BTRM

Hedge Fund Returns Replication

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In this article we will introduce an effective statistical approach to replicate hedge fund returns. The approach is based on a carefully designed stepwise regression procedure. The objectives of the regression procedure are to 1) identify the strategies and markets to which a hedge fund manager is exposed, and 2) to analyze the progression of these exposures over time. While a hedge fund manager will continually change their overall exposure to exploit market anomalies, we wouldn't expect a manager who for many years traded in the long/short equity space to suddenly switch to the stressed equity space. The regression procedure is designed to capture such strategy drifts.

Introduction:

While hedge fund managers differ in their abilities to generate alpha, there is a strong argument to suggest that hedge fund managers, on average, have a high degree of beta dependencies. Hedge fund indices provide us with enough data to test and measure these dependencies. For example, Table 1 shows the average returns of CSFB/Tremont Long/Short Equity Index and CSFB/Tremont Managed Futures Index relative to the returns of the Russell 3000 Total Return Index. Table 1 is generated by dividing the historical monthly returns of the Russell 3000 Total Return Index into five economic regimes and computing the average returns of the index in each regime. We then match the monthly returns of each hedge fund index to the monthly returns of the Russell 3000 Total Return Index in each regime and compute the average returns of the hedge fund index in each economic regime.

No. Of Data Points	14	66	66	91	3
ECONOMIC STATES	**1**	**2**	**3**	**4**	**5**
Russell 3000 TR Index	-9.91%	-2.94%	0.33%	4.68%	10.49%
CSFB/Tremont - Long/Short Equity	-3.66%	-1.14%	0.27%	2.65%	4.03%
CSFB/Tremont - Managed Futures	2.68%	-0.22%	0.14%	0.69%	-1.84%

Table 1

Table 1 clearly illustrates the strong directional "beta" dependencies that exist between the general market and the hedge fund industry.

The Concept:

Here is the rationale: if we can effectively map the returns of a hedge fund manager to market factors (equity, fx, yield curves, volatility, correlation, etc.) which have consistently influenced the volatility and return profile of that manager then we should be able to safely replace the manager's history with that of the market factors. Now, while it may not be possible to monitor the day-to-day trading activity of the manager, the market factors can be monitored on a daily basis. That is, the market factors will provide us with some degree of forecast-ability of the manager's performance. In addition, given that market factors have longer and richer history than most managers have, we can effectively run stress tests on a manager's trading strategy via stress testing the market factors. The procedure we employ in this article to stress test the manager's trading strategy is based on the Monte Carlo simulation of the risk factors and it proceeds as follows:

1. We first use the stepwise regression procedure to map the manager's returns to relevant market factors which reflect the markets traded by the manager;
2. We ensure the effectiveness of the mapping and the persistence of the market factors by running out-of-sample and advanced statistical tests;
3. Once we are satisfied with the results of the mapping procedure, we use an empirical simulation procedure to simulate thousands of potential return-history profiles for the manager. Each return-history profile represents a potential performance history which the manager can potentially experience as long as the manager's exposures to the market factors remain consistent on average;
4. With the results of the Monte Carlo simulations, we can build the extreme loss distribution of the manager's returns and compute any returns statistic such as value-at-risk, drawdown, and other risk measures.

Illustration:

We will illustrate the effectiveness of the approach using the HFRI Event Driven Strategy Index. Hedge fund managers in the Event Driven space maintain positions in companies involved in corporate transactions such as mergers, restructuring, financial distress, tender offers, and capital structure adjustments. These are some of the most exciting trading themes in the hedge fund industry. We will take this index through the steps listed above:

1. We first map the strategy index returns to market factors: for this first step we used the index returns history from Jan. 1994 to Dec. 2004. The mapping process was successful in that we were able to replicate the index returns very closely using market factors. The results of the mapping procedure are shown in Table 2 and Figure 1 below. According to our mapping procedure, there are three factors that influence the returns of this strategy; namely, the equity market excess returns as represented by the Fama-French market excess returns index, the equity spread as represented by the spread between the returns on small-cap stocks and large-cap stocks, and the yield on sub-investment grade bonds as represented by the CSFB High Yield Index. Table 2 also indicates how each market factor affects the returns of the event-driven strategy. All three factors exhibit positive beta coefficients with the returns of the strategy; we therefore conclude that a rise in equity returns, equity spreads, and sub-investment grade bond yields should be positive for the event-driven strategy.

Table 2

Figure 1

In-Sample Period: Jan. 1994 – Dec. 2004
Risk Factors & Direction:
- Market Excess Return [+]
- Equity Spread: Spread between the returns of small-cap stocks and large-cap stocks [+]
- CSFB High Yield Index [+]

Favorable Environment:
- Rising equity markets;
- Rising equity spreads;
- Increasing high-yield returns;

HFRI Event-Driven (Total) Index Replication with 0.86 Correlation
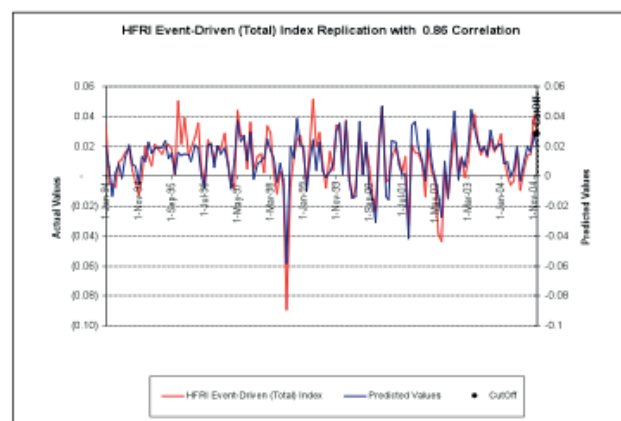
2. In the second step we conduct an out-of-sample test to ensure the effectiveness of the mapping procedure and the persistence of the market risk factors: the out-of-sample period extends from Jan. 2005 until Sept. 20131. During this period we run the mapping procedure using the same market factors and the same beta coefficients we computed in the first step. Effectively we create an alternative market-based index which tracks the HFRI Event Driven index. A hedge fund investor can then use this alternative market-based index to track the performance of the actual hedge fund index, in which case it will also be important to periodically re-balance the alternative market-based index. In the figures below, we refer to this alternative market-based index as the "HFRI Event-Driven Index (OOS)". Even without any rebalancing of the beta coefficients, the alternative market-based index is able to track the direction and volatility of the HFRI Even Driven index very closely. The results are shown below: figure 2 shows how closely the out-of-sample mapping of the market risk factors tracks the HFRI Event-Driven Index. The "Cut-Off" point on the graph is where the in-sample period ends and the out-of-sample period begins. Figure 3 shows the strength of the regression relationship between the alternative market-based index and the HFRI Event Driven Index. We can strongly argue that the alternative index (HFRI Event-Driven Index (OOS)) can safely be used to track the performance of the actual HFRI Event-Driven index.
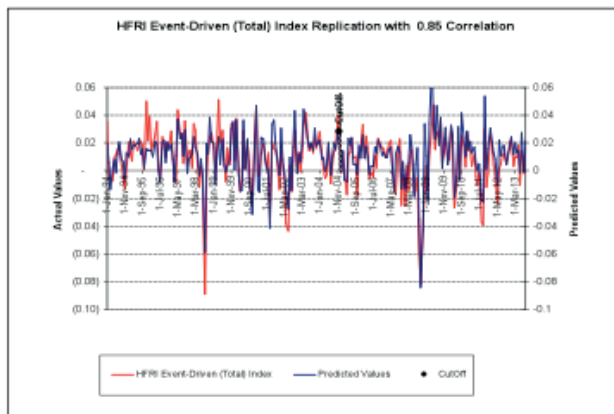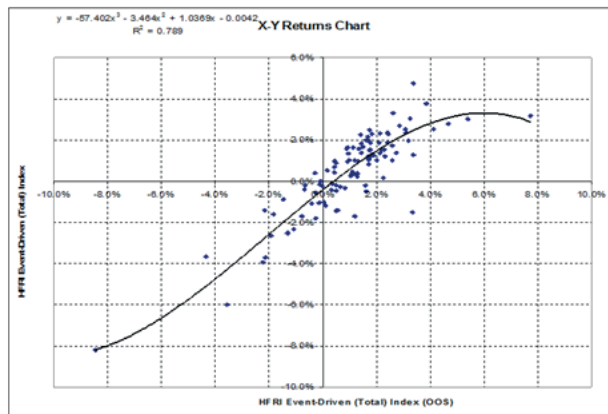
Figure 2

HFRI Event-Driven (Total) Index Replication with 0.85 Correlation

Figure 3

X-Y Returns Chart

$y = -57.402x^3 - 3.464x^2 + 1.0369x - 0.0042$
$R^2 = 0.789$

3. In this last step, we use Monte-Carlo simulations to generate thousands of potential return-history profiles for the index and calculate the extreme losses associated with each return-history. This procedure will effectively use the market risk factors to develop the distribution of extreme losses for the hedge fund index. Figure 4 shows the results of the Monte Carlo simulations: the horizontal axis shows the loss range while the vertical axis shows the frequency of each loss range. We can see from Figure 4 that most losses are centered around the range from [-3.0% to -6.0%] and from [-6.0% to -9.0%]. This loss range is in line with the historical losses of the strategy. However, the strategy could also experience more pronounced losses, albeit with a lower probability.
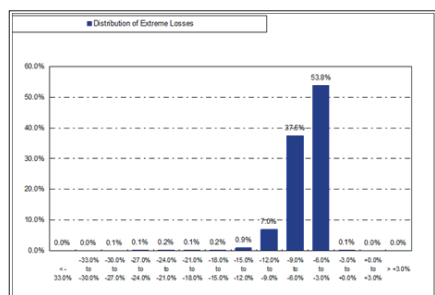

Figure 4

Risk Exposure Matrix of Hedge Fund Strategies:

Using the multistep procedure described in this article, we mapped the hedge fund strategy indexes to several market risk factors. Table 3 below lists the market risk factors and the directional influence these risk factors have on each hedge fund strategy. Double "+" and "-" signs are added to emphasize the strength of the directional influence. All the beta coefficients used to generate Table 3 are statistically significant at the 1% significance level.

Table 3

Market Factors / HF Strategies	Convertible Arbitrage	Dedicated Short Bias	Emerging Markets	Equity Market Neutral	ED - Distressed
High-Yield Returns	++			++	++
MSCI Emerging Markets [Default Risk]			++		
VIX Index [Equity Volatility]					-
VIX Volatility [Vol of Vol]				-	-
Equity Markets [Small Caps]					++
Broad Equity Markets		-			+
Equity Spreads [Small - Large]		-			
Equity Spreads [Value - Growth]		+			
Credit Spread				-	--
Commodity Index					
Interest Rate Level	+			+	
Term Spread [Slope of Yield Curve]					

Market Factors / HF Strategies	ED - Risk Arbitrage	Fixed Income Arbitrage	Long-Short Equity	Managed Futures	Relative Value
High-Yield Returns	+	++			+
MSCI Emerging Markets [Default Risk]					
VIX Index [Equity Volatility]		-			
VIX Volatility [Vol of Vol]	-				-
Equity Markets [Small Caps]			++		
Broad Equity Markets	+		+		
Equity Spreads [Small - Large]	+		-		
Equity Spreads [Value - Growth]			-		
Credit Spread	-	-			-
Commodity Index				+	
Interest Rate Level	+	+			+
Term Spread [Slope of Yield Curve]		+			

The "+" and "-" signs represent the directional influence of the market factors on the returns of the hedge fund strategy. Double "+" and "-" signs indicate a stronger degree of influence.

*The views expressed in this article are solely those of the author and do not necessarily reflect the views of Bank ABC. The Bank does not trade any of the products mentioned in this article.