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# A Quantitative Framework for Hedge Fund Manager Selection[1]

At PIMCO, we have developed a quantitative approach to hedge fund manager selection as a complement to – not a substitute for – traditional, time-intensive qualitative due diligence. Our framework is based on an econometric risk factor analysis that decomposes hedge fund manager returns into alpha and beta components. The most attractive managers exhibit *statistically significant alpha and limited beta risk* with only small exposures to traditional risk factors. A ranking methodology based on these criteria allows us to select hedge fund managers that significantly outperform their peers out of sample.

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## Quantitative screens for hedge fund manager selection

Our ranking methodology uses three "screens" that identify managers with the following characteristics:

- Consistent **high risk-adjusted returns** across a set of relevant measures of overall risk as well as tail risk.
- **Substantial and significant statistical alpha generation** over time. We define alpha as a positive return component that may be the result of superior market timing abilities, relative value/security selection, or capabilities that allow funds to access and exploit special market opportunities.
- **Limited exposures to the risk factors ("betas") that drive volatility in multi-asset class portfolios**, with only a small part of the return attributed to traditional risk factors.

Figure 1 is a ranking of a random sample of 24 managers from the Eurekahedge fund database based on the most commonly used risk-adjusted return measure, the Sharpe ratio. For this set of managers the Sharpe ratios range from -0.3 to 1.0 over the period from January 2006 to December 2012. The hedge fund with the highest Sharpe ratio is manager "Event Driven-A," and the fund with the lowest Sharpe ratio is "Multi-Strategy-A." The table also shows historical excess returns, volatilities, maximum drawdowns and the Calmar ratio. The Calmar ratio normalizes manager returns by their tail risk. It is defined as the average annualized return divided by the maximum drawdown. The ranking of managers by Sharpe ratio is similar to the ranking by their Calmar ratio. More often than not these measures provide very similar rankings of the managers' risk-adjusted performance.

One of the problems with a ranking of managers based on the Sharpe ratio is that it provides no sense of the types of risk that the managers explicitly or implicitly take to generate their returns.

That is, to what extent can a manager's returns be viewed as "pure alpha" (i.e., an expression of specialized investment skills such as security selection, relative value trades or highly dynamic market timing ability) that investors should be willing to pay for? Or, to what extent is a manager's returns driven by exposures to broad asset classes or risk factors that investors could access at a lower cost elsewhere or may want to control more explicitly?

**FIGURE 1. RANKING OF MANAGERS BASED ON SHARPE RATIO/CALMAR RATIO (JANUARY 2006 TO DECEMBER 2012)**

| Manager | Historical excess return | Historical volatility | Maximum drawdown | Sharpe ratio | Calmar ratio |
|---|---|---|---|---|---|
| Event driven-A | 4% | 4% | 5% | 1.0 | 0.8 |
| Multi-strategy-C | 6% | 7% | 19% | 0.9 | 0.3 |
| Multi-strategy-B | 7% | 8% | 15% | 0.9 | 0.4 |
| Long short equities-D | 7% | 10% | 25% | 0.7 | 0.3 |
| Fixed income-E | 6% | 9% | 22% | 0.7 | 0.3 |
| Long short equities-G | 6% | 9% | 6% | 0.6 | 1.0 |
| Arbitrage-A | 10% | 18% | 48% | 0.6 | 0.2 |
| Relative value-A | 6% | 12% | 24% | 0.5 | 0.3 |
| Long short equities-E | 2% | 4% | 5% | 0.5 | 0.4 |
| Macro-A | 4% | 10% | 15% | 0.4 | 0.3 |
| CTA/managed futures-A | 6% | 17% | 19% | 0.4 | 0.3 |
| Long short equities-F | 8% | 31% | 71% | 0.2 | 0.1 |
| Long short equities-C | 3% | 14% | 32% | 0.2 | 0.1 |
| Macro-B | 3% | 14% | 30% | 0.2 | 0.1 |
| Long short equities-A | 6% | 29% | 60% | 0.2 | 0.1 |
| Others-B | 3% | 19% | 51% | 0.2 | 0.1 |
| Long short equities-B | 5% | 31% | 76% | 0.2 | 0.1 |
| Others-A | 1% | 10% | 26% | 0.1 | 0.0 |
| Long short equities-H | 2% | 28% | 56% | 0.1 | 0.0 |
| Event driven-B | 0% | 12% | 27% | 0.0 | 0.0 |
| Distressed debt-A | -2% | 16% | 50% | -0.1 | 0.0 |
| Fixed income-F | -1% | 3% | 7% | -0.2 | -0.1 |
| Fixed income-D | -4% | 14% | 43% | -0.3 | -0.1 |
| Multi-strategy-A | -5% | 16% | 32% | -0.3 | -0.2 |

**Note:** Hedge fund "screen 1" ranks managers according to the risk-adjusted historical return in excess of the risk-free rate (Sharpe ratio). The managers were selected at random from the Eurekahedge fund database with the following criteria: at least 100 USD MM assets under management (average), at least 6 years of return history and categorized as a flagship fund.

## Risk factor models for manager returns

To answer these questions a risk factor based model of returns must be estimated for each manager. We believe the following four-factor model for manager returns is a useful benchmark:

$$r_t = \alpha + \beta_{\text{equity}} r_{\text{equity}} + \beta_{\text{rates}} r_{\text{rates}} + \beta_{\text{credit}} r_{\text{credit}} + \beta_{\text{cmdty}} r_{\text{cmdty}} + \epsilon_t$$

where $r_{\text{equity}}$, $r_{\text{rates}}$, $r_{\text{credit}}$, and $r_{\text{cmdty}}$ represent the equity, duration, credit and commodity factor returns and $\alpha$ represents the alpha return component for each manager.[2] Investors should be interested in their managers' potential to diversify and generate returns *relative to* these four factors, because these factors tend to dominate returns and volatility in most broadly diversified multi-asset portfolios.[3] The model specification may in some cases be too restrictive because it does not capture all the diverse strategies that hedge fund managers engage in. In practice it is therefore appropriate to consider several alternative model specifications. More elaborate expanded risk factor models could, for instance, include currency, volatility, liquidity, momentum, value and carry factors. Factors related to non-agency mortgages and ABS sectors may also have been important drivers of returns, especially in the period after the financial crisis of 2008. For some global macro managers and CTAs, exposures to specific macro-driven commodities such as oil and gold can also play a dominant role.

Despite these caveats, we feel simpler models allow for better apples-to-apples comparisons across a broad range of funds. Importantly, our results show that the simple four-factor model can produce a quite robust ranking of managers.

**FIGURE 2. RANKING OF MANAGERS BASED ON ESTIMATED ALPHA T-STATISTIC (SIGNIFICANCE)**

| Manager | Estimated alpha | T-alpha | Appraisal ratio | Sharpe beta |
|---|---|---|---|---|
| Multi-strategy-B | 6.6% | 3.1 | 1.3 | 0.1 |
| Multi-strategy-C | 6.1% | 3.0 | 1.3 | 0.1 |
| Fixed income-E | 5.1% | 3.0 | 1.2 | 0.1 |
| Event driven-A | 3.6% | 2.9 | 1.1 | 0.2 |
| Long short equities-D | 7.4% | 2.6 | 0.8 | -0.1 |
| Arbitrage-A | 9.7% | 2.0 | 0.8 | 0.1 |
| Long short equities-G | 5.4% | 1.8 | 0.6 | 0.1 |
| Long short equities-E | 1.7% | 1.5 | 0.5 | 0.1 |
| Macro-A | 3.9% | 1.1 | 0.4 | 0.0 |
| Long short equities-A | 7.4% | 1.0 | 0.4 | -0.1 |
| CTA/managed futures-A | 6.4% | 1.0 | 0.4 | -0.1 |
| Long short equities-F | 4.9% | 1.0 | 0.3 | 0.1 |
| Macro-B | 1.7% | 0.7 | 0.2 | 0.1 |
| Long short equities-C | 1.6% | 0.5 | 0.2 | 0.1 |
| Others-A | 1.0% | 0.5 | 0.1 | 0.1 |
| Long short equities-B | 0.4% | 0.2 | 0.0 | 0.1 |
| Others-B | 0.1% | 0.1 | 0.0 | 0.2 |
| Long short equities-H | 0.1% | 0.0 | 0.0 | 0.1 |
| Event driven-B | -0.8% | 0.0 | -0.1 | 0.2 |
| Relative value-A | -0.9% | -0.2 | -0.1 | 1.0 |
| Distressed debt-A | -1.4% | -0.2 | -0.1 | 0.0 |
| Fixed income-F | -0.7% | -0.2 | -0.3 | 0.1 |
| Fixed income-D | -4.9% | -0.7 | -0.5 | 0.1 |
| Multi-strategy-A | -10.8% | -1.1 | -0.8 | 0.7 |

**Note:** Hedge fund "screen 2" ranks the sample set of managers according to their risk-adjusted alpha or equivalently the alpha t-statistic. The appraisal ratio normalizes the estimated alpha returns with historical alpha volatility. The Sharpe ratio of beta is calculated as the estimated beta return divided by the volatility of the beta return. Alpha is measured relative to the estimated four-factor model for returns. For each manager a general-to-specific modeling process is used to estimate the relevant risk factors and arrive at a final model specification.

## Manager alpha

Figure 2 shows the estimated alpha, $\hat{a}$, for each manager, the t-statistic of the estimated alpha, as well as the manager's appraisal ratio or risk-adjusted alpha. The managers have been ranked according to the t-statistic of their estimated alpha. Formally the alpha t-statistic is defined as

$$T_{(alpha)} = \frac{\hat{a}}{std(\hat{a})}$$

This statistic is important because the magnitude of $T_{alpha}$ measures the "significance" of the manager's alpha. A value above 1.645 suggests that the manager has been able to generate persistent positive alpha over time (it is significant at a 5% significance level). A value below this threshold suggests that the manager's actual alpha may be zero or even negative.

In our randomly selected sample of 24 hedge funds more than half of the managers have "insignificant" estimated alpha (i.e., $T_{alpha} < 1.645$ ) and six of the managers have negative estimated alpha. These managers have failed to generate the positive, un-correlated returns that are required to improve the hedge fund investor's overall risk-return profile. The hedge fund investor may consequently want to evaluate whether their fees are justified and reconsider the allocation to these managers.

In some instances, hedge fund managers may have been selected based on their ability to construct efficient portfolios of risk factor exposures and allocate optimally across asset

**FIGURE 3. RANKING MANAGERS BY THEIR REGRESSION R-SQUARES (FACTOR FOOTPRINT)**

| | Factor footprint | Equity diversification | | Multi-factor risk exposure | | | |
|---|---|---|---|---|---|---|---|
| Manager | R-square | Beta | Correlation | Equity | Credit | Rates | Cmdty |
| Others-A | 2% | 0.0 | 0.0 | | 0.09 | | |
| CTA/managed futures-A | 4% | -0.2 | -0.2 | | -0.43 | | |
| Long short equities-E | 4% | 0.0 | 0.2 | | 0.10 | | |
| Event driven-B | 8% | 0.1 | 0.2 | 0.15 | | | |
| Long short equities-G | 10% | 0.1 | 0.2 | | 0.38 | | |
| Macro-A | 14% | -0.2 | -0.3 | | | | -0.19 |
| Fixed income-F | 14% | 0.1 | 0.3 | | 0.17 | | |
| Long short equities-D | 17% | 0.0 | 0.1 | -0.22 | 0.51 | | 0.17 |
| Distressed debt-A | 18% | 0.4 | 0.4 | | 0.54 | | 0.25 |
| Multi-strategy-A | 21% | 0.4 | 0.4 | 0.30 | 0.62 | 0.64 | |
| Relative value-A | 35% | 0.1 | 0.2 | | 0.93 | 0.95 | |
| Event driven-A | 44% | 0.1 | 0.6 | 0.12 | 0.21 | | -0.05 |
| Fixed income-D | 46% | 0.5 | 0.6 | 0.28 | | | 0.28 |
| Arbitrage-A | 48% | 0.5 | 0.5 | | 1.21 | | 0.23 |
| Multi-strategy-C | 51% | 0.2 | 0.5 | | 0.70 | | |
| Long short equities-H | 53% | 1.0 | 0.6 | 0.38 | 1.06 | | 0.47 |
| Multi-strategy-B | 57% | 0.2 | 0.5 | | 0.44 | | 0.15 |
| Long short equities-A | 58% | 1.2 | 0.7 | 0.85 | 0.98 | -0.73 | |
| Long short equities-C | 58% | 0.6 | 0.8 | 0.37 | 0.85 | | |
| Long short equities-F | 71% | 1.3 | 0.7 | 0.62 | 0.77 | | 0.68 |
| Others-B | 71% | 0.9 | 0.8 | 0.88 | | | |
| Macro-B | 75% | 0.6 | 0.7 | 0.23 | 0.67 | | 0.27 |
| Fixed income-E | 76% | 0.4 | 0.7 | 0.14 | 0.79 | | |
| Long short equities-B | 81% | 1.6 | 0.9 | 1.20 | 0.87 | | 0.23 |

**Note:** Hedge fund "screen 3" ranks managers according to their overall factor footprint as measured by the four-factor model R-squares. Also reported are the CAPM regression betas, the equity correlation and the four-factor risk exposures and the associated t-statistics. For each manager a general-to-specific model was used to determine the set of significant factor exposures.

classes. Examples include global tactical asset allocation managers and some global macro managers. For these managers a low alpha component may be acceptable over a given time period if the beta component of their return remains very attractive. For the purpose of evaluating such managers, the estimated information ratio of the beta component of the manager's returns is also shown in Figure 2.

### Manager betas and "Factor Footprint"

To construct a well-diversified portfolio of hedge funds - and to be able to assess the impact that the hedge fund portfolio has on the risk characteristics of the overall portfolio - it is necessary to evaluate the factor exposures of the individual managers. Figure 3 shows the estimated risk factor exposures for each manager and the R-squares using the same four-factor model specification. One-factor equity betas and correlations of returns to equities are also shown for each manager since the diversification of equity risk is a very important goal for most investors.

The managers have been ranked on their regression R-square, which we will refer to as the overall "factor footprint" of each manager. The size of the factor footprint indicates how much the hedge fund managers' returns may interact with the rest of the investor's portfolio. All things equal, managers with smaller factor footprints are desirable because their returns are independent of the key risk factors that are included in the model. A small R-square in the four-factor model confirms that managers are not playing with standard risk factors or asset classes in a static fashion. To get a more detailed sense of the types of "bets" that these managers are making to generate their returns, qualitative due diligence and more elaborate risk factor models should be employed. If all "hedge" funds were truly "hedging" out their exposures to the dominant risk factors, one would expect to see a small factor footprint for all managers. This is, however, not generally the case.

The average R-square for the managers represented in Figure 3 is close to 50%. The average equity beta for these managers is 0.4. Most of the managers have significant positive exposures to credit risk or equity risk. Clearly not all hedge fund managers "hedge" their beta exposures. Indeed only three managers of the 24 managers have negative equity betas.

It is also useful to note the significant differences in beta exposures between different hedge fund managers that have the same "style" classification. Long/short equity manager E, for instance, has a much lower beta exposure and a much smaller "factor footprint" than the rest of the managers in this category. This highlights the potential imprecision of a purely "style" based approach to hedge fund investing.

### An aggregate (composite) ranking of managers

It is useful to summarize the relative merits of each hedge fund manager in a composite ranking of the individual hedge funds. One such ranking is shown in Figure 4. The aggregate ranking was constructed by weighting the ranking of managers in each of three categories. Specifically, a weight of 50% was assigned to the statistical significance of alpha, $T_{Alpha}$, 25% to the estimated alpha, $\hat{a}$, and 25% weight to the ranking by R-square. The reliance on $T_{Alpha}$ is justified in the subsequent section.

Overall, Figures 1, 2, 3 and 4 constitute a very simple set of quantitative screens of hedge fund managers, which can help investors evaluate their existing hedge fund manager lineup and identify prospective managers who may be able to improve the existing hedge fund portfolio.

### Evidence of persistence in performance measures and factor exposures

Our approach to hedge fund portfolio construction relies on two crucial assumptions:

- **Alpha persistence:** The estimated measures of alpha should predict the relative performance of managers in the future.
- **Beta persistence:** The estimated risk characteristics should predict the managers' future risk profile and betas (for instance, their equity beta).

**FIGURE 4. OVERALL RANKING OF MANAGERS (ALPHA AND FACTOR FOOTPRINT)**

| Manager | Alpha | T-alpha | R-square | Rank |
|---|---|---|---|---|
| Long short equities-D | 7% | 2.6 | 17% | 1 |
| Multi-strategy-B | 7% | 3.1 | 57% | 2 |
| Multi-strategy-C | 6% | 3.0 | 51% | 3 |
| Long short equities-G | 5% | 1.8 | 10% | 4 |
| Arbitrage-A | 10% | 2.0 | 48% | 5 |
| CTA/managed futures-A | 6% | 1.0 | 4% | 6 |
| Long short equities-E | 2% | 1.5 | 4% | 7 |
| Event driven-A | 4% | 2.9 | 44% | 8 |
| Macro-A | 4% | 1.1 | 14% | 9 |
| Fixed income-E | 5% | 3.0 | 76% | 10 |
| Long short equities-A | 7% | 1.0 | 58% | 11 |
| Others-A | 1% | 0.5 | 2% | 12 |
| Long short equities-F | 5% | 1.0 | 71% | 13 |
| Event driven-B | -1% | 0.0 | 8% | 14 |
| Long short equities-C | 2% | 0.5 | 58% | 14 |
| Macro-B | 2% | 0.7 | 75% | 16 |
| Long short equities-H | 0% | 0.0 | 53% | 17 |
| Fixed income-F | -1% | -0.2 | 14% | 18 |
| Relative value-A | -1% | -0.2 | 35% | 19 |
| Distressed debt-A | -1% | -0.2 | 18% | 20 |
| Long short equities-B | 0% | 0.2 | 81% | 20 |
| Others-B | 0% | 0.1 | 71% | 22 |
| Fixed income-D | -5% | -0.7 | 46% | 23 |
| Multi-strategy-A | -11% | -1.1 | 21% | 24 |

**Note:** Hedge fund "screen 4" provides an overall ranking of managers based on their alpha (25%), alpha significance (50%) and multi-factor R-square (25%).

We examined these two assumptions across a data set of more than 700 hedge fund managers. The data set consists of all managers in the Eurekahedge fund database with at least $100 million in assets under management that reported returns on a consistent basis over a six-year period from January 2006 to December 2012.

Figure 5 shows the correlation of the Sharpe ratio, the Calmar ratio and the appraisal ratio (or equivalently the t-statistic on alpha) across non-overlapping 24-month and 36-month sub-samples for the managers. The correlations are all positive and fall between 0.45 and 0.9. This result appears to provide strong support for the hypothesis that hedge fund manager performance is persistent over time.

**FIGURE 5. CORRELATION OF RISK-ADJUSTED PERFORMANCE MEASURES AND ALPHA**

**T-stat alpha (4-factor model)**

| Sub-sample | '07 - '09 | '10 - '12 | '07 - '08 | '09 - '10 | '11 - '12 |
|---|---|---|---|---|---|
| '07 - '09 | 1.00 | 0.50 | | | |
| '10 - '12 | 0.50 | 1.00 | | | |
| '07 - '08 | | | 1.00 | 0.53 | 0.46 |
| '09 - '10 | | | 0.53 | 1.00 | 0.88 |
| '11 - '12 | | | 0.46 | 0.88 | 1.00 |

**Sharpe ratio**

| Sub-sample | '07 - '09 | '09 - '12 | '07 - '08 | '09 - '10 | '11 - '12 |
|---|---|---|---|---|---|
| '07 - '09 | 1.00 | 0.49 | | | |
| '09 - '12 | 0.49 | 1.00 | | | |
| '07 - '08 | | | 1.00 | 0.58 | 0.43 |
| '09 - '10 | | | 0.58 | 1.00 | 0.89 |
| '11 - '12 | | | 0.43 | 0.89 | 1.00 |

| | Calmar ratio | | | | |
|---|---|---|---|---|---|
| **Sub-sample** | **'07 - '09** | **'09 - '12** | **'07 - '08** | **'09 - '10** | **'11 - '12** |
| **'07 - '09** | 1.00 | 0.50 | | | |
| **'09 - '12** | 0.50 | 1.00 | | | |
| **'07 - '08** | | | 1.00 | 0.55 | 0.45 |
| **'09 - '10** | | | 0.55 | 1.00 | 0.88 |
| **'11 - '12** | | | 0.45 | 0.88 | 1.00 |

**Note:** Table shows the correlation of risk-adjusted performance (Appraisal ratio/t-statistic, Sharpe ratio, Calmar ratio) across sub-samples.

However, despite the overwhelming evidence of significant persistence in the *risk-adjusted* manager alphas, and their risk-adjusted returns (Sharpe ratios and Calmar ratios), there is surprisingly little evidence that the estimated *level* of alpha, $\hat{a}$, is highly persistent over time. This can be seen in Figure 6, which shows the correlation of the managers' measured *level* of alpha over time. The correlation is close to zero and even negative in some cases. Consequently, the historical level of a manager's alpha does not provide much insight about the future level of alpha.

**FIGURE 6: CORRELATION OF THE ESTIMATED LEVEL OF ALPHA ACROSS SUB-SAMPLES**

| | Alpha (4-factor model) | | | | |
|---|---|---|---|---|---|
| **Sub-sample** | **'07 - '09** | **'10 - '12** | **'07 - '08** | **'09 - '10** | **'11 - '12** |
| **'07 - '09** | 1.00 | -0.01 | | | |
| **'10 - '12** | -0.01 | 1.00 | | | |
| **'07 - '08** | | | 1.00 | 0.21 | -0.12 |
| **'09 - '10** | | | 0.21 | 1.00 | -0.05 |
| **'11 - '12** | | | -0.12 | -0.05 | 1.00 |

**Note:** Table shows the correlation of the level of estimated alpha (based on the four-factor regression model, which includes equity, rates, credit and commodity factors) across sub-samples.

A regression of the estimated alphas on the previous period's alphas confirms this conclusion, which can be seen in model specification (a) in Figure 7. The previous period's alpha estimate is highly insignificant as a predictor of the next period's alpha. This picture changes dramatically when the managers' *alpha t-statistic*, $T_{alpha}$, is included in the regression model. The coefficient on this variable is positive and statistically significant at the 5% level in all model specifications. This finding holds irrespective of whether the variable is directly included in the regression model, as in (b), or whether it is represented by a dummy variable, as in model specification (c), (d) and (e).

**FIGURE 7: REGRESSION OF ALPHA, $\hat{a}_t$, ON PREVIOUS ALPHA $\hat{a}_{t-1}$), AND $T_{alpha,\,t-1}$**

| | Model specification | | | | |
|---|---|---|---|---|---|
| **Regressors** | **(a)** | **(b)** | **(c)** | **(d)** | **(e)** |
| **Alpha**<br>**Alpha (t-1)** | -0.01<br>-0.24 | **-0.08**<br>-2.30 | | **-0.10**<br>-2.64 | **-0.10**<br>2.64 |
| **Alpha significance**<br>**T-alpha (t-1)** | | **0.01**<br>4.73 | | | 0.00<br>0.37 |
| **Dummy variables**<br>**T-alpha (t-1)>2** | | | **0.02**<br>4.20 | **0.03**<br>3.20 | **0.03**<br>2.86 |
| **T-alpha (t-1)>4** | | | **0.06**<br>4.20 | **0.06**<br>4.00 | **0.06**<br>2.95 |
| **R-square** | 0.01% | 3.37% | 4.94% | 5.96% | 5.97% |
| **Observations** | 646 | 646 | 646 | 646 | 646 |

**Note:** Table shows regression of the estimated manager alpha from 2009-2012 on the historical alpha estimate as well as the t-statistic of the historical alpha based on the 2006-2009 sub-samples. All alphas estimated relative to a four-factor model of manager returns. Model (a) includes only the historical alpha. Model (b) includes the t-statistic on alpha. Specification (c), (d), (e) includes dummy variables for different levels of alpha significance. A t-statistic of alpha greater than 2 indicates a highly statistically significant level of alpha. Note that the seemingly low R-square applies at the individual manager level. It is a powerful indicator at the portfolio level.

The t-statistic of alpha is a more robust indicator of future performance because it normalizes the alpha estimates by the volatility of the manager's returns. As a result it provides a more appropriate and comparable measure of the strength of the "alpha signal" for each manager. The implication is that it is extremely important to make a distinction between a *high level* of estimated alpha and a *highly significant* alpha when ranking hedge fund managers. The latter measure has more predictive power about the relative future performance of the hedge fund managers.

## Empirical evidence: Hedge fund risk and equity beta persistence

Next we examined whether the factor exposures (betas) of individual hedge fund managers are persistent over time. One may be tempted to argue that hedge fund risk factor exposures are inherently unstable and cannot be reliably predicted "out of sample" because managers change their factor exposures and investment strategies over time. A manager may, for instance, be "short" a specific factor at one time and "long" the same factor at another time. For this reason it may seem somewhat naive to rely on the estimated risk factor exposures to control the aggregate exposures in the hedge fund portfolio. This argument may be true in some cases, but it does not generally appear to be a valid criticism. As shown in Figure 8, the correlations across sub-samples of the hedge fund managers' equity betas, equity correlations, multi-factor regression R-squares and overall volatilities are remarkable high. This means that the measured risk factor exposures may provide a reliable estimate of the realized exposures in the subsequent period, especially at the portfolio level. Additionally, it may be prudent to explicitly constrain the factor exposures of a hedge fund manager so that the overall factor exposures do not drift over time. Alternatively, investors may implement overlay portfolios to dynamically manage the systematic factor betas of their hedge fund portfolio.

**FIGURE 8: CORRELATION OF KEY RISK MEASURES ACROSS SUB-SAMPLES**

**Equity correlation**

| Sub-sample | '07 - '09 | '10 - '12 | '07 - '08 | '09 - '10 | '11 - '12 |
|---|---|---|---|---|---|
| '07 - '09 | 1.00 | 0.69 | | | |
| '10 - '12 | 0.69 | 1.00 | | | |
| '07 - '08 | | | 1.00 | 0.72 | 0.60 |
| '09 - '10 | | | 0.72 | 1.00 | 0.74 |
| '11 - '12 | | | 0.60 | 0.74 | 1.00 |

**R-square (4-factor model)**

| Sub-sample | '07 - '09 | '10 - '12 | '07 - '08 | '09 - '10 | '11 - '12 |
|---|---|---|---|---|---|
| '07 - '09 | 1.00 | 0.63 | | | |
| '10 - '12 | 0.63 | 1.00 | | | |
| '07 - '08 | | | 1.00 | 0.57 | 0.51 |
| '09 - '10 | | | 0.57 | 1.00 | 0.66 |
| '11 - '12 | | | 0.51 | 0.66 | 1.00 |

**Volatility**

| Sub-sample | '07 - '09 | '10 - '12 | '07 - '08 | '09 - '10 | '11 - '12 |
|---|---|---|---|---|---|
| '07 - '09 | 1.00 | 0.83 | | | |
| '10 - '12 | 0.83 | 1.00 | | | |
| '07 - '08 | | | 1.00 | 0.77 | 0.79 |
| '09 - '10 | | | 0.77 | 1.00 | 0.78 |
| '11 - '12 | | | 0.79 | 0.78 | 1.00 |

**Note:** Tables show the correlation of manager risk characteristics between different sub-samples. The top table shows persistence in manager level equity correlations, the middle table shows the correlation of manager R-squares across periods and the last table shows correlation of realized volatility across time and across managers.

## Implications for hedge fund portfolio construction

We have identified the alpha t-statistic as a potentially powerful predictor of future hedge fund performance. Our empirical analysis suggests that information about this variable can be exploited in the hedge fund manager portfolio construction process. To explore this idea we constructed a set of six hypothetical portfolios of hedge fund managers based on their composite ranking from 2007 to 2009. Again the aggregate ranking assigned 25% weight to the manager's factor footprint, 25% weight to the estimated alpha, $\hat{a}$, and 50% weight on the t-statistic of alpha, $T_{alpha}$. Each portfolio consists of an equally weighted allocation to managers in the different percentile "buckets" of the distribution.

Figure 9 summarizes the performance of these hedge fund portfolios in the subsequent period from 2010 to 2012. The table shows that the set of managers who were ranked in the top 10% of the distribution from 2007 to 2009 significantly outperformed the rest of the managers in the subsequent three-year period. The highest ranked managers, above the 90th percentile, outperformed the managers in the 70th to 90th percentile, who in turn outperformed the managers ranked below the 70th percentile. These results hold on both an absolute return basis and also across all risk-adjusted return measures.

**FIGURE 9: HEDGE FUND PORTFOLIO PERFORMANCE (PORTFOLIOS BASED ON AGGREGATE RANKING OF FUNDS)**

| Aggregate ranking | | Performance of equally weighted portfolio (EW) | | | | | |
|---|---|---|---|---|---|---|---|
| Percentile | | Alpha | T-stat (alpha) | Volatility | Return | Sharpe ratio | Equity Beta |
| 90% | 100% | 4.81% | 5.04 | 2.55% | 6.65% | 2.60 | 0.13 |
| 70% | 100% | 2.78% | 1.51 | 4.65% | 5.99% | 1.29 | 0.23 |
| 0% | 70% | 0.63% | 0.29 | 6.86% | 5.98% | 0.87 | 0.38 |

**Note:** Figure 9 shows the performance from 2010 to 2012 of equally weighted portfolios of hedge funds that were constructed based on rankings of managers for the period 2007 to 2009.

These results provide strong support for the use of statistical analysis in the hedge fund manager selection process and are consistent with the findings in Alexander and Dimitriu (2005), Agarwal and Naik (2000, 2004) and Kosowski, Teo and Naik (2006).[4] As shown in the last column of the table, the equity beta of the portfolios varied, but the best hedge fund managers were able to achieve their high returns with a low equity beta on average of 0.13. The stated objective for most hedge fund investors is to create a hedge fund portfolio that produces superior risk-adjusted returns with a low correlation and a low beta to the equity market. This objective may be achieved by imposing constraints on the total estimated equity beta at the hedge fund portfolio level during the optimization process. Our research indicates that it is possible to successfully manage the equity beta at the *portfolio level* - even if the manager level betas may be somewhat unstable over time.

## Conclusion

Our simple returns-based approach to ranking hedge fund managers focuses on key characteristics that collectively provide clear insights into the managers' relative performance and diversification properties. It relies on a multi-factor representation of manager returns that attributes their historical returns and volatilities to alpha and beta components.

Our ranking of managers puts substantial weight on the *t-statistic of alpha*, which we identify as a powerful indicator of future performance of the manager. We believe this variable provides a *far better* signal of the managers' subsequent performance than the estimated *level of alpha* itself.

In an application to a large data set of hedge funds, the highest ranked managers systematically outperform their hedge fund peers in subsequent periods.

Several key risk characteristics, such as the equity factor exposure, the equity correlation and the overall "factor footprint," generally are highly persistent at the manager level. Investors may therefore be able to consistently manage the risk factor exposures of their hedge fund investments over time. In doing so they can better manage the interaction of the hedge fund portfolio with the rest of their multi-asset class portfolios.

Ultimately, the statistical analysis should be viewed as a useful and potentially important tool for hedge fund investors. It is simple to implement and it gives clear and actionable results. However, it is a complement to, not a substitute for, the traditional, more time-intensive qualitative due diligence process, which continues to be extremely important due to the multi-faceted range of risks and issues hedge fund investors face.

## References:


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[2]The general risk factor model for manager returns can be stated as follows

$$r_t = \alpha + \sum_i \beta_i f_{i,t} + \epsilon_t$$

where $r_t$ is the return of the asset, $\alpha$ is the intercept, $\beta_i$ is the exposure of the asset to the ith factor, $f_i$ is return for the ith factor, and $\epsilon_t$ is an error term. The risk factor model can be used to decompose the returns of a given manager into returns that can be attributed their risk factor exposures, $\sum_i \beta_i f_{i,t}$ and an uncorrelated return component, $\alpha + \epsilon_t$.

[3]Equity returns are represented by the excess return of the S&P 500 returns, interest rate factor risk (duration), represented by the excess return of the Merrill Lynch 10 year Treasury Futures Index. Credit risk, $r_{credit}$, is represented by the excess return of the Barclay's US Investment Grade index over duration-matched treasuries, and commodity risk, $r_{cmdty}$, is represented by the excess return of the DJ UBS Commodities index.

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