A New Kind of Style Analysis

Barry Feldman, Ph.D., CFA
Prism Analytics
www.prismanalytics.com
barry@prismanalytics.com

Prepared remarks for the Institutional Investor conference *Performance and Risk Attribution for Hedge Funds*, November 17, 2004.

0. Introduction [Slide 2]

Hedge funds may be the active management vehicle of the future. But today's investment management tools are not quite up to the task of handling hedge funds. My topic today is a new technique, returns-based style analysis using proportional marginal variance decomposition or "PMVD." This technique can be of help in handling hedge funds at several steps in the investment management process. In this very short presentation, I will compare PMVD to conventional style analysis and other returns-based methods in concept and with examples.

These slides and more information are available on the Prism Analytics web site.

1. Background and motivation [Slide 3]

In the world of mutual funds, style analysis is widely used for essential tasks such as screening funds, constructing investor portfolios, monitoring managers, and reporting manager performance. This, in spite of the often-short data histories, challenges in defining benchmarks, and limitations of statistical methods.

Returns-based analysis is more important for hedge funds than mutual funds. Why? Hedge fund managers have greater complexity and diversity in strategy. Hedge funds are less transparent. Holdings are harder to analyze. Strategy drift may not be apparent from holdings. And understanding a hedge fund's profile against conventional markets from its holdings may be difficult.

Returns-based analysis of hedge funds faces additional challenges. Histories are shorter. Manager strategies are more dynamic. Reported asset values are less reliable. And, most importantly for my presentation, the statistical assumptions that define conventional style analysis are not appropriate.

2. Other Returns-based techniques [Slide 4]

Let's review current returns-based techniques.

Factor models produce factor betas and statistical significance levels. The significance of factor betas is often low because of high levels of correlation between factors. Precision may be improved by requiring that betas sum to one. This is the no-arbitrage constraint. It assumes that futures positions are fully collateralized and that options are hedged asset positions.

Style analysis imposes the additional constraint that factor betas are non-negative. This assumption is untenable when profiling against conventional markets. It is problematic even when using hedge fund benchmarks, if only because it becomes impossible to have a beta greater than one against any factor. These constraints may produce considerable bias in reported style weights.

Covariance decomposition, or inferred marginal contribution to risk, is based on betas and factor covariances, as you can see from this formula. Covariance components can be unstable due to factor colinearity. A factor's covariance component can be zero even though it is statistically significant and components can be negative, both conditions reflecting marginal contribution to risk rather than risk decomposition.

3. PMVD [Slide 5]

PMVD is based on bargaining theory. Imagine that factor owners bargain to get as much explained variance credited to their factors as possible; and that owners can form coalitions. If bargaining power of any coalition is the joint marginal contribution to explained variance of its factors, then one particular bargaining solution, the proportional value, divides the explained variance of all factors in a very desirable way.

PMVD is consistent with statistical theory. A factor with no contribution to explained variance receives no variance share and a factor with no variance share is statistically insignificant. It is the only variance decomposition method with these properties.

PMVD variance shares are a measure of relative importance. Relative importance is not completely determined by factor betas or their statistical significance. As you will see, it is possible that one variable is statistically more important than another even though it has a lower statistical significance level. PMVD takes a factor's joint contributions to explained variance into account.

PMVD allows quick identification of key factors driving a fund's volatility profile, and, perhaps, its returns.

PMVD does not require statistical constraints to obtain understandable results.

PMVD shares are non-negative. They are reported signed by the sign of the factor beta in order to facilitate interpretation.

4. Style analysis of an anonymous fund [Slide 6]

I will now show you several analyses of an equity market neutral fund.

4.1 Style analysis with hedge fund benchmarks

This is a Sharpe-style analysis using CSFB hedge fund benchmarks, large cap, small cap, the long bond, and cash.

The top left chart is a rolling window of monthly analyses. The left-most set of stacked bars is for the 36-month period ending December 2000. The right-most is for the 36-month period ending March 2004. The height of each bar is the percentage of the portfolio invested in that strategy on that date. The dedicated short bias strategy in dark blue is apparently employed with 40% to 60% of assets. The set of stacked bars immediately to the left of the legend represents the analysis using the complete fund history. The charts directly below display the R^2 for each time period.

Style analysis finds dedicated short bias is the dominant strategy, along with consistent fixed income arbitrage, managed futures, and long bond components.

The average rolling R^2 is about 43%.

4.2 Constrained factor model with hedge fund benchmarks [Slide 7]

Here's a factor model with the no-arbitrage constraint. The bars are now factor betas. The average rolling window short bias beta is only 6%, compared to −183% for market neutral and 64% for fixed income arb. These factors are not statistically significant.

The style analysis non-negativity constraints are strongly rejected statistically. But most of the factor model betas have low precision, as you can determine from tables at the end of my workbook presentation. The small cap beta has the highest significance with an all-history t-statistic of 3.44.

4.3 *Unconstrained PMVD with hedge fund benchmarks* [Slide 8]

Unconstrained PMVD finds that the fund risk is mostly short small and large cap. There is no evidence of managed futures and very little of equity market neutral or fixed arb.

The average R^2 is 66%, an increase of more than 20% over the style analysis.

4.4 Constrained PMVD with conventional asset benchmarks [Slide 9]

Constrained PMVD with conventional asset style benchmarks indicates the fund is short mostly small and large growth and that it is long mid growth and small value. Notice that the dominance of large growth in later months has diminished greatly with style benchmarks.

The large long cash component suggests the fund may be market neutral. Note the average R^2 is higher than with hedge fund benchmarks.

4.5 Unconstrained PMVD with conventional and CBOE benchmarks [Slide 10]

Adding CBOE volatility benchmarks and removing the no-arbitrage constraint further increases average R^2. It appears that the fund had a long large cap volatility strategy until about November 2002. Notice that this strategy replaces the short large growth exposure over that period.

4.6 Covariance decomposition with conventional and CBOE benchmarks [Slide 11]

Here's a covariance decomposition.

The signs of small, mid, and large growth are reversed from PMVD and factor results. In principle, these components show the marginal change in fund variance from the addition of a small quantity of each benchmark. The negative mid growth component is consistent with this interpretation. The positive small and large growth components are not.

5. Relative importance [Slide 12]

Now consider relative importance. The PMVD results are striking for the large short large cap growth variance component.

The table on the left is based on all style benchmarks. It shows that large growth is less important than mid growth according to factor model betas and significance levels. The table on the right is based on only small, mid, and large growth. It shows large growth is more important.

The smaller model explains 51.9% of the all-history R^2, compared to 57.8% for all style factors. The hypothesis that all other factors are zero cannot be rejected at any reasonable significance level. The smaller model could be considered the "right" model. PMVD shows us this result without requiring time-consuming rounds of statistical tests.

A more complete explanation is that these three factors have strong explanatory power and strong interactions. PMVD identifies this strength and incorporates it in consistent and rational way into the variance decomposition process.

6. Evaluation [Slide 13]

The fund is small cap and market but not style neutral. Style analysis results are way off. PMVD clearly shows the importance of short small growth, which can be found with some effort from the factor model.

A fund-of-funds manager holding this fund agrees the fund effectively had a long volatility strategy.

The fund is long small value. This position, however, contributes very little to the risk profile.

The short large growth exposure may seem to be an error given that the fund invests only in small cap. It is likely that a careful evaluation of the characteristics of the holdings would explain why. Regardless, this fund appears to have significant exposure to large growth risk factors without holding large growth names.

7. Limitations [Slide 14]

Now, some limitations.

Like all statistical procedures, PMVD is vulnerable to noise. You should approach any returns-based analysis with care.

Further, all returns-based methods are inherently backward rather than forward looking.

Variance decomposition is not tail risk decomposition. However, a skilled analyst can often make useful inferences about tail risk.

We think about volatility in standard deviations. Variance is its square. Working with variance takes some getting used to.

Finally, PMVD components are not additive. Thus, the portfolio variance component of a factor many not be equal to the weighted sum of the components for individual funds.

8. Conclusion [Slide 15]

PMVD-based style analysis is a new returns-based method for analyzing hedge fund performance. PMVD avoids the distorting constraints of Sharpe’s style analysis and distills the relative importance of factors from the complexity of factor models. PMVD analyses can be displayed graphically and evaluated quickly. We expect that PMVD will prove useful in fund screening and monitoring, in reporting, and in portfolio construction.