply the volatility of the difference between the portfolio and benchmark returns. Residual risk is active risk after adjusting for market exposure, measured in the form of beta. In fact, TE\(^2\) = (Beta - 1)\(^2\) \* \(\sigma_m^2\) + \(\sigma_{\text{residual}}\)
This type of framework might seem out of place when we think about hedge funds. However, we believe that although hedge fund managers do not explicitly measure themselves against performance benchmarks, this type of framework is useful to investors for at least three reasons. First, framing the issues this way forces us to think very carefully about the sources of return from their hedge fund managers. Second, this framework can help us meaningfully compare hedge fund managers with other sources of active return. Finally, sizing allocations to hedge funds relative to other investments cannot be done without developing a framework such as this.

Evaluating performance using the framework: Examples

A long-only manager

Perhaps the best way to understand this framework is first to apply it to the familiar problem of a traditional long-only manager. Suppose we have invested with an equity manager and have given that manager the MSCI-World Index as a benchmark. Many investors will compare the manager's return to the benchmark return and use that alpha as the basis for evaluating the manager's performance.

We should also ask a few other questions, however. First, how much market risk did the manager take? By simply looking at the difference between portfolio return and benchmark return, we are implicitly assuming the manager had a beta of one. More careful attribution will help us understand the sources of active return, which may include both stock bets and beta bets. The second question is how much risk did the manager take to achieve the alpha?

We can make the example more concrete with some numbers. Let's say that for a given period the MSCI-World Index returns 10%, the manager returns 12%, the risk-free rate is 2% and the manager's active risk is 10%. Taking a very simple view, and assuming the manager's beta is one, the manager outperformed the MSCI-World Index by 2%, with 10% tracking error, yielding an IR of 0.2.

Suppose, instead, that we account for the manager's beta, which is actually 1.25. Now, using our framework, we see that the true alpha = 12% - [2% + 1.25*(10%-2%)] = 0%. Clearly, accounting for market risk can have a material effect on our conclusion about the manager's ability to add value.

To set an expectation for this manager's alpha, we need to have an expected IR and residual risk.

We assume an IR of 0.4 at 10% residual volatility, so the expected return is:

\[
\text{risk-free rate} + 1.25 \times (R_m - R_f) + 0.4 \times 10%
\]

or

\[
\text{risk-free rate} + 10\% + 4\%
\]

Here, we expect the manager to generate 10% return from market exposure, and an alpha of 4%. In two out of three years, we should expect the manager's alpha to be in the range of alpha +/- residual risk, so 4% +/- 10%. The range on alpha for two out of three years should be -6% to +14%.

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1 See "Active Risk Budgeting in Action: Evaluating Traditional Active Managers" by Yoel Lax, Tarun Tyagi and Kurt Winkelmann.

3 Arguably, the manager may be actively managing market exposure. We can capture this by extending the framework to encompass tactical changes in beta. We can decompose the manager's active return into a piece owing to the decision to vary beta as well as from other active decisions. For simplicity, suppose the manager only varies beta and makes stock selections. This requires us to define a "policy" (unconditional) beta, which may be defined in investment guidelines, or may be articulated by the manager. Performance may be decomposed to be:

\[ R_p = R_f + \text{stock selection alpha} + \text{active return from varying beta} + \text{policy beta} \times (R_m - R_f), \]

where,

\[ \text{active return from varying beta} = (\text{active beta} - \text{policy beta}) \times (R_m - R_f) \]

In our example, if we assume the policy beta =1, then active return from varying beta = (1.25 - 1) x (10% - 2%) = 2%. Consequently, stock selection alpha = 0%.
Hedge fund managers

A few examples will help demonstrate how this well-established framework can be used in evaluating hedge funds.

Continuing with our assumptions that the market returns 10% and the risk-free rate is 2%, let’s suppose we have a hedge fund that has a zero beta to equity markets, operates with a 10% residual volatility, and is expected to have an IR of 0.7. Our hurdle for the hedge fund would be:

\[
\text{risk-free rate} + 0 \times (R_m - R_f) + 0.7 \times 10%
\]

or

\[
\text{risk-free rate} + 7\%
\]

If market exposure is zero, then the entire risk premium comes from active risk. Unless the manager’s expected IR changes or its active risk changes, this expected premium over the risk-free rate should be constant. Since the hedge fund has a residual volatility of 10%, we would expect returns to be within the range of risk-free rate + 7% +/- 10%, or risk-free rate -3% to risk-free rate +17%, in two out of three years. Moreover, we would expect to see returns outside of the range risk-free rate + 7% +/- (2 x 10%) one year out of every twenty. That is, we could reasonably expect to see returns within the range of risk-free rate -13% to risk-free rate +27%.

If instead the manager had a beta of 0.5, a residual volatility of 10%, and an IR of 0.7, then the hurdle would be:

\[
\text{risk-free rate} + 0.5 \times (10\% - 2\%) + 0.7 \times 10%
\]

or

\[
\text{risk-free rate} +11\%
\]

Interestingly, if the manager is expected to take some amount of market risk, the realized risk premium will depend upon market return. For example, if the market delivers a -10% return, then we may reasonably compare the manager’s performance to:

\[
\text{risk-free rate} + 0.5 \times (-10\% - 2\%) + 0.7 \times 10%
\]

or

\[
\text{risk-free rate} +1\%
\]

Of course, to seriously apply this framework to issues such as expected hedge fund return estimation or active risk budgeting, we need to estimate information ratios, residual risk levels and values for beta. To estimate these parameters, we will need to rely on data for hedge fund managers. Many practitioners use data on hedge fund index returns. The next section reviews some of the issues associated with hedge fund index data.
II. Issues with Hedge Fund Indices

Much of the debate around hedge fund performance measurement has focused on assessing the performance of a portfolio of hedge funds relative to an index of hedge fund peers. We are all conditioned to compare portfolio returns to an asset class, or index, return. However, in the case of hedge funds there is no equilibrium asset class return just as there is no equilibrium metric for benchmarking active risk. Consequently, a cottage industry of hedge fund indices has emerged. These peer indices are collections of returns to hedge fund managers who have chosen to report to the index provider.

The fundamental challenge is that there is no theoretical basis for creating an index of hedge funds. In the case of equities, for example, indices are intended to capture the investment opportunity set. This guides principles for both inclusion and weighting of assets. For hedge funds, no well-defined investment opportunity set exists, and there is no equilibrium holding of hedge funds. Strategy weights, number of managers represented and even weighting scheme are all questions for which there is no real guidance. This, of course, has not prevented the creation of indices, each with its own idiosyncrasies, and it does not relieve hedge fund of fund managers of responsibility and accountability to clients. Nevertheless, the following is a discussion of the litany of potential shortcomings in available indices.

The Association for Investment Management and Research lists five shortcomings of peer indices, all of which apply to hedge fund peer indices:

1. They are not available real time, resulting in a time lag for comparison
2. There is no established oversight process for determining universe participants and whether the universe accurately represents the entire asset class or style of management
3. Survivor bias will develop over time as some managers are deleted from the universe
4. They are not replicable or investible
5. They do not permit the manager to move to a known neutral position

The starting point for any index is collecting data for the universe of assets. With hedge funds, even this is complicated by the fact that no comprehensive database exists. As a result, each provider must start by collecting data from hedge fund managers. Since managers are not required to report – the first shortcomings are readily apparent. Indices are built from a sample of managers who choose to report, that may not be representative of the available strategies, and that typically choose which strategy grouping in which to classify themselves. As listed in Exhibit 1, as of July 2003, there were 164 funds in the CSFB/Tremont Equity Long/Short index, and there were 360 funds in the HFR Equity Hedge index.

Exhibit 1: Equity long/short statistics – January 1994 through December 2003

<table>
<thead>
<tr>
<th></th>
<th>CSFB/Tremont Equity</th>
<th>HFR Equity Hedge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of funds at July 2003</td>
<td>360</td>
<td>164</td>
</tr>
<tr>
<td>Annualized Return</td>
<td>12.2%</td>
<td>15.6%</td>
</tr>
<tr>
<td>Beta to S&amp;P 500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Period</td>
<td>0.40</td>
<td>0.41</td>
</tr>
<tr>
<td>Minimum 36 month beta</td>
<td>0.14</td>
<td>0.30</td>
</tr>
<tr>
<td>Maximum 36 month beta</td>
<td>0.65</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Asset Management

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Because there are no theoretical underpinnings to the index, the process for including managers and assigning weights is up to the index provider. Whether managers should be equally weighted, or weighted by assets under management, is a matter of discretion. For example, the CSFB/Tremont indices weight fund returns by assets under management, while the HFR Indices are equally weighted.

Some of the most successful managers in the index may not be accepting new capital, referred to as closed managers. Further, some index providers do not reveal the index constituents, while others do not disclose the weights of the constituents in the index. The lack of transparency and the inclusion of closed managers in the index render an index not investible, and potentially an unrealistic standard to beat. In August 2003, CSFB/Tremont introduced a series of investible indices as companions to their standard indices. Returns for the indices were generated using data starting January 2000. To demonstrate the discrepancies between the two indices, the Equity Long/Short Index returned an annualized 3.2% between January 2000 and June 2003, while its investible counterpart delivered an annualized return of 1.3%. In contrast, the Event Driven Index returned 9.5% over the same period, while the investible version returned 10.3%.

The tremendous diversity of hedge fund strategies and trading approaches mean that there are differences between managers executing the same strategy, ranging from small nuances to large discrepancies. For example, the degree of leverage used varies greatly across managers executing the same strategy. The inability to evaluate these manager nuances without making an investment (and, occasionally, even after making significant investment in managers that do not provide transparency) weakens understanding of index characteristics.

Over time the indices have suffered from backfill bias and survivor bias. Backfill bias is introduced when the new managers are included only after they have been trading for some time, and then all performance data up to the date of inclusion are added to the index history as if the manager had always been there. The problem is that the manager’s returns are only included conditional on the manager having survived. Survivor bias is an issue if managers that go out of business are removed from the index retroactively, thereby leaving only managers that eventually survive in the performance record. This implicitly supposes omniscience on the part of the index and overstates returns.

Finally, an investor may consciously choose to avoid risks that seem to be inherent in some strategies. For example, long-short equity managers that do not have a large directional bias in their portfolios, but rather use bottom-up fundamental equity selection to build exposures could have a lower beta than the CSFB/Tremont Equity Long/Short Index.

In spite of all the challenges in creating indices, they are still helpful to us in both developing long term expectations for hedge fund performance and in providing a rough guide to hedge fund performance relative to other asset classes. For example, when the MSCI-World was down 19.9% in 2002, it was useful to know that the CSFB/Tremont Equity Long/Short Index was down only 1.6%. Performance differences between a specific portfolio of hedge funds and a seemingly appropriate hedge fund index may exist for any of the reasons outlined above.

**III. Analysis of Hedge Fund Index Returns**

Although hedge fund index data should not be regarded as suitable for performance measurement purposes, they can be useful for active risk budgeting purposes. Institutional investors face choices regarding the size of the total allocation to hedge funds and the distribution of investments across types of hedge funds. These issues should be treated analytically even though these index data are of dubious quality. The real issue is to put the data to uses for which the quality issues are less onerous. In our view, risk characteristics estimated from hedge fund index data can be used as part of the ex ante risk budgeting process.
Our analysis of the hedge fund index returns starts with a broad classification of hedge fund strategies into six specific types. These are:

- convertible arbitrage
- equity market neutral
- fixed income arbitrage
- event driven
- equity long/short
- tactical trading

Index returns from the CSFB/Tremont hedge fund indices were used for the first five strategies, and the Barclays CTA index was used for the tactical trading indices.

Exhibit 2 shows the summary statistics for each of the six strategies. These statistics were estimated using monthly returns over the period January 1994 through November 2003. The exhibit shows the average monthly return, the standard deviation of returns, the excess kurtosis and the skewness for each strategy. All performance characteristics are reported relative to cash (i.e., they are excess returns).

<table>
<thead>
<tr>
<th></th>
<th>Convertible Arbitrage</th>
<th>Equity Market Neutral</th>
<th>Fixed Income Arbitrage</th>
<th>Event Driven</th>
<th>Equity Long/Short</th>
<th>Tactical Trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Monthly Return</td>
<td>0.45</td>
<td>0.46</td>
<td>0.16</td>
<td>0.51</td>
<td>0.56</td>
<td>0.13</td>
</tr>
<tr>
<td>Monthly Std Deviation</td>
<td>1.37</td>
<td>0.85</td>
<td>1.16</td>
<td>1.79</td>
<td>3.14</td>
<td>2.44</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.71</td>
<td>0.04</td>
<td>-3.41</td>
<td>-3.85</td>
<td>-0.1</td>
<td>0.23</td>
</tr>
<tr>
<td>Excess Kurtosis</td>
<td>4.68</td>
<td>0.39</td>
<td>18.25</td>
<td>26.91</td>
<td>3.55</td>
<td>-0.05</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Asset Management

As is evident from the Exhibit, on average the indices outperformed cash over the entire period: that is, if a hedge fund investor had been able to invest in any of the indices, their performance would have beaten a cash benchmark.

Not surprisingly, the indices differ in terms of their risk characteristics. Equity long/short strategies had the highest monthly standard deviation of returns, while equity market neutral strategies had the lowest. Historically, neither tactical trading nor equity market neutral strategies seemed to have had much skewness or excess kurtosis. By contrast, negative skewness was evident in the convertible arbitrage, fixed income arbitrage and event driven strategies, while the equity long/short index showed some evidence of excess kurtosis.7

Of course, the summary statistics shown in Exhibit 2 don’t tell the entire story about the sources of performance. In particular, they do not tell us anything about the attribution of performance to manager skill (in the form of alpha) and market performance (in the form of beta). A simple way to analyze this issue is to regress the monthly performance of each hedge fund index on a suitably chosen market portfolio.

Exhibit 3 shows the results of a regression of hedge fund index performance on the Russell 3000.8 The exhibit reports the estimated beta (or market exposure) and the estimated alpha (or the value added from the strategy) for each hedge fund sector.

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7 The skewness statistics present interesting analytic challenges, principally because we are not able to assess the true source of the skewness. One possibility is that hedge fund managers in these sectors are using option-like strategies to generate excess returns. In this case, statistical analysis that relied on symmetric distributions would clearly mis-state the return expectations. A second possibility is that the computation of summary statistics is being swamped by a small number of observations in a small sample.

8 We could also consider multi-factor models, e.g., including an international equity index or a fixed income index in addition to a broad US equity index. Or, we could estimate the beta values by choosing appropriate lags for the market index, as in Asness, Krail and Liew, 2001. Both of these issues are relevant but neither will change the fundamental points of this paper.
Exhibit 3: Summary Regression Statistics (Annualized)

<table>
<thead>
<tr>
<th></th>
<th>Convertible Arbitrage</th>
<th>Equity Market Neutral</th>
<th>Fixed Income Arbitrage</th>
<th>Event Driven</th>
<th>Equity Long/Short</th>
<th>Tactical Trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annualized Alpha</td>
<td>5.16</td>
<td>5.15</td>
<td>1.92</td>
<td>4.93</td>
<td>4.38</td>
<td>2.09</td>
</tr>
<tr>
<td>Beta</td>
<td>0.04</td>
<td>0.07</td>
<td>0.01</td>
<td>0.23</td>
<td>0.45</td>
<td>-0.10</td>
</tr>
<tr>
<td>Annualized Residual Volatility</td>
<td>4.73</td>
<td>2.74</td>
<td>4.04</td>
<td>5.02</td>
<td>8.26</td>
<td>8.34</td>
</tr>
<tr>
<td>T-stat for Alpha</td>
<td>3.42</td>
<td>5.88</td>
<td>1.49</td>
<td>3.08</td>
<td>1.66</td>
<td>0.79</td>
</tr>
<tr>
<td>T-stat for Beta</td>
<td>1.59</td>
<td>4.47</td>
<td>0.35</td>
<td>7.91</td>
<td>9.35</td>
<td>-2.07</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Asset Management

Two interesting features are worth noting:

- First, the estimated alpha for each strategy is still positive. That is, even after adjusting for market exposure, historically the hedge fund managers in these indices added value. However, while all estimated alphas are positive, not all are statistically significant. In particular, once market exposure is eliminated, the estimated alphas from equity long/short, tactical trading and fixed income arbitrage are not statistically different from zero.

- Second, four of the strategies have estimated betas that appear to be quite close to zero. The estimated betas for the convertible arbitrage, fixed income arbitrage, equity market neutral and tactical trading strategies lie in the range -.10 to .07. Of these, only the tactical trading and equity market neutral strategies have betas that are statistically different from zero. The remaining two strategies, event driven and equity long/short, have estimated beta values that are meaningfully different from zero (e.g. equity long/short has an estimated beta of .45). These results, combined with the estimated alphas, suggest that the tactical trading, equity market neutral, convertible arbitrage and fixed income arbitrage appear to represent pure forms of alpha, i.e., one that is uncorrelated with market risk. On the basis of this analysis, allocations to equity long/short and event driven should be determined after adjusting for market exposure.

Of course, we can expect to see time variation in each of these risk characteristics. Exhibit 4 illustrates this point by plotting the estimated beta and residual volatility levels for each of the six hedge fund sectors, estimated over a rolling 36-month period. Evidence of time variation in the risk characteristics should not be particularly surprising, since hedge fund managers are largely unconstrained. This information is telling us that there are periods where hedge fund managers, on average, increase their market exposure, and other periods where they choose to reduce exposure to market returns; effectively, they are making a timing bet. In many respects, hedge fund managers who vary their market exposure are no different from traditionally oriented active equity managers who do the same.

Exhibit 4: Time Varying Risk Characteristics

Source: Goldman Sachs Asset Management
An analysis of the rolling beta and residual volatility calculations reveals three interesting points. First, we can see that the estimated beta values for three sectors have uniformly declined (equity long/short, equity market neutral and tactical trading). Second, we can see clear evidence of a data induced “jump” in the estimated market exposure for the event driven and convertible arbitrage strategies. Finally, this data “jump” is also evident in the time series of estimated residual volatility for the equity long/short, convertible arbitrage and fixed income arbitrage strategies.

Understanding the source of the time variation in the estimated risk characteristics is an important topic, and one that is beyond the scope of this paper. Interpretation of the results will clearly depend on how readily more data become available. For example, it is evident that market events in the fall of 1998 produced jumps in estimated market exposures and residual volatility levels for a number of strategies. However, this was one extreme market event over a 10-year sample. It is not obvious that we can infer that market participants will necessarily react in the same way during another period of market stress.

Similarly, we see evidence that estimated beta values have steadily declined for a number of strategies. The period during which the estimated beta values have declined corresponds to the period where broad market declines were negative. What should we infer from the decline in estimated beta values? Two possibilities could be: managers in these sectors are responding to market events with a timing decision; managers in these sectors are permanently reducing their beta exposures and producing portfolios of pure alpha. Because we have data on manager risk characteristics over only two market environments (equity markets up and equity markets down), it is hard to make a case for one scenario over another.

From the perspective of developing an ex ante active risk budget, time variation in market exposure and residual volatility is of interest because of its impact on our assessments of long-term market exposure and active risk. Our interest from investment policy purposes is to develop a long-term allocation of active risk to hedge funds and other sources of active risk. To that end, we should focus on the estimates of long-term risk characteristics. These estimates might change if we believe that managers in a particular style have systematically changed the way they structure their portfolios. For example, if we believe that all equity long/short managers will be setting their beta exposure at permanently lower levels, then we would want to discount any observations from periods where managers had higher betas. However, it is hard to draw firm conclusions on the precise level of manager risk characteristics, given that we have data on only two market environments. Thus, our preference is to use all available data in estimating our long term beta and residual volatility characteristics.

From the perspective of short-term manager risk and performance evaluation, time variation in beta and residual volatility is not merely an interesting discovery from the data. Understanding the sources of manager risk is important for ongoing risk management, and understanding the sources of manager return is important for identifying those decisions where the manager has skill. For example, understanding whether the manager is skilled in making timing decisions cannot be done unless the investor has the manager’s short-term risk characteristics at their disposal.

The final set of risk characteristics that is useful to us is the correlation of excess returns across strategies. For example, we are interested in the correlation of excess returns between, say, the Equity Market Neutral sector and the Tactical Trading sector after the impact of market exposure has been eliminated. These characteristics are important for both developing long-term expected return assumptions as well as an ex ante active risk budget.
Exhibit 5 shows the estimated correlation of excess returns for the six hedge fund sectors under consideration. As we can see, most of the correlations of excess returns differed from zero historically. In fact, on average the correlation of excess returns was about .25, although there is some clear variation around that average. When the excess returns for two sectors are positively correlated, then if the excess return for one sector is positive, the second sector will also be positive. For example, the correlation of excess returns between the Equity Market Neutral and Equity Long/Short sectors is .13. Holding other factors constant, when the alpha for equity market neutral is positive we should also expect a positive alpha for Equity Long/Short.

### Exhibit 5: Correlation of Excess Returns

<table>
<thead>
<tr>
<th></th>
<th>Convertible Arbitrage</th>
<th>Equity Market Neutral</th>
<th>Fixed Income Arbitrage</th>
<th>Event Driven</th>
<th>Equity Long/Short</th>
<th>Tactical Trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convertible Arbitrage</td>
<td>1.00</td>
<td>0.25</td>
<td>0.55</td>
<td>0.63</td>
<td>0.21</td>
<td>-0.01</td>
</tr>
<tr>
<td>Equity Market Neutral</td>
<td>0.25</td>
<td>1.00</td>
<td>0.06</td>
<td>0.19</td>
<td>0.13</td>
<td>0.30</td>
</tr>
<tr>
<td>Fixed Income Arbitrage</td>
<td>0.55</td>
<td>0.06</td>
<td>1.00</td>
<td>0.45</td>
<td>0.23</td>
<td>0.08</td>
</tr>
<tr>
<td>Event Driven</td>
<td>0.63</td>
<td>0.19</td>
<td>0.45</td>
<td>1.00</td>
<td>0.44</td>
<td>-0.03</td>
</tr>
<tr>
<td>Equity Long/Short</td>
<td>0.21</td>
<td>0.13</td>
<td>0.23</td>
<td>0.44</td>
<td>1.00</td>
<td>0.15</td>
</tr>
<tr>
<td>Tactical Trading</td>
<td>-0.01</td>
<td>0.30</td>
<td>0.08</td>
<td>-0.03</td>
<td>0.15</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Asset Management

### IV. Calibrating Information Ratios

How can we put the figures in Exhibits 2 and 3 to work? From a risk budgeter’s perspective, there are four figures that are of interest:

1. the market exposure for each strategy
2. the estimated alpha
3. the estimated residual volatility.
4. the correlation of excess returns.

Each sector’s market exposure is important because it gives a sense for how much of the total premium can be expected from equity market performance. Estimated alpha and residual volatility are important because they can be used to develop an historical information ratio, which can in turn be used as one factor in forming expectations for future performance. The correlation matrix of excess returns is important because it helps determine the proper size of each position in the portfolio.

Exhibit 6 reproduces the historical alpha and residual risk levels from Exhibit 2, as well as the historical information ratio. (The exhibit also shows the t-statistics for each estimate of alpha). For example, the figures in Exhibit 5 indicate that the historical alpha from the Equity Market Neutral sector was 515 basis points, with a residual volatility of 274 basis points. These figures combine to produce a historical information ratio of 1.88. For another example, the historical alpha for the Tactical Trading sector was 209 basis points, with a residual volatility of 834 basis points. Therefore, the historical information ratio for the Tactical Trading sector was .25. The average of the information ratios for all six sectors is .87.

### Exhibit 6: Historical Alphas and Information Ratios

<table>
<thead>
<tr>
<th></th>
<th>Convertible Arbitrage</th>
<th>Equity Market Neutral</th>
<th>Fixed Income Arbitrage</th>
<th>Event Driven</th>
<th>Equity Long/Short</th>
<th>Tactical Trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>5.16</td>
<td>5.15</td>
<td>1.92</td>
<td>4.93</td>
<td>4.38</td>
<td>2.09</td>
</tr>
<tr>
<td>Residual Volatility</td>
<td>4.73</td>
<td>2.74</td>
<td>4.04</td>
<td>5.02</td>
<td>8.26</td>
<td>8.34</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>1.09</td>
<td>1.88</td>
<td>0.48</td>
<td>0.98</td>
<td>0.53</td>
<td>0.25</td>
</tr>
<tr>
<td>Alpha T-Statistic</td>
<td>3.42</td>
<td>5.88</td>
<td>1.49</td>
<td>3.08</td>
<td>1.66</td>
<td>0.79</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Asset Management
If we thought that our estimates of the historical alpha were accurate predictors of the future alpha that can be expected from each hedge fund sector, then our task would be complete: we could simply use the historical information ratios (and the historical beta estimates) for projecting future expected returns and for developing active risk budgets. Of course, we always know that there is some uncertainty around our estimates of alpha, since we are trying to infer the characteristics of a “true” distribution from a sample of data. One way to measure the uncertainty that is inherent in this exercise is to calculate the t-statistic for each estimate of alpha. This figure tells us whether the estimate of alpha is statistically different from zero. As a rule of thumb, t-statistics that exceed two suggest that with 95% confidence, we can reject the hypothesis that the “true” value of alpha is zero. For example, the estimated alpha for Event Driven is 4.93% and the t-statistic is 3.08. Thus, we can reject the hypothesis that the true alpha for the Event Driven sector is not statistically different from zero (at the 95% confidence level).

Unfortunately, the historical alphas do not necessarily provide accurate predictors of expected future alphas, even if we use the t-statistics. There are two reasons for this: First, historical average returns are notoriously bad predictors of future performance, in large part due to the sensitivity of the choice of sample period. Secondly, and as discussed above, the hedge fund index data are subject to biases. Thus, the best we can hope to get from the historical alphas is a sense of the relative ranking of hedge fund alphas. In other words, we may be able to use the historical alphas to help us judge expected future alphas in one hedge fund sector versus another, without necessarily calibrating the actual level of all hedge fund sectors. For the latter, at a minimum we will need to adjust the historical alphas for any biases that are in the hedge fund index data.

Two decisions would seem to be important when developing alpha projections for hedge fund sector returns. Each decision can be stated in terms of expected information ratio assumptions. The first of these is the expected information ratio for all hedge fund sectors, while the second decision is the information ratio-ranking across hedge fund sectors. The first decision answers the question, “what expected alpha can I be expected to achieve irrespective of sector”, while the second answers the question, “is there any reason to differentiate across hedge fund sectors”. The process that we follow to determine the answers to these questions is just as important as the actual numbers.

One framework that can help to isolate the key decisions is the Black-Litterman model. In this model, expected returns depend on equilibrium returns, investor specific views, a weight on equilibrium returns and view-specific confidence levels (see He and Litterman, 1999 and Winkelmann, 2003 for discussions of applications of the Black-Litterman model). With a few simple assumptions, this model can be easily applied to our problem.

A natural starting point is the assumption regarding equilibrium returns. We know that when capital markets are in equilibrium, active returns (as measured by alpha) are zero. Thus, our equilibrium alphas are zero.

Although equilibrium alphas are zero, our views on hedge fund alphas are most definitely not zero. In fact, it is the development of skill-based strategies to exploit deviations from equilibrium that, paradoxically, push markets towards equilibrium. There are a number of ways to express views about hedge fund alphas. For our purposes, though, we will assume that our view on hedge fund information ratios is given by the historical information ratios.

The next issue that we need to confront is how much weight should be placed on equilibrium versus our views. Placing all of the weight on equilibrium means that the expected alpha for all hedge fund sectors is zero, and consequently, investors will have no hedge fund allocations. By contrast, placing all of the weight on our view means that the expected alphas will overstate the “true” alphas (because of the biases discussed above). As a result, views that incorporate none of the equilibrium are likely to lead to portfolios that are overexposed to hedge funds.
A simple way to find the weight on equilibrium is to set a target information ratio. This target information ratio is not manager specific, but rather reflects a target that we would like to achieve from the hedge fund program. Ideally, this target information ratio would reflect the overall historical information ratio as well as the impact of adjusting for the biases inherent in the hedge fund data. As well, we might set the target information ratio relative to information ratio assumptions about other sources of active return.

From our earlier discussion, we know that the historical information ratio is .87. For illustrative purposes suppose that the overall target information ratio is .5. Now we can back out the weight on equilibrium that is necessary to achieve an overall target of .5.

The final step in the process is to assign a confidence level to each particular view. Confidence levels reflect the level of uncertainty around a specific view. These levels can reflect both statistical (e.g., the t-statistics of Exhibit 5) and other analysis.

Exhibit 7 shows the impact on expected alpha estimation after we apply the Black-Litterman process. The Exhibit shows the historical alpha and information ratio, the residual volatility, and the adjusted alpha and information ratio. As anticipated, all of the adjusted alphas and information ratios are below their historical counterparts. (Notice that the impact of shrinkage is most pronounced in the Convertible Arbitrage, Equity Market Neutral and Event Driven sectors).

**Exhibit 7: Adjusted and Historical Alphas and Information Ratios**

<table>
<thead>
<tr>
<th></th>
<th>Convertible Arbitrage</th>
<th>Equity Market Neutral</th>
<th>Fixed Income Arbitrage</th>
<th>Event Driven</th>
<th>Equity Long/Short</th>
<th>Tactical Trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical Alpha</td>
<td>5.16</td>
<td>5.15</td>
<td>1.92</td>
<td>4.93</td>
<td>4.38</td>
<td>2.09</td>
</tr>
<tr>
<td>Historical IR</td>
<td>1.09</td>
<td>1.88</td>
<td>0.48</td>
<td>0.98</td>
<td>0.53</td>
<td>0.25</td>
</tr>
<tr>
<td>Residual Volatility</td>
<td>4.73</td>
<td>2.74</td>
<td>4.04</td>
<td>5.02</td>
<td>8.26</td>
<td>8.34</td>
</tr>
<tr>
<td>Adjusted Alpha</td>
<td>3.24</td>
<td>1.29</td>
<td>1.85</td>
<td>2.97</td>
<td>4.26</td>
<td>2.14</td>
</tr>
<tr>
<td>Adjusted IR</td>
<td>0.69</td>
<td>0.47</td>
<td>0.46</td>
<td>0.59</td>
<td>0.52</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Asset Management

How can we put the figures in Exhibits 3 and 7 to work? A natural application of these figures is to develop projections for expected excess returns for each hedge fund sector. Recall from our earlier discussion that the expected excess return (i.e., the return over a risk-free rate) for any hedge fund sector has two pieces: the expected return due to market exposure and the expected alpha (which is itself the product of the information ratio times the estimated residual volatility). The expected return from market exposure is simply the equity premium times the sector beta.

Expected excess returns for each hedge fund sector are shown in Exhibit 8. The exhibit assumes an equity premium of 350 basis points. The expected alphas for each sector are taken from Exhibit 7.

**Exhibit 8: Expected Excess Returns**

<table>
<thead>
<tr>
<th></th>
<th>Convertible Arbitrage</th>
<th>Equity Market Neutral</th>
<th>Fixed Income Arbitrage</th>
<th>Event Driven</th>
<th>Equity Long/Short</th>
<th>Tactical Trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta</td>
<td>0.04</td>
<td>0.07</td>
<td>0.01</td>
<td>0.23</td>
<td>0.45</td>
<td>-0.10</td>
</tr>
<tr>
<td>Equity Premium</td>
<td>3.50</td>
<td>3.50</td>
<td>3.50</td>
<td>3.50</td>
<td>3.50</td>
<td>3.50</td>
</tr>
<tr>
<td>Market Return</td>
<td>0.15</td>
<td>0.25</td>
<td>0.03</td>
<td>0.80</td>
<td>1.56</td>
<td>-0.35</td>
</tr>
<tr>
<td>Adjusted Alpha</td>
<td>3.24</td>
<td>1.29</td>
<td>1.85</td>
<td>2.97</td>
<td>4.26</td>
<td>2.14</td>
</tr>
<tr>
<td>Excess Return</td>
<td>3.39</td>
<td>1.54</td>
<td>1.88</td>
<td>3.77</td>
<td>5.82</td>
<td>1.79</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Asset Management

Of course, actual performance achieved in any particular sector is likely to vary from the figures shown in Exhibit 8. The actual equity market performance is likely to be quite different from the long-term equity premium assumption. Furthermore, the figures in Exhibit 8 reflect an assumption about the average return to all hedge fund sectors, rather than a particular assumption about skill in manager selection.
This last assumption is crucial for hedge funds, as investors cannot passively implement a hedge fund portfolio in the same way that they can passively receive the long-term equity premium. What investors are paying for when they make allocations to hedge funds is exposure to skill-based strategies that exploit opportunities to deviate from equilibrium. It is reasonable to expect that some managers may be more skilled than others in exploiting these opportunities. Thus, manager selection is critical in determining actual hedge fund performance.

For a simple example, suppose that we represent skill in manager selection as corresponding to using managers whose expected alpha is one standard deviation higher than the average. The new expected total returns are shown in Exhibit 9, together with the expected returns if we continue to use the adjusted alphas from Exhibit 7. The difference row corresponds to the impact of manager selection on total return.

### Exhibit 9: Impact of Manager Selection

<table>
<thead>
<tr>
<th></th>
<th>Convertible Arbitrage</th>
<th>Equity Market Neutral</th>
<th>Fixed Income Arbitrage</th>
<th>Event Driven</th>
<th>Equity Long/Short</th>
<th>Tactical Trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Excess Return</td>
<td>3.39</td>
<td>1.54</td>
<td>1.88</td>
<td>3.77</td>
<td>5.82</td>
<td>1.79</td>
</tr>
<tr>
<td>Skilled Excess Return</td>
<td>8.12</td>
<td>4.28</td>
<td>5.92</td>
<td>8.79</td>
<td>14.08</td>
<td>10.13</td>
</tr>
<tr>
<td>Impact of Skill</td>
<td>4.73</td>
<td>2.74</td>
<td>4.04</td>
<td>5.02</td>
<td>8.26</td>
<td>8.34</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Asset Management

### V. Conclusions and Investment Policy Implications

Hedge funds are an important part of an investor’s tool kit. Because hedge funds represent relatively unconstrained sources of active risk, their importance is likely to grow. As a result, investors are seeking ways to determine the appropriate size of their hedge fund allocation. The size of the hedge fund allocation, in turn, will depend on the expected return associated with hedge funds relative to the expected returns associated with other asset classes. This paper has developed a framework that investors can use to understand the dimensions of the problem of setting hedge fund returns. The framework is relevant to all hedge fund investors because it allows them to analyze and address three key questions for hedge fund performance:

1) how much of the projected performance is due to market movements
2) how much of the projected performance is due to manager skill
3) how confident am I in the manager’s (or strategy’s) ability to continue to deliver performance.

In our framework, hedge fund returns can be attributed to three easily understood components: the return on a risk free asset, the return due to exposure to market movements and the return due to manager skill. The impact of market movements is, in turn, the product of the manager’s (or strategy’s) exposure to market movements and the actual market return. Similarly, the impact of manager skill is simply the product of the manager’s information ratio and their residual volatility. This framework can be applied at the level of individual managers, specific portfolios or indexes. Thus, our framework gives investors a way to address the first big question they should be asking of their hedge fund managers, namely, how much of the projected performance is due to market moves.

The second big question that hedge fund investors need to ask is, how much of the projected performance is due to manager skill. Our framework addresses this issue by focusing on target information ratios. We believe that investors can set this statistic by relying on achievable information ratios from other sources of active return as well as understanding the underlying financial economics of hedge funds.
The final question that hedge fund investors need to address is the confidence they place in one manager or group of strategies relative to other strategies. Our framework addresses this question in the context of the Black-Litterman model. This model lets investors vary the confidence that they place in any particular view on returns. From the perspective of hedge fund investors, resolving this question is critical for the formulation of hedge fund portfolios.

To illustrate how our approach can be used in practice, we used hedge fund index data. These data suffer from a number of biases. However, in our view these biases further draw out the importance of having a framework to inform discussion.

It is natural that some investors will have different opinions on hedge fund returns. However, we believe that these opinions can be best understood and discussed through the application of well-understood principles of finance.
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References