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Hedge Fund Returns:
An Overview of Return-Based and Asset-Based Style Factors

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Abstract

The goal of modelling is to find one or more factors that offer the best explanatory power for a given variable. Applied to hedge fund returns, it allows their sources to be better understood. In the search for significant factors, two approaches can be employed, namely return-based style factors (RBS factors) and asset-based-style factors (ABS factors). This paper proposes an overview of the extensive literature dedicated to RBS and ABS style factors by describing approaches that identify ABS factors in four strategies (Convertible Arbitrage, Equity Long/Short, Risk Arbitrage and Trend Following), examining studies that deduce ABS factors from RBS factors, and summarising a method for modelling the returns of a diversified portfolio of hedge funds.

The goal of modelling is to find one or more factors that offer the best explanatory power for a given variable. Applied to hedge fund returns, it allows their sources to be better understood. In the search for significant factors, two approaches can be employed, namely return-based style factors (henceforth RBS factors) and asset-based-style factors (henceforth ABS factors).

RBS factors refer to the notion of implicit factor models. They are obtained through Principal Component Analysis. The aim is to explain the return series of observed variables through a smaller group of non-observed implicit variables. Each implicit factor is defined as a linear combination of the primary variables. The implicit factors are extracted from the time-series of returns. The advantage is that it avoids the risk of underspecifying the model (omitting true factors) or overspecifying the model (including spurious factors). The drawback relates to the economic significance of the implicit variables obtained.

ABS factors refer to the notion of explicit factor models. In this approach the specification of the model plays an important role. Observable market risk factors are included through a discretionary choice, and the risks of misspecification are non-negligible. On the other hand, it is easier to interpret the different factors from the model.

However, the two approaches are not fully opposed. A combination of both approaches can be achieved by initially conducting the RBS factor approach and by then deducing the ABS factors from the RBS factors.

The heterogeneity of the strategies used in the hedge fund industry raises the question of modelling the returns obtained by a diversified portfolio of hedge funds. The most relevant method seems to be modelling the returns strategy by strategy. Nevertheless, a combination of the factors issued from models specific to their respective strategy can lead to the modelling of the returns of a diversified portfolio.

This paper proposes an overview of the extensive literature dedicated to RBS and ABS style factors. It proceeds as follows: the first section describes approaches that identify ABS factors in four strategies (Convertible Arbitrage, Equity Long/Short, Risk Arbitrage and Trend Following), the second section deals with studies that deduce ABS factors from RBS factors, and the third section summarises a method for modelling the returns of a diversified portfolio of hedge funds.

1. ABS factors in four strategies

1.1. Focus on the Convertible Arbitrage strategy

Agarwal, Fung, Loon and Naik (2004) study the Convertible Arbitrage strategy, on the basis of a database containing "daily closing prices on the convertible bonds and their underlying stocks for 593 convertible bonds issued by Japanese companies". This strategy is based on a long position in convertible securities and a short position in the underlying stocks, in order to hedge equity risk. Three sub-strategies are pursued: positive carry (henceforth PCASi), credit arbitrage (PCASc), and volatility arbitrage (PCASv). The authors create three ABS factors by simulating the returns generated by the three sub-strategies.

Concerning PCASi, two scenarios are elaborated. First, the manager "raises sufficient capital to support the trade throughout its entire life", and "the capital base remains unchanged". Second, the manager raises capital just-in-time and does not store excess capital.

For the first scenario, PCASi returns are equal to:

$$R_{1,t} = \frac{\text{marked - to - market return} + \text{interest on short sale proceeds} + \text{interest on excess capital}}{\text{capital base}}$$

For the second scenario, PCASi returns are equal to:

$$R_{2,t} = \frac{\text{marked - to - market return} + \text{interest on short sale proceeds}}{\text{capital base}}$$

PCASc returns are simulated as follows:

$$Credit_t = BRET_t^c - \hat{\gamma}_1 EQ_t - \hat{\gamma}_2 IR_t$$

where *Credit t* is the ABS factor, PCASc, on day *t*, $BRET_t^c$ is the day *t* return on the credit bond portfolio, EQ_t is the day t return on the equally-weighted portfolio of underlying stocks and IR_t is the Japanese 3-5 year Government Bond total return index. $\hat{\gamma}_1$ and $\hat{\gamma}_2$ are the hedge ratios for equity and interest rate risks respectively.

PCASv returns are simulated as follows:

$$Gamma_t = BRET_t^v - \hat{\gamma}_1 EQ_t - \hat{\gamma}_2 IR_t - \hat{\gamma}_3 CR_t$$

where *Gamma t* is the ABS factor, PCASv, on day *t*, $BRET_t^v$ is the day *t* return on the credit bond portfolio, EQ_t is the day t return on the equally-weighted portfolio of underlying stocks, IR_t is the Japanese 3-5 year Government Bond total return index and CR_t is a proxy for credit risk. $\hat{\gamma}_1$, $\hat{\gamma}_2$ and $\hat{\gamma}_3$ are the hedge ratios for equity, interest rate risks, and credit risks respectively.

In order to validate the three ABS factors, three regressions are conducted where the explained variable is the returns of convertible arbitrage indexes (four different sources: TASS, HFR, MSCI and CISDM) and the explanatory variables are successively PCASi, PCASi plus PCASv, and PCASi, PCASv plus PCASc. The third regression is as follows:

$$CAI_t = \alpha + \beta_1 Carry_t + \beta_2 Gamma_t + \beta_3 Credit_t + \varepsilon_t$$

where *CAI t* is the convertible arbitrage index's month *t* return, *Carry t* is the month *t* return for the PCASi ABS factor, *Gamma t* is the month *t* return for the PCASv ABS factor, and *Credit t* is the month *t* return for the PCASc ABS factor. α, β_1, β_2, and β_3 are the regression parameters and ε_t is the error term.

Each regression is conducted twice: once in the first PCASi scenario, and once for the second scenario. Using the PCASi model in the first scenario, the first regression shows that while the beta of the PCASi ABS factor is significantly positive, the in-sample adjusted R² only ranges from 0.017 to 0.059 according to the index provider. In the second regression, the inclusion of the PCASv ABS factor improves the in-sample adjusted R², which ranges from 0.063 to 0.235 according to the index provider. The last regression, including the three ABS factors, highlights a stability of the PCASi and PCASv coefficients, while the results are more mitigated for the PCASc ABS factor. Its inclusion generates an increase in the adjusted R² in three of the four indexes (the CISDM index shows a decrease). The in-sample adjusted R² ranges from 0.087 to 0.227. The PCASc ABS factor only has a significant coefficient with the HFR and TASS indexes. An application to the second scenario gives similar results.

1.2. Focus on the Equity Long/Short strategy

Fung and Hsieh (2003) regress the HFR Equity Hedge Index onto a stock market factor and the spread between large cap and small cap stocks, from 1994 to 2002. The in-sample R² is 0.77.

They obtain:

HFR Equity Hedge Index = 0.0097 + 0.46 * S&P500 + 0.44 * [SC – LC]

where *SC* represents the Wilshire 1750 Small Cap Index and *LC* is the Wilshire 750 Large Cap Index.

Equity long/short hedge funds are exposed to the stock market and the spread between large cap and small cap stocks.

1.3. Focus on the Risk Arbitrage strategy

Mitchell and Pulvino (2000) examine the replication of the Risk Arbitrage strategy from 1963 to 1998, using a database of 4750 mergers. The authors evaluate risk arbitrage returns through the Risk Arbitrage Index Manager returns (henceforth RAIM returns). A capital of USD 1 million is held at the beginning of 1963. After that, three investment rules are respected when a merger occurs. First, “an investment in any merger cannot exceed 10% of total capital”. Second, the impact of the investment on the price of the underlying securities has to be less than 5%. Third, use of leverage is prohibited.

The authors apply the CAPM and the Fama and French (1993) three-factor model to the RAIM return series. Both models seem to indicate a feeble exposure of Risk Arbitrage returns to the market returns, with respectively an alpha of 29 basis points per month and a beta of 0.12, and an alpha of 27 basis points per month and a beta of 0.11.

When a restriction is applied to the months where the market return minus the risk free rate is negative, the CAPM provides an alpha of 260 basis points per month and a beta of 0.51, and the Fama and French model gives an alpha of 206 basis points.

The most interesting point is the increase in the in-sample R^2, suggesting that the relationship between Risk Arbitrage returns and market returns is non-linear (the exposure to the market returns is more pronounced in market downturns). By dividing the whole period into several sub-periods, it appears that the non-linearity of this relationship is not time-dependent.

Such results lead the authors to the conclusion that the Risk Arbitrage strategy can be replicated by a long position in a risk free bond combined with a short position in index put options.

1.4. Focus on the Trend Following strategy

Fung and Hsieh (1997b) demonstrate that the dominant strategy pursued by CTA funds is Trend Following. Fung and Hsieh (2001) demonstrate that the Trend Following strategy has option-like payouts similar to those generated by a long position in a lookback straddle.

Trend following consists of capturing market trends, i.e. “series of asset prices that move persistently in one direction over a given time interval”. A Primitive Trend Following Strategy (henceforth PTFS) aims to capture the largest price movement over a given period.

The authors simulate PTFS returns on the basis of the returns of 26 futures contracts on 5 markets: 5 futures contracts on stocks, 5 futures contracts on bonds, 4 futures contracts on currency, 6 futures contracts on three-month interest rates, and 6 futures contracts on commodities. For each of the five markets, one portfolio of lookback straddles is formed. This gives five PTFS portfolios.

Trend Following funds’ returns are regressed onto the five PTFS portfolios’ returns. The in-sample R^2 is 47.9%. Currency and commodities PTFS portfolios have the highest coefficients. The five PTFS portfolios are correlated to the funds’ returns. While a linear eight-asset class factor model (following Sharpe (1992)) tends to indicate that Trend Following funds are not exposed to systematic risks, the lookback straddle approach highlights that the strategy is exposed to systematic risks, but in a dynamic and non-linear way. It corroborates the fact that the Trend Following strategy can capture the largest price movement over a given period when this period corresponds to an extreme market environment. In extreme market environments, a combination of PTFSs on currencies, commodities and bonds allow the Trend Following funds’ returns to be explained.

2. From RBS factors to ABS factors

2.1. Focus on the Fixed-Income strategy

Fung and Hsieh (2002) study the Fixed-Income strategy on the basis of a database provided by HFR. Five sub-strategies are examined: Fixed-Income Convertible Bond, Fixed-Income High-Yield, Fixed-Income Mortgage-Backed, Fixed-Income Arbitrage and Fixed-Income Diversified.

First they conduct a Principal Component Analysis on funds included in a common peer group. Proxies of the RBS factors are identified, and Sharpe's (1992) asset class model is used to link RBS factors to ABS factors, by regressing RBS factors onto several factors. Moreover, to verify the presence of a dynamic trading strategy, additional ABS factors (related to option-like payoffs) are included in the model as a last step.

Concerning the Fixed-Income Convertible Bond sub-group, the HFR Fixed-Income Convertible Bond peer-group average has a correlation of 0.932 with the first principal component and is used to proxy the RBS factor. The two ABS factors are the CSFB Convertible Bond index and the difference between the CSFB Convertible Bond index return and the Lehman Treasury Bond index return. The in-sample R^2 is 0.70. The inclusion of the short-horizon lookback straddle on the swap/treasury spread gives an in-sample R^2 of 0.75.

Concerning the Fixed-Income High-Yield sub-group, the HFR Fixed-Income High-Yield peer-group average has a correlation of 0.874 with the first principal component and is used to proxy the RBS factor. The two ABS factors are the CSFB High-Yield Bond index and the difference between the CSFB High-Yield Bond index return and the Lehman Treasury Bond index return. The in-sample R^2 is 0.78. The use of a long-horizon straddle as a unique factor gives an in-sample R^2 of 0.79.

Concerning the Fixed-Income Mortgage-Backed sub-group, the HFR Fixed-Income Mortgage-Backed peer-group average has a correlation of 0.949 with the first principal component and is used to proxy the RBS factor. The three ABS factors are change in mortgage rate, change in the 10-year swap rate and change in the 10-year treasury rate. The in-sample R^2 is 0.59. The inclusion of a long-horizon straddle allows an in-sample R^2 of 0.66 to be reached.

Concerning the Fixed-Income Arbitrage sub-group, the two principal components are kept to proxy RBS factors. The ABS factors are the difference between the CSFB High-Yield Bond index return and the Lehman Treasury Bond index return, and the difference between the CSFB Arbitrage Bond index return and the Lehman Treasury Bond index return. Straddles do not allow the explanatory power to be increased.

Concerning the Fixed-Income Diversified sub-group, the two principal components are kept to proxy RBS factors. The ABS factors are the Lehman Corporate Bond index and the difference between the JP Morgan Emerging Market Bonds and the Lehman Treasury Bond index returns.

2.2. Diversified portfolio of hedge funds

Fung and Hsieh (1997a) isolate a sample of 409 hedge funds and CTA pools. Using a Principal Component Analysis, the authors extract 5 principal components that explain 43% of the cross-sectional return variance. On the basis of the funds' disclosure documents, the authors associate qualitative style categories with each principal component, which gives the following five styles: Systems/Opportunistic, Global/Macro, Value, Systems/Trend Following and Distressed.

Fung and Hsieh examine whether the five style factors are location choices or dynamic trading strategies. Five "states" are distinguished, by sorting the monthly returns of each asset class factor (except cash) into five quintiles. For each state of each asset class factor, returns of hedge fund style factors are computed from 1991 to 1995. If a style is sensitive to the market factors in the medium states, location choices are the source of return. This is the case for the Value style (linear exposure to the U.S equity factor) and the Distressed style (linear exposure to the high yield corporate bond factor). If a style is sensitive to market factors only during extreme states, it is a dynamic trading strategy. This is the case for the other three styles, which show option-like payouts. According to the authors, the Systems/Trend Following return series can be replicated by a straddle on U.S. equities. The Systems/Opportunistic return series are similar to those of a call on gold. The Global/Macro return series can be reproduced by a straddle on the U.S. dollar.

3. Application to a diversified portfolio of hedge funds: combination of ABS factors

Fung and Hsieh (2004) examine whether combining 7 ABS factors (from three distinct strategies) in a unique model allows a significant part of the returns of a diversified hedge fund portfolio to be explained.

The seven factors are changes in credit spreads, the change in ten-year Treasury yields (Fixed-Income strategy), a stock market factor, the spread between large cap and small cap stocks (Equity Long/Short), and a lookback straddle on currencies, lookback straddle on commodities and lookback straddle on bonds (Trend Following/CTA).

They regress the HFR Fund-of Funds Index returns onto the seven ABS factors, from 1994 to 2002. The in-sample adjusted R^2 is 0.55. The coefficients of the equity long/short and fixed-income ABS factors are significant. This is not the case for the trend-following ABS factors.

The stability of the coefficients (i.e. the betas) is tested "by running the regression backwards starting in December 2002, adding observations one month at a time." This allows September 1998 and March 2000 to be identified as marker break points. Two sub-periods are formed, from January 1994 to September 1998, and from April 2000 to December 2002. The second sub-period corresponds to a bear market. First, it permits the explanatory power of the model to be improved (the in-sample adjusted R^2 is 0.69 and 0.8). The coefficients of the equity long/short ABS factors are significant in the two sub-periods, with a decline in the coefficient of the market factor. Considering fixed-income ABS factors, the coefficient of the ten-year Treasury factor increases, while the coefficient of the changes in credit spread decreases. According to the authors, all beta changes for equity long/short and fixed-income ABS factors are consistent with the downturn market characterising the second sub-period. Considering the trend-following ABS factor on commodities, a dramatic increase in its coefficient confirms that Trend Followers benefit during downturns.

Conclusion

By reviewing studies on hedge fund performance modelling, some concluding remarks can be made. First, when ABS factors are used, the appropriateness of the model (by considering the in-sample R^2) is heterogeneous among strategies. For example, a "pure" ABS factor approach does not exhibit convincing results in the case of the Convertible Arbitrage strategy. Second, a combined RBS/ABS factors approach presents the advantage of deducing the ABS factors from the most significant factors, resulting in solid R^2. Third, when a diversified hedge fund portfolio is examined, it is tempting to seek the ABS factors directly on the basis of the returns of the diversified portfolio, while a combination of ABS factors obtained strategy by strategy discloses consistent R^2. Lastly, further research on hedge fund performance modelling can add value to the existing studies by conducting out-of-sample analysis of the explanatory power of the modelling.

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