This paper offers institutional investors an intuitive framework to evaluate the strategic role of hedge funds and implement allocations to this alternative asset class.

We introduce the notion of an *implied hurdle* rate as a yardstick by which hedge fund allocations can be judged. We use a risk-budgeting framework to analyze allocations to hedge funds and hurdle rates.

The paper concludes that a well-constructed portfolio of hedge funds has an important role in the strategic asset allocation of institutional investors.
A Strategic Role for Hedge Funds

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I. INTRODUCTION

The same informational inefficiencies which allow skilled hedge fund managers to produce excess returns make hedge fund allocations in general difficult to analyze. This paper provides a framework to understand the strategic role of hedge funds.

Many institutional investors are considering strategic allocations to hedge funds. Investors are interested in hedge funds for two reasons. First, they believe that hedge funds offer the opportunity to increase expected portfolio returns. Secondly, investors believe that hedge funds diversify total portfolio risk. In short, hedge funds are attractive to investors because they believe that hedge funds offer the potential to increase expected portfolio return at the expense of little or no change in expected portfolio risk.

While most investors would agree that hedge funds are attractive because of their potential to enhance risk-adjusted performance, they would also agree that allocations to hedge funds are difficult to analyze, largely because of the general lack of consistent data. Consequently, investors are faced with a dilemma: because they believe that hedge fund managers can produce excess returns by exploiting informational inefficiencies, they believe that their portfolios should have hedge fund allocations. However, hedge fund allocations are difficult to analyze, in part because the same informational inefficiencies translate into inconsistent time series data.

This paper gives investors an intuitive framework that they can use to evaluate the strategic role of hedge funds. Our framework can be beneficial to investors because it focuses on our ability to use available data to estimate volatility and correlation of hedge fund returns rather than project expected returns. In this respect, our approach to portfolio advice differs somewhat from standard practice.

Standard portfolio advice is usually based on mean/variance analysis. Typically, an analyst will use historical time series data to estimate the expected return, volatility and correlation of returns for various asset classes. Portfolio weights are then found by using these figures in an optimizer.

However, practitioners have had reservations about fully embracing this approach. They have found that optimal portfolio weights are incredibly sensitive to small changes in expected return assumptions. Additionally, they have found that historical average returns provide poor predictors of expected future performance. The strength of these reservations is intensified for hedge funds, due in part to the generally poor relative quality of hedge fund data.

Our approach to the role of hedge funds in some senses inverts the problem. Instead of asking what the portfolio weights should be on the basis of specific expected return assumptions, we instead ask what return justifies a specific allocation. The benefit of this approach to investors is that we rely on our ability to estimate volatility and correlation from time series data instead of expected returns. As it turns out, volatility and correlation are more easily estimated from historical data than expected returns.

We call the returns required to justify a specific hedge fund allocation the implied “hurdle rates.” We find the hurdle rates by making specific reference to the other holdings in an investor’s portfolio. Hurdle rates can
Our analysis suggests that a strategic allocation to hedge funds makes sense.

be viewed as setting the minimum expected return that an investor should require for a particular hedge fund allocation. They are useful because they can give investors a yardstick by which a specific hedge fund portfolio should be judged.

Our principal finding is that the implied “hurdle rates” for well-diversified hedge fund portfolios are quite low, especially for modest allocations. Moreover, our historical analysis suggests that some hedge fund portfolios have been able to achieve these hurdle rates. As a result, our principal recommendation is that investors should include hedge funds as part of their strategic asset allocation.

The remainder of the paper is organized as follows. The next section discusses why we believe hedge funds can add value. Section III addresses the issue of available hedge fund data. In Sections IV and V, we develop our framework for analyzing hedge fund allocations. Implementation of the hedge fund program is covered in Sections VI and VII, with concluding comments in Section VIII.
II. THE POTENTIAL ADVANTAGES OF HEDGE FUNDS TO INVESTORS

Hedge funds offer the potential for positive returns with diversification benefits for one’s overall portfolio.

Why are hedge funds attractive to investors? At one level, this is an easy question to answer: a suitably constructed portfolio of hedge funds can be attractive because it has the potential to generate positive returns for the overall portfolio. However, in judging hedge fund performance we must ask the question “attractive relative to what.” Posing the question in this way forces us to explicitly consider the underlying economics of hedge funds relative to other investment choices.

Since views on equity and fixed income markets are ultimately expressed through long and short positions in public securities markets, one natural comparison for hedge fund portfolios is the active risk taken by traditional active managers. We can reframe the question to ask what *structural* factors give hedge fund managers the capability to generate value relative to traditional active managers. In particular, we want to compare the risk and performance characteristics of hedge fund managers relative to cash with the risk and performance characteristics of traditional active managers relative to an index of publicly traded securities.

Why does it make sense to compare a hedge fund manager to a traditional active manager? After all, traditional active managers usually hold long positions in the securities in their portfolios and are measured versus an index while hedge fund managers usually take long and short positions and are measured relative to cash. How can the two be compared?

Let’s look at the return on the traditional active manager a little more closely, and in particular relative to cash. By adding and subtracting the manager’s index, the active manager’s return is reconstituted as a long position in the index, a long position in a long/short portfolio and a short position in cash. The long/short portfolio is simply the difference between the security weights in the actual portfolio and the benchmark. The difference between the long/short portfolio and cash can now be compared to the excess return on hedge funds (i.e., the hedge fund return relative to cash rates).

There are three fundamental characteristics of hedge fund managers that give them the potential to add value relative to their traditional active management counterparts. First, hedge fund managers do not face the same constraint on short positions that traditional active managers face. For example, suppose that a hedge fund manager and a traditional active manager have the same views on two securities such that one stock appears as a long position (or overweight relative to the benchmark) and the other appears as a short position (or underweight relative to the benchmark). If the active manager has a net short constraint, then the potential to generate higher excess returns can be reduced. Exhibit 1 illustrates this point with a simple hypothetical example.

The figures in Exhibit 1 show the expected return for two optimized portfolios, based on the same assumptions regarding the returns to individual securities. Risk, as measured by the volatility of portfolio return, is the same for both portfolios. The first portfolio, labeled Unconstrained Optimal Portfolio, assumes that the managers can take long
and short positions irrespective of size. The second portfolio, Constrained Optimal Portfolio, imposes a constraint on the size of the short positions. As Exhibit 1 illustrates, the impact of the short constraint is to reduce the potential to add value: the expected return on the unconstrained portfolio is higher than that of the constrained portfolio for the same level of portfolio volatility.

Exhibit 1: Impact of Short Constraints — a hypothetical example

<table>
<thead>
<tr>
<th></th>
<th>Asset 1</th>
<th>Asset 2</th>
<th>Asset 3</th>
<th>Correlation</th>
<th>Volatility</th>
<th>Expected Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset 1</td>
<td>1</td>
<td>0.2</td>
<td>0.3</td>
<td>13.0%</td>
<td>4.7%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Asset 2</td>
<td>0.2</td>
<td>1</td>
<td>0.1</td>
<td>3.0%</td>
<td>4.7%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Asset 3</td>
<td>0.3</td>
<td>0.1</td>
<td>1</td>
<td>16.0%</td>
<td>4.7%</td>
<td>-5.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Unconstrained Optimal Portfolio</th>
<th>Constrained Optimal Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset 1</td>
<td>21%</td>
<td>29%</td>
</tr>
<tr>
<td>Asset 2</td>
<td>99%</td>
<td>71%</td>
</tr>
<tr>
<td>Asset 3</td>
<td>-20%</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Expected Return</th>
<th>Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Return</td>
<td>8.0%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Volatility</td>
<td>6.5%</td>
<td>4.7%</td>
</tr>
</tbody>
</table>

The second fundamental characteristic of hedge funds that can influence their ability to add value is the composition of the investment universe. Many traditional active managers are allowed to purchase only those securities that are part of their performance benchmark. Since hedge fund managers do not have performance benchmarks, they are not limited in the same way. For example, a hedge fund manager and a traditional active manager may each have strong positive views on a particular security. Unless that security is part of the traditional active manager’s investment universe, he will not be able to hold the stock in their portfolio.

Finally, although most hedge fund managers stick to one investment style, they are not necessarily restricted from making changes. Traditional active managers, by contrast, are usually restricted to the investment style for which they were selected. Consequently, a hedge fund manager has the ability to more quickly change portfolio characteristics to reflect changes in market conditions. For example, a hedge fund manager would potentially have the ability to switch from growth to value stocks, depending on the market cycle, in a way that a traditional active manager who is categorized by style cannot. Similarly, hedge fund managers may be able to dynamically adjust the level of market exposure (See Litterman and Winkelmann, 1996.) in a way that a traditional active manager may not. Thus, hedge fund managers could have the potential to generate out-performance through market timing that traditional active managers may not.
III. HEDGE FUND DATA

Determining the appropriate benchmark for a hedge fund has been a topic of some debate. Because hedge fund returns are driven more by human skill than long-only indices, each hedge fund’s returns are as unique as the individuals who generate them. Despite this challenge, however, it is important to know how a manager’s performance ranks against other managers who invest using similar methodologies and assets to express their views. For this reason, there has been a growing demand for hedge fund indices and sub-indices which can be used to gauge a manager’s relative performance. Importantly, these indices do not typically pass the tests that would be required for them to be considered to be benchmarks — for many, either constituents or constituent weights are not known in advance, and some contain funds in which investors cannot place capital.

There are several major hedge fund index providers which provide index and sub-index performance information. Among these are Hedge Fund Research (HFR), CSFB/Tremont, Altvest, Mar-Hedge, Van Hedge, Hennesse and FRM/MSCI. In our judgment, there is no one “best” index that addresses all concerns. Prior to using any particular index, we recommend that great care be taken to understand the index’s strengths and weaknesses, as well as the construction methodology.

Self-Reporting Biases

Hedge fund managers are not allowed to solicit business, so presence on a hedge fund database, and in an index, represents an opportunity to raise a fund’s profile among potential investors. Consequently, in most hedge fund indices the managers choose to report, which can introduce a number of potential biases. For example, a manager may stop reporting either because of very poor performance, or because the manager has had strong performance and is no longer raising assets.

Some of the more significant concerns that should be understood include:

Survivorship Bias — Hedge fund managers are dropped from an index if they stop reporting to the index provider. It is clear that periods of non-reporting can coincide with periods of significant loss. Since this lost information is not included in the index’s construction, index performance is biased upwards and downside volatility is possibly understated.

Backfill Bias — Hedge funds are added after they have a few successful years managing money, at which point their entire return history is put on the database. This biases the data toward firms that managed to survive the first few, difficult years.

Investibility — Indices potentially include funds which are no longer accepting new assets. The index is therefore not investible, so it is not a true benchmark.

Transparency — Some index providers reveal the number of managers in each category but not the actual names of the managers. These indices are therefore not known in advance, and so are not useful for true benchmarking. This feature makes comparing any one fund to the index less effective.
Incorrect Fund Categorization — Funds can identify their own category, and some funds report themselves in categories in which they do not manage capital.

Frequency of Reporting — For many traditional investment products, index performance can be calculated on a daily basis. Hedge fund indices, by contrast, are typically only reported monthly. This occurs because many hedge fund managers only report results on a monthly basis. Monthly data tends to understate a fund’s true peak-to-trough losses. It is not unusual to encounter short-term periods of significant loss which would be revealed if daily data, as opposed to monthly data, were available.

Leverage Measurement — With conventional indices (e.g., the S&P), there is no ambiguity about what it means to be fully invested versus the index. The same degree of certainty does not exist with respect to hedge fund indices. Differences in returns among managers are caused, to some degree, by different levels of leverage inherent in each manager’s strategy. Of course, statistical methods can be used to infer the effective leverage of a manager relative to an index. For example, one can calculate the beta of any manager’s returns to the index. However, there will likely be a wide confidence interval around any statistical estimate since the hedge fund index providers only have monthly data.

Constituent Weightings — Some indices equal weight the funds in their indices while others use weights based on assets under management. An equally weighted index is particularly suspect because this construction process gives equal weight to returns from both small and large funds. In fact, large funds and small funds, even if they operate in the same investment space, are often not comparable. To the extent that large returns may be easier to achieve on smaller rather than larger amounts of capital under management, this approach overstates the performance of the investment sector the index purports to measure.

Completeness — Many of the most successful hedge managers choose to not report to index providers. Accordingly, the index may not be representative of what the universe of managers is actually achieving.
IV. A FRAMEWORK FOR EVALUATING PORTFOLIO ALLOCATIONS

Hedge fund programs should be evaluated relative to assets already held.

How should investors think about hedge fund allocations? The very features that make hedge funds attractive (ability to transact in a large number of markets, the ability to consider a wide variety of active strategies) also complicate the evaluation of a hedge fund program. In our view, since most investors already have a portfolio of assets, the most effective way to evaluate a hedge fund program is relative to those assets already held. That is, for given a portfolio of assets investors should:

- First assess the impact of a hedge fund allocation on the level and distribution of portfolio risk, then
- Calculate the implied hurdle rate relative to cash of alternative hedge fund allocations and finally,
- Determine whether a specific hedge fund program can achieve those hurdle rates.

Why do we choose to use portfolio risk characteristics as the basis for our analysis? The reason for this relates to how much information we feel that we can reliably extract from historical time series. While estimation of expected returns, volatility and correlation are all complicated exercises, we believe that historical time series are better suited to the estimation of volatility and correlation than expected returns. This issue becomes even more important when we consider asset classes such as hedge funds, where data availability is even more limited.

To illustrate our approach, let’s work through a simple example. Suppose that our current asset allocation is as shown in Exhibit 2. In many respects, this portfolio represents a stylized asset allocation of a hypothetical US Defined Benefit (US DB) program, albeit with a larger allocation to International Equity than is typically seen in US DB plans.

- The asset allocation in Exhibit 2 has around 43% allocated to US Equity, which we will assume is held in a broad index such as the Russell 3000.
- Non-US Equity constitutes about 22% of the portfolio in Exhibit 2, which we will represent as exposure to MSCI non-US Developed Equity.
- Finally, the fixed income allocation is about 35%, which we will assume is held in US Investment Grade bonds.

By combining the portfolio weights of Exhibit 2 with a covariance matrix of asset returns (included in Appendix A), we can calculate the overall portfolio volatility as 9.6%.
There are two natural questions we would like to answer about the portfolio allocations in Exhibit 2. First, we would like to know how the overall volatility of 9.6% is distributed across the various asset classes. Second, we would like to understand the impact on portfolio risk and return of allocating a portion of the portfolio away from each of the asset classes and into hedge funds.

Exhibit 3 shows the risk decomposition corresponding to the allocations of Exhibit 2. These figures show us how much of the portfolio’s volatility, at the margin, can be attributed to each of the asset classes. Effectively, they show us how we are “spending” or “budgeting” our overall portfolio volatility of 9.6%. It is not too surprising that at the margin, almost 67% of the volatility is attributable to US Equity, given the portfolio’s high equity allocation. The risk decomposition in Exhibit 3 is important, as it serves as a reference point for any portfolio reallocations: we want to know how the distribution of risk changes as we allocate portions of the portfolio to hedge funds.

Almost 67% of the total portfolio volatility of 9.6% is attributable to US Equity.
Hedge Fund Classifications

Hedge funds can be classified into a number of different sectors and strategies. Goldman Sachs categorizes hedge funds into four sectors, each of which include a number of strategies. The four sectors are: Relative Value, Event Driven, Equity Long/Short, and Tactical Trading.

### Relative Value
Managers generally identify relationships between securities. When the current pricing relationship deviates from the manager’s expectations about the normal pricing relationship, trades are structured to take advantage of the anomaly: the manager will profit when prices revert to their normal relationship. Strategies include convertible bond arbitrage, equity arbitrage and fixed income arbitrage. Equity arbitrage includes statistical arbitrage and equity market neutral strategies.

### Event Driven
Managers identify corporate events they expect to affect valuations, and construct trades to extract value when the event occurs. The predominant strategy in this area is merger arbitrage, in which the manager typically buys shares in the target company and shorts shares of the acquiring company, with the expectation that any spread between valuations will disappear upon completion of the merger. Other strategies include special situations, high yield and distressed debt.

### Equity Long/Short
Managers develop views on stocks and express those views by going either long or short in amounts that reflect the manager’s conviction about the view. Managers can further express conviction about the views by varying the amount of capital invested, and are able to express directional views by adjusting the net long or short exposure of the portfolio. Most managers tend to have a long bias, but short-biased managers do exist. Specializations within the equity long/short sector are typically along geographic and industry lines.

### Tactical Trading
Includes both macro managers and managed futures. Macro managers typically develop views on broad economic themes and then implement those views with a variety of instruments. Using either systematic or discretionary approaches, managed futures traders develop views on a variety of markets and typically implement those views through futures contracts and interbank currency forwards.
V. DEVELOPING A HEDGE FUND ALLOCATION

Although some investors will make allocations to specific hedge funds, many more will instead make broad allocations to the asset class. Since the term “hedge funds” covers many alternative strategies, it is reasonable to first identify a potential hedge fund portfolio structure and then assess the volatility of this structure and its correlation with other asset classes. Ideally, the hedge fund portfolio would be structured so that the allocation of risk across hedge fund strategies would be consistent with the investors’ views about expected returns.

Exhibit 4 illustrates this point with two potential portfolios. The first portfolio, labeled Portfolio A, has equal weight assigned to each of four hedge fund sectors: Relative Value, Event Driven, Equity Long/Short and Tactical Trading. (The Relative Value sector is itself a blend of three strategies: Equity Market Neutral, Fixed Income Arbitrage and Convertible Arbitrage.) The overall volatility of this portfolio is 6.1% (using the correlation and volatility data shown in Appendix A). However, although equal investments are made in each sector, Exhibit 4 also shows that each sector does not contribute equally to hedge fund portfolio volatility. In fact, in this example the Equity Long/Short sector at the margin contributes about half of the risk in the hedge fund portfolio.

Although some investors would be comfortable with a disproportionate amount of risk allocated to just one strategy, many would not. In fact, analysis of the level of diversification in the portfolio provides a useful way to think about structuring the portfolio. Rather than beginning with portfolio weights and then calculating the risk decomposition, let’s instead begin with a target of equal risk contributions and work backwards to find the corresponding portfolio weights.

The results of this exercise are shown in Portfolio B. We see that the portfolio weights can change significantly when we make diversification across strategies our goal. For example, the equally weighted portfolio has 25% of the portfolio weight and 47% of the portfolio risk at the margin in Equity Long/Short, while the equal risk weight portfolio has 25% of the portfolio volatility (at the margin) in Equity Long/Short and only 14% of the portfolio value.

Exhibit 4: Equal Value Weight and Equal Risk Weight Portfolios

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Relative Value</th>
<th>Event Driven</th>
<th>Equity Long/Short</th>
<th>Tactical Trading</th>
<th>Portfolio Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio A</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Contribution to Risk</td>
<td>12%</td>
<td>24%</td>
<td>47%</td>
<td>17%</td>
<td>12%</td>
</tr>
<tr>
<td>Portfolio B</td>
<td>39%</td>
<td>22%</td>
<td>14%</td>
<td>26%</td>
<td>5.2%</td>
</tr>
<tr>
<td>Contribution to Risk</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
</tr>
</tbody>
</table>

In assigning weights to hedge fund sectors, investors should assess the distribution of risk in the hedge fund portfolio.
The portfolios in Exhibit 4 are clearly two among many, and are meant to illustrate the following point: Investors should be careful to allocate risk to those hedge fund strategies that they think will offer the best opportunities to enhance risk-adjusted performance. For example, an investor with no specific information about the relative merits of one hedge fund sector versus another might be inclined to pick portfolio weights so that each hedge fund sector had an equal contribution to risk (e.g., Portfolio B). However, if an investor believed that one particular sector was likely to do better than another, then risk in the hedge fund portfolio should be shifted into the sector with the higher return expectations.
VI. IMPLEMENTING THE HEDGE FUND ALLOCATION

Investors can make an outright allocation to hedge funds...

...or substitute the hedge fund portfolio for other active strategies.

When investors make an outright allocation...

...they need to fund the allocation by choosing which asset class to substitute for the hedge fund program.

There are two ways (at least!) that investors can implement their hedge fund allocation. The first is to make an outright allocation to hedge funds in the same way that allocations are made to other asset classes (e.g., US Equity). Effectively, hedge funds are substituted for exposure to other asset classes.

Alternatively, investors can treat the hedge fund portfolio as a substitute for other active strategies, e.g., active US Large Cap equity or active US Fixed Income. Suppose an investor wanted to substitute a hedge fund portfolio for a traditional active manager, say an active US Large Cap equity manager. If the hedge fund manager equitizes a portion of the cash (e.g., by purchasing futures contracts), and invests the rest in the specific hedge fund portfolio, the investor now has a portfolio that can be compared with a traditional active manager. This strategy is called a “portable alpha” strategy.

For our purposes, we’ll assume that investors are substituting away from equity and fixed income and into hedge funds. The basic principles that are described in this case can be easily applied to analyze portable alpha strategies.

Let’s look at the case where an investor decides to make outright allocations to hedge funds. In this case, the investor must consider the volatility of a hedge fund portfolio and its correlation with other asset classes. For discussion purposes, we’ll assume that the hedge fund portfolio is the equal risk portfolio discussed above (i.e., Portfolio B). This portfolio has a volatility of 5.2% and a correlation with US equity of 0.51.

An investor who chooses to make an outright allocation to hedge funds must also choose how to “fund” the allocation. That is, the investor must choose which asset class (or combination of asset classes) the hedge fund program substitutes for in the overall portfolio. In our simple example, there are three natural alternatives:

- First, the investor can scale all other assets down proportionately.
- Secondly, the investor can substitute away from equity holdings and into the hedge fund portfolio.
- Finally, the investor can substitute away from bonds and into hedge funds.

The impact on total portfolio volatility of each funding alternative is summarized in Exhibit 5. The Exhibit plots alternative allocations to hedge funds and the resulting portfolio volatility for each of the three funding methods.
In this example, substituting out of high volatility equity and into low volatility hedge funds reduces total portfolio volatility.

Substituting out of fixed income leaves total portfolio volatility relatively unchanged.

Exhibit 5: Portfolio Volatility and Hedge Fund Allocations

What happens when we substitute out of equity and into hedge funds? In our example, hedge fund volatility declines almost linearly. The principal reason for this is that we are effectively substituting an asset with low volatility (the hedge fund portfolio) for one with higher volatility (the equity portfolio or the total portfolio). In addition, the hedge fund portfolio is not perfectly correlated with the equity portfolio. Both of these effects mean that substituting into the hedge fund portfolio reduces total portfolio volatility. Clearly, if the hedge fund portfolio is riskier or more highly correlated with equity market returns, then total portfolio volatility will not be reduced by as much, or even at all, when we substitute into hedge funds.

Suppose, though, that an investor wanted to add hedge funds to the portfolio, but didn’t want a change in total portfolio risk. Since the hedge fund portfolio (Portfolio B) in our hypothetical example has a bond-like volatility, the investor might substitute hedge funds for fixed income. For example, in Exhibit 5 allocations to hedge funds funded through reductions in fixed income leave the total portfolio volatility more or less unchanged. Again, this result depends on the structure of the hedge fund portfolio and our assumptions on hedge funds volatility and correlation. If the hedge fund portfolio is skewed towards higher volatility strategies or strategies that are more highly correlated with equity markets (e.g., Equity Long/Short), then total portfolio volatility will increase if the hedge fund allocation is funded out of fixed income.

The analysis of the impact on total portfolio volatility is important to investors for two reasons. First, it reinforces the point that investors should analyze the characteristics of their hedge fund portfolio prior to investing. The second reason Exhibit 5 is important is because it provides investors with an easy decision rule: how they fund the hedge fund allocation depends in part on how much risk they would like to take in the overall portfolio.

In addition to analyzing the impact on total portfolio volatility, investors should consider the impact of each funding alternative on the marginal contribution to total portfolio risk. Exhibit 6 illustrates this point by
showing the marginal contribution to risk (expressed in percentage terms) for each hedge fund allocation and under each scenario.

**Exhibit 6: Hedge Fund Contribution to Risk**

![Graph showing marginal contribution to risk from hedge fund allocations]

The important feature of Exhibit 6 is the illustration that the marginal impact on portfolio risk from hedge fund allocations can be quite small. Here, a 20% allocation to hedge funds contributes less than 10% of the total portfolio risk at the margin. In this example, even a 20% allocation to hedge funds contributes less than 10% of the total portfolio risk at the margin, irrespective of which funding choice is made. Of course, this conclusion depends on the actual structure of the hedge fund portfolio. If the hedge fund portfolio were concentrated in a highly volatile sector (e.g., Equity Long/Short), then we would anticipate a more significant marginal contribution to total portfolio risk at each hedge fund allocation.

Exhibits 5 and 6 suggest that a hedge fund program can be designed to have a modest impact on total portfolio volatility and the distribution of portfolio risk. What about the returns associated with hedge fund allocations?

Rather than focus on projecting future returns to hedge funds on the basis of historical averages, our preferred approach is to find the implied excess returns (i.e., returns over cash rates) associated with alternative allocations. Implied returns are the returns that are implied by the optimality of the portfolio structure under the assumed correlation and volatility structure of all the asset classes in the portfolio. The results are shown in Exhibit 7, again using the same equal risk-weight hedge fund portfolio. In keeping with the analysis of Exhibits 5 and 6, we also show the impact of alternative funding scenarios.

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1 The marginal contribution to risk from a hedge fund depends on its weighting in the portfolio, its level of volatility and its correlations with the other assets in the portfolio.

2 Implied returns can be found for any set of portfolio weights as $R = \lambda \Omega X$. In this equation, $R$ is a vector of asset returns, $\Omega$ a covariance matrix of asset returns, $X$ a vector of portfolio weights and $\lambda$ a risk aversion parameter.
What is striking about the figures in Exhibit 7 is how low the implied premia actually are. For instance, the implied return for a 10% allocation to hedge funds is around 107 basis points, irrespective of which funding choice is used. In fact, the choice of how the hedge fund allocation is funded only really begins to matter at more significant hedge fund allocations.

For example, suppose that an investor allocated 25% to hedge funds. If the hedge fund allocation is made out of equities, then the implied hedge fund return is around 127 basis points. On the other hand, if the hedge fund portfolio is made out of bonds, then the implied return is fourteen basis points lower. Similar to Exhibits 5 and 6, the relationship between the implied returns and the hedge fund allocation will depend on the actual structure of the hedge fund portfolio: a more volatile hedge fund portfolio (e.g., one that is concentrated in Equity Long/Short managers) will have a higher implied return. Alternatively, a hedge fund portfolio that is not especially highly correlated with the other assets (e.g., concentrated in commodities futures trading) will have a lower implied return at every allocation.

The implied returns shown in Exhibit 7 are best interpreted as hurdle rates. In other words, they are the minimum returns required by the investor to hold the hedge fund allocation and all other asset classes in the indicated proportions. Of course, higher returns on hedge funds would be preferred (and perhaps even expected). In some senses, then, it is reasonable for an investor to ask whether a particular implementation of a hedge fund program can achieve these hurdle rates.
VII. EVALUATING IMPLIED HURDLE RATES

How can we use the implied hurdle rates? Our implied hurdle rates correspond to the minimum return required to invest at a particular level in a hedge fund portfolio with specific risk characteristics. In our example, the risk characteristics are those of the portfolio with an equal contribution to risk from each hedge fund strategy. The risk characteristics of the hedge fund strategies, in turn, were developed from time series of hedge fund indices. At one level, we might think about making passive investments to each of the hedge fund strategies by investing in the indices.

However, this choice is not available to us — we cannot implement a hedge fund allocation by passively investing in a hedge fund index. Thus, an investor can reasonably ask whether a portfolio of particular hedge funds can be constructed whose historical volatility and correlation resemble the characteristics of the indices, and whose historical performance at least matches the implied hurdle rates.

A simple way to approach these issues is to begin with an evaluation of the risk characteristics and then analyze the historical performance. Our purpose in evaluating historical volatility is to determine whether it is feasible to construct a portfolio of hedge funds for each strategy whose volatility matches that of the hedge index for that strategy.

Our analysis of historical volatility focused on manager specific returns in the following hedge fund strategies — Event Driven, Equity Long/Short, Convertible Arbitrage, Equity Market Neutral, Fixed Income Arbitrage and Tactical Trading (Convertible Arbitrage, Equity Market Neutral and Fixed Income Arbitrage are the subsectors of the Relative Value sector). Exhibit 8 shows the number of managers in each hedge fund sector and the data source. Although our database covered manager returns from January 1994 through May 2001, we chose to reduce the number of managers used in the study to a more relevant subset. In particular, we selected only those managers that had reported at least nine consecutive months of performance, and excluded managers for which we had missing monthly performance data points. (It is important to keep in mind that managers reported returns over differing time periods and that most managers did not report returns over the entire period indicated in Exhibit 8).

Exhibit 8: Hedge Fund Managers (1/94 – 5/01)

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Source</th>
<th>Number of Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event Driven</td>
<td>TASS</td>
<td>179</td>
</tr>
<tr>
<td>Equity Long/Short</td>
<td>TASS</td>
<td>622</td>
</tr>
<tr>
<td>Convertible Arbitrage</td>
<td>TASS</td>
<td>71</td>
</tr>
<tr>
<td>Equity Market Neutral</td>
<td>TASS</td>
<td>177</td>
</tr>
<tr>
<td>Fixed Income Arbitrage</td>
<td>TASS</td>
<td>89</td>
</tr>
<tr>
<td>Tactical Trading</td>
<td>Barclay</td>
<td>1355</td>
</tr>
</tbody>
</table>

For each strategy, we then developed samples of equally weighted portfolios. Our objective was to determine how many managers were
necessary within each strategy to match the volatility of the strategy index. For the purposes of this analysis, we decided to consider the individual components of the relative value sector. That is, rather than focus on Relative Value, we looked at Convertible Arbitrage, Fixed Income Arbitrage and Equity Market Neutral.

For Event Driven, Equity Long/Short, Convertible Arbitrage, Equity Market Neutral and Fixed Income Arbitrage, the CSFB/Tremont index was used, while the Barclays CTA index was used for Tactical Trading. (The CSFB/Tremont indices use only a subset of the managers in the TASS database). We further restricted the sample to use only those managers who had a complete history of data for the three-year period from June 1998 through May 2001. On the basis of these data, we formed 1000 samples of five, 10 and 20 managers for each strategy, and calculated portfolio risk characteristics.

Exhibit 9 summarizes our analysis. For each hedge fund strategy, and each portfolio size (measured by number of managers), we show the median and the mean portfolio volatility, as well as the median and mean manager volatility. The Exhibit also shows the average correlation of excess returns between the managers for each hedge fund strategy. For comparison purposes, we also show the corresponding index volatility, calculated over the same time period. (The volatility differences between the indices and the portfolios can be explained, in part, by the weighting schemes — the indices are approximately capitalization-weighted while the portfolios are equally weighted).

As the Exhibit clearly illustrates, an investor does not need to hold all of the managers in each hedge fund sector to approximate index level volatility. Part of the explanation for this lies in the low levels of manager specific correlation for some of the sectors. For example, the average correlation between manager returns in the Fixed Income Arbitrage sector is around 0.19. Clearly, a low level of correlation across managers can help to reduce the volatility in a hedge fund portfolio.

While this result is good news for investors, it is also cautionary. Our results suggest that investors can achieve index-like volatility without holding an exceptionally large number of hedge fund managers within each sector. However, to achieve these volatility levels, investors must also ensure that the correlation of returns across managers within each sector are relatively low. Consequently, our results also suggest that investors will need to rely on thoughtful portfolio construction tools to develop an initial hedge fund portfolio, and robust risk management systems to ensure that the hedge fund portfolio remains within its proscribed risk tolerances.
Can a constructed portfolio of hedge fund managers achieve the same implied hurdle rates as our earlier passive allocation?

Yes ...our analysis suggests hurdle rates have been achievable, especially for modest allocations, but investors need to monitor the diversified portfolio, and carefully select managers within each sector.

What about historical performance? The objective of our analysis in this case is to verify whether a portfolio of hedge fund managers can achieve the implied hurdle rates shown in Exhibit 7. Those hurdle rates range between 100 and 125 basis points over cash rates, for allocations between five and 25 percent.

One easy step we can take is to assess the historical performance for each hedge fund strategies index. For example, we can regress the historical performance (measured as excess return over cash) of each hedge fund on historical US equity performance (also excess return over cash) and evaluate whether each hedge fund strategy added value after adjusting for the performance of the overall equity market. We’ll call the performance after all the adjustments the strategy’s alpha.

The results of this analysis, summarized in Exhibit 10, are comforting. Over the period January 1994 through May 2001, the historical performance for each hedge fund strategy is positive, after adjusting for cash rates and market returns. (All return numbers are annualized). In some sectors, the value added historically is quite high. For example, the alpha (or adjusted performance) for Equity Long/Short is 310 basis points.

### Exhibit 10: Adjusted Historical Hedge Fund Performance (1/94 – 5/01)

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Index Level Alpha</th>
<th>Index Level Beta</th>
<th>t-stat (Alpha)</th>
<th>t-stat (Beta)</th>
<th>Residual Volatility</th>
<th>Total Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event Driven</td>
<td>3.6%</td>
<td>0.25</td>
<td>1.77</td>
<td>6.55</td>
<td>5.4%</td>
<td>6.6%</td>
</tr>
<tr>
<td>Equity Long/Short</td>
<td>3.1%</td>
<td>0.52</td>
<td>0.86</td>
<td>7.65</td>
<td>9.5%</td>
<td>12.3%</td>
</tr>
<tr>
<td>Convertible Arbitrage</td>
<td>4.8%</td>
<td>0.04</td>
<td>2.60</td>
<td>1.17</td>
<td>4.9%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Equity Market Neutral</td>
<td>5.0%</td>
<td>0.10</td>
<td>4.59</td>
<td>4.83</td>
<td>2.9%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Fixed Income Arbitrage</td>
<td>1.0%</td>
<td>0.03</td>
<td>0.62</td>
<td>0.87</td>
<td>4.3%</td>
<td>4.3%</td>
</tr>
<tr>
<td>Tactical Trading</td>
<td>1.1%</td>
<td>-0.03</td>
<td>0.36</td>
<td>-0.47</td>
<td>8.2%</td>
<td>8.2%</td>
</tr>
</tbody>
</table>

Source: CSFB/Tremont

Although each strategy’s alpha is positive (and in some cases high), we can still ask whether it was generated by chance. To answer this question, we’ll calculate the t-statistic for each adjusted performance. For a simple rule of thumb, we’ll regard an alpha as statistically different from zero if the
t-statistic is greater than two in absolute value\(^3\). That is, when the alpha is positive and the t-statistic is greater than two, then we are more inclined to regard the historical performance as representing something other than chance. On the other hand, a positive alpha that is not statistically significant could be merely happy coincidence rather than manager skill.

In our case, two of the six strategies (Convertible Arbitrage and Equity Market Neutral) have statistically significant historical alphas. For example, the Equity Market Neutral alpha is 500 basis points and the t-statistic is 4.69. By contrast, the Equity Long/Short alpha is 310 basis points, but the t-statistic is 0.86. On the basis of these figures, we are more inclined to regard the Equity Market Neutral composite performance as representing something other than chance.

Index performance statistics are composites of many individual managers. The figures summarized in Exhibit 10 suggests some historical variation across hedge fund strategies in producing alpha. However, even though the composite performance in a particular strategy does not have a statistically significant alpha, there may be managers in that strategy who have been able to generate significant outperformance.

A simple way to approach this issue is to do the same type of analysis that was done on each hedge fund index, except at the manager level. In other words, we can find the alpha for each manager in each strategy and determine whether the manager’s alpha is positive and statistically different from zero. Just as with the analysis at the index level, we’ll find the alpha for each manager by regressing their historical performance on the performance of the US equity market, after adjusting both for the level of cash returns. As before, when the alpha is positive and the t-statistic is greater than two, we are inclined to regard the historical performance as representing something other than chance.

In Exhibit 11 we show the distribution of t-statistics for the alphas for the managers in each hedge fund strategy. We have focused on the t-statistics for only those managers who had positive alphas, since we want to know whether there are some managers who historically were able to add value through skill rather than chance. These alphas were estimated from the larger manager universe, and covered a longer time period. (Many managers reported returns over differing time periods, and most managers did not report returns over the entire time period indicated in Exhibit 11).

It is quite clear from the Exhibit 11 that some managers had statistically significant alphas. For example, in Equity Long/Short 71% of the managers had positive alphas of which around 33% had t-statistics greater than two. However, it is important to remember that a positive and significant historical performance does not constitute a prediction that those same managers will be able to add value in the future. (Appendix B shows the quartile distribution for the manager-specific alphas)\(^4\).

---

\(^3\) We are measuring statistical significance with a 95% confidence interval.

\(^4\) In the presence of sufficient data, it is often useful to stratify the data into favorable and unfavorable equity market periods and separately calculate the beta in each of these scenarios. If a hedge fund portfolio becomes more (positively) correlated with equity markets in difficult environments, the implied equilibrium hurdle rate of return for that manager should increase as well.
Exhibit 11: Historical Manager-Specific Alpha (1/94 – 5/01)

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Number of Managers</th>
<th>% Managers with positive alpha</th>
<th>% Managers statistically significant out of those with positive alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event Driven</td>
<td>179</td>
<td>82%</td>
<td>59%</td>
</tr>
<tr>
<td>Equity Long/Short</td>
<td>622</td>
<td>71%</td>
<td>33%</td>
</tr>
<tr>
<td>Convertible Arbitrage</td>
<td>71</td>
<td>80%</td>
<td>77%</td>
</tr>
<tr>
<td>Equity Market Neutral</td>
<td>177</td>
<td>62%</td>
<td>49%</td>
</tr>
<tr>
<td>Fixed Income Arbitrage</td>
<td>89</td>
<td>66%</td>
<td>42%</td>
</tr>
<tr>
<td>Tactical Trading</td>
<td>1355</td>
<td>57%</td>
<td>12%</td>
</tr>
</tbody>
</table>

Source: TASS

How does our analysis help us evaluate the implied hurdle rates? In our opinion, investors can draw three principal inferences.

First, the fact that the historical adjusted performance for each hedge fund sector substantially exceeds the implied hurdle rates suggests that the hurdle rates have been achievable, particularly for modest allocations.

Second, the fact that there is some variation across strategies in the significance of the historical adjusted performance suggests to us that investors are advised to carefully consider how to develop, monitor and maintain their hedge fund portfolio.

Finally, the variation in significance in historical performance across managers within each hedge fund sector seems to us to imply that investors will need to be quite careful in how they select specific hedge fund managers.
VIII. CONCLUSIONS

Our framework offers investors a tool for deciding the implied hurdle rate or incremental return they need to receive, relative to other assets, to justify a particular hedge fund allocation.

Implied hurdle rates for hedge fund allocations are quite small but careful manager selection is critical to achieving these returns.

Many institutional investors are perplexed by the challenges associated with investing in hedge funds. Paradoxically, the characteristics of the asset class that make it an attractive investment also confound careful analysis. In this paper, we have provided an analytic framework that gives investors the ability to make reasoned allocations to hedge funds.

Our framework relies on the principles of applied portfolio theory. Since hedge fund returns are more difficult to estimate than hedge fund volatility and correlation, our portfolio advice relies instead on hedge fund risk characteristics. In addition, our portfolio advice relies on an investor’s existing portfolio as a neutral reference point. Thus, our approach gives investors a framework for deciding how much incremental return they must receive on hedge funds relative to the other assets in the portfolio to justify a particular allocation. We view these returns as implied hurdle rates for hedge fund allocations.

Applying our framework to a stylized version of a typical US institutional investor’s portfolio, we conclude that the implied hurdle rates for hedge fund allocations are quite small. Indeed, the implied hurdle rates for modest allocations to hedge fund portfolios diversified across strategies are in the range of 100 to 125 basis points over cash. Our analysis of specific hedge fund managers is indicative that at least historically, investors could have constructed portfolios to achieve or even exceed these hurdle rates. However, our analysis also shows how important manager selection is to achieving these hurdle returns.

Investors have a number of available investment alternatives for which data are not readily available. Hedge funds are just one example of these alternatives. However, our analysis should be reassuring, as it demonstrates that investors can still find reasonable portfolios without abandoning basic portfolio principles. Indeed, many extraordinary investment gains have been achieved by those who applied basic portfolio principles to nascent asset classes.
IX. APPENDIX A: VOLATILITY AND CORRELATION ASSUMPTIONS

### Equity and Fixed Income Data

<table>
<thead>
<tr>
<th></th>
<th>Correlation</th>
<th>Volatilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>US Equity</td>
<td>Int'l Equity</td>
</tr>
<tr>
<td>US Equity</td>
<td>1</td>
<td>0.75</td>
</tr>
<tr>
<td>Int'l Equity</td>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td>Fixed Income</td>
<td>0.23</td>
<td>0.03</td>
</tr>
</tbody>
</table>

### Hedge Fund Data

<table>
<thead>
<tr>
<th></th>
<th>Correlation</th>
<th>Volatilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Equity Long/Short</td>
<td>Relative Value</td>
</tr>
<tr>
<td>Equity Long/Short</td>
<td>1</td>
<td>0.30</td>
</tr>
<tr>
<td>Relative Value</td>
<td>0.30</td>
<td>1</td>
</tr>
<tr>
<td>Event Driven</td>
<td>0.64</td>
<td>0.64</td>
</tr>
<tr>
<td>Tactical Trading</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Based on data from CSFB/Tremont and Barclays CTA index, adjusted to reflect our long-term strategic assumptions.
X. APPENDIX B: HISTORICAL MANAGER PERFORMANCE DISTRIBUTION

Hedge Fund Manager Specific Quartiles (1/94 – 5/01)

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Number of Managers</th>
<th>1st Quartile Alpha</th>
<th>2nd Quartile Alpha</th>
<th>3rd Quartile Alpha</th>
<th>Average Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event Driven</td>
<td>179</td>
<td>2.2%</td>
<td>5.3%</td>
<td>8.8%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Equity Long/Short</td>
<td>622</td>
<td>-1.7%</td>
<td>7.8%</td>
<td>16.1%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Convertible Arbitrage</td>
<td>71</td>
<td>1.4%</td>
<td>6.1%</td>
<td>11.5%</td>
<td>6.8%</td>
</tr>
<tr>
<td>Equity Market Neutral</td>
<td>177</td>
<td>-3.7%</td>
<td>2.6%</td>
<td>11.2%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Fixed Income Arbitrage</td>
<td>89</td>
<td>-0.8%</td>
<td>2.7%</td>
<td>6.6%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Tactical Trading</td>
<td>1355</td>
<td>-5.6%</td>
<td>1.6%</td>
<td>8.4%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

Source: TASS, Barclays CTA

(The average alphas in Appendix B are somewhat different from the index level alphas in Exhibit 10 for two reasons. First, the manager universe in Appendix B is more extensive than that of Exhibit 10. Second, the indices in Exhibit 10 are approximately capitalization-weighted while the average alpha in Appendix B is simply the arithmetic mean of the alphas of the individual managers in each hedge fund sector).
References:


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